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SVIC NOTES

New Rail Vehicles Promise Softer Ride

On a recent weekend, the railroads serving the Washington, D.C. area, sponsored an open house to exhibit both new and old locomotives and rolling stock.

One of the most interesting items exhibited was a highway trailer that can be rapidly converted for operation as a railroad freight car. This convertible rail/highway operation concept is not totally new; first, it is a logical outgrowth of the trailer on flat car concept, and second, the railroads have used other types of convertible rail/highway vehicles in the past.

In the rail mode of operation, this vehicle differs from the conventional railroad freight car and from the trailer on flat car concept in other respects besides appearance. It is manually coupled to the unit in front of it, using a linkage and pin arrangement, instead of the automatic coupler which is found on conventional freight cars. It is supported by a single axle wheel-pair at its rear, and is supported at the front by its coupling linkage and the unit ahead of it. It has separate air cushion suspension systems for the rail and the highway modes of operation, and they are also used to convert this vehicle from one mode of operation to the other. Because of their design, their construction, and the nature of its intended service, these vehicles are operated in dedicated trains of like units; they are not operated in conventional freight trains. Further, because they are lighter, these trains can operate at higher speeds than conventional freight trains.

What about the shock and vibration environments for cargo shipped in these units. I am not aware of any measured vibration data for this vehicle in its rail mode of operation, therefore no comparison can be made with the vibration environment of conventional freight trains. Regarding the highway mode of operation, it is well known that an air suspension trailer's vibration environment is lower than that of the conventional highway trailer. But, in conventional railroad freight transportation, shock is of greater concern, and switching shock is the most severe environment. Since virtually no switching operations are conducted, and in view of the manual coupling arrangement, it is reasonable to expect that cargo shipped in these vehicles should experience lower shock levels compared to shipments in conventional freight cars. In conclusion, I believe this is an interesting concept for shipping delicate cargo in a virtually low shock transportation environment.

R.H.V.

EDITORS RATTLE SPACE

VIBRATION MEASURES AND CRITERIA

About ten years ago I wrote about vibration measures and criteria in this column.

> "The selection of vibration measuring and evaluation criteria to evaluate machine performance and structural integrity has been a controversial subject in national and international technical committee circles. In earlier years when low speed machines were common and failures did not result in millions of dollars loss for downtime and equipment costs, the measurement of vibration displacement was sufficient. In recent years the demand for better means of vibration evaluation, diagnosis and analysis in an attempt to lower production costs through preventive maintenance has resulted in the development of differing new vibration measuring and evaluation criteria. In any active, growing technology, differing views promote healthy interchange and result in a stronger technology."[1]

The good news is that we have made progress in the measurement and analysis of machine vibrations. Furthermore, engineers and technicians are using this technology. The bad news is that almost no progress has been made on vibration criteria. It is not difficult to see why the difficulty arises. When will we make progress in the development of vibration criteria?

It is easy to see why measurement and analysis techniques developed so rapidly. The development of sophisticated, useful electronics at an unparalleled pace gave us tools to do an important job. Detect mechanical faults in machinery during operation. This technology allows us the luxury of taking a machine apart only when a serious fault is present. It allows us to accurately and rapidly isolate faults in machinery. In general, it does not tell us the severity of the fault. With high production quotas of today the cost of downtime makes the cost of mechanical equipment a minor consideration. It is no wonder that measurement technology was developed and embraced.

Why has the development of vibration criteria been so slow? The first problem is that large volumes of data are needed on classes of machines to confirm and validate theoretical models. No large data gathering programs have been undertaken since the U.S. Navy effort in collecting balancing data in the 60's. This work resulted in one of the few criteria documents we have today -- the ISO/ANSI[2] Standard on balancing of machines. The second and perhaps most difficult problem involves the agreement of technical people on suitable criteria and levels of vibration that support these criteria. As an example, the vibration severity (true rms vibration velocity) document[3] for bearing cap readings which was developed prior to 1973 is just coming to reality as an ANSI standard.

Of course the growth of measurement and analysis technology was easy because it required little agreement among technicians. In fact they still don't agree on what measures to use in certain situations. However, as far as predictive maintenance work is concerned, technicians are soon going to realize that the development of measurement and analysis techniques will yield no increased capabilities. The point of diminishing returns approaches. Criteria are going to have to be developed if we are to progress in the prediction of the severity of mechanical faults -- the central goal of predictive maintenance.

R.L.E.

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[1] *Shock and Vibration Digest,* 5 *(12) (Dec 1973)*

[2] *American National Standard Balancing Technology, ANSI S2.7-1982*

[3] *Measurement and Evaluation of Mechanical Vibration of Non-Reciprocating Machines as Measured on Structural Members, ISO 2372*

EQUIVALENCE TECHNIQUES FOR VIBRATION TESTING

H.S. Blanks*

Abstract. *This survey covers the literature from 1980 to 1982 for producing, evaluating, and utilizing equivalence techniques in field and laboratory vibration testing. Different forms of laboratory testing are also surveyed; modal testing is not covered. Screening by vibration exposure is included although its purpose is not the reproduction of field vibration.*

This survey of the literature relevant to equivalence techniques in vibration testing covers the period 1980 to 1982. A previous survey was published in 1980 [1]. An overview of dynamic test techniques has been provided by Curtis [2].

THE MEANING OF EQUIVALENCE

According to Lambert [3] the requirements of equivalence include the stress states, resonant mode shapes, internal stress spectrum shapes, and stress peak distributions. The type and location of failure mechanisms and damage states must be the same for both field and laboratory environments. He noted that threshold-sensitive and other nonlinear response effects tend to violate similitude.

Full equivalence requires damage equality; i.e., the test must produce the same type and magnitude of damage and the same type and level of malfunction. The majority of papers dealing with vibration-caused damage refer only to fatigue. A useful state-of-the-art summary of metal fatigue under variable amplitude and random stress is available [4]. Few relevant papers have dealt with wear; Pearson [5] is one of the exceptions.

It is often assumed that equivalence in dynamic response also produces equivalence in damage, but, because of the limited number of response parameters generally specified -- in one or a limited number of directions -- this assumption is not necessarily valid. In the area of response equivalence, however, Sylwan [6] and Hell [7] have determined the laboratory test levels necessary to produce equivalence to a service environment; they accounted for the differences in service and test mounting. Schmidt [8] has developed equations for comparing shock and sinusoidal and random vibrations in terms of response spectra.

DAMAGE OBSERVATION AND CALCULATION

True equivalence produces the same type and magnitude of damage or malfunction. Torvik and Bourne [9] found that damping can be used as an index of damage accumulation in composites, although it is more of qualitative than a quantitative value. Damping changes are small because damage can occur in only a small percentage of the specimen volume. They also reported a drop in resonant frequency, as has been reported by others. Ultrasonic and acoustic emission techniques have been investigated for early detection of fatigue damage in aluminum alloys [10].

The most common method for quantifying fatigue damage to establish or evaluate vibration test equivalence or to predict failure time is the Palmgren-Miner model; damage is quantified as $\Sigma n_i/N_i$, the sum of damage fractions incurred during the vibration history. A table of statistical summaries of the model's accuracy as obtained by various investigators is available [4]. Lambert [11] used the model to obtain life prediction expressions for various random-stress peak distributions, and the model has also been applied [12] to a multilevel strain loading program. The positive and negative strain peaks appeared in random sequence, and the total damage fraction was the sum of fractions due to different sizes of hysteresis loops; e.g., a four-level program

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has 16 possible loops. Wirsching and Light [13] used the model to predict life under wide band random stress and to develop a relation between damage due to wide band and narrow band random stresses having the same rms stress and rate of zero crossings. Dalton [14] described a system of computer-simulation and analysis of aircraft in-flight loading; fatigue damage is computed using the model.

Modifications of the Miner model are also used to quantify damage. Lambert [15] used linear elastic fracture theory to develop an equation for cumulative damage of structures subject to a sequence of sinusoidal or random stresses. The n_j/N_j damage fractions were multiplied by a factor $X_{j,n}$ that involves initial crack length, stress levels of the j^{th} and n^{th} blocks, fracture toughness, a geometric constant, and the crack growth-rate curve constant. Hashin [16] investigated departure from the Palmgren-Miner predicted life, particularly for ascending and descending staircase loading programs. Huang and Nagpal [17] considered the variables affecting fatigue life under random loading in the elastic and plastic ranges; they reported major differences between their life predictions and those calculated on the basis of linear damage accumulation and cycle counting. Bui-Quoc [18] explained a major departure from Miner's rule in multilevel cyclic torsion as an interaction effect between strain levels.

FIELD-LABORATORY EQUIVALENCE

Simulation of in-service vibration in the test laboratory is of course the equivalence sought for. Coupland and Nintzel [19] described a system for simulating railcar/track dynamics that simultaneously provided lateral and vertical excitation. Mirow [20] dealt with the instrumentation for laboratory simulation of several simultaneous operational motions and forces. Everett [21] described a test system in which the impact of small projectiles -- random with respect to relative location, time interval, and intensity -- on a vehicle surface simulates the multidirectional broadband random vibration of in-flight missiles. The suitability and accuracy of using a Markov matrix of transition probabilities, based on the FALSTAFF standard fighter loading sequence, for the analysis and synthesis of operational loads, have been examined [22].

A major problem in field-laboratory equivalence is condensing the mass of service vibration environments into a meaningful laboratory test sequence. The Markov transition probability matrix, which is based on a number of standardized flight profiles, is one approach. Stouder [23] described a facility for processing aircraft flight and laboratory test dynamic data. Hall [24] discussed the many aircraft and flight variables that influence vibration spectra. He noted that the concern for combined environmental reliability testing (CERT) is laboratory identification of realistic failure rates and modes. Hall also compared the test concepts of MIL-STD-781 C, which has only two broadband random spectrum shapes, with those of AFWAL's CERT. Schedules for laboratory vibration tests that simulate logistic and tactical transportation of army material and equipment in ground vehicles and helicopters have been provided [25]. An investigation aimed at developing more realistic vibration test schedules for transport of loose, restrained, and secured cargo has been reported [26].

Curtis [2] urged avoidance of undue conservatism; an example is the practice of specifying broadband test spectra that are the envelopes of spectral response at the in-service mounting points of equipment. The problem arises from the difference between the test fixtures and in-service support structure; Curtis suggests the use of less stiff test fixtures.

Sylwan [6] developed a method for determining more realistic test levels. He gave equal test and service rms acceleration in five bands into which a spectrum had been divided. He thus accounted for the difference between test fixture and service support mechanical impedances and the transfer function between mountings and critical areas of the equipment under test. Hell [7] found that test levels using Sylwan's method were on average three times lower than those determined from enveloping while still giving a higher response at critical areas during test than was obtained in flight simulations.

Simple broadband random resting has also been elaborated. Mercer [27] described implementation of a technique that superimposes up to five sweeping narrow-band random vibrations, with differing bandwidths and g levels, on a broadband background vibration. Vibration testing in a simultaneous constant-acceleration environment has been discussed [28].

EFFECTS OF STRESS DISTRIBUTION, MEAN STRESS, AND ENVIRONMENT

Lambert [11] considered stress peak distributions other than the generally assumed Rayleigh distribution, including the truncated exponential that is relevant to finite duration aerodynamic gust and some sea state conditions. Matolcsy [29] dealt with the failure of machine parts; he argued the importance of determining the extreme stress distribution for complex vibration processes. He gave theoretical considerations, measuring methods, and an analysis of measured distributions.

Curtis and Moite [30] studied the errors introduced by limiting the crest factor in random vibration analysis to three and ignoring the existence of an endurance limit. The effect of non-zero mean stress on low cycle fatigue has been dealt with [31]. Three methods were evaluated: the nonlinear Goodman diagram, Jaske's equivalent strain formulation, and Manson's mean stress correction. Comparison with experimentally observed cycles to failure showed the equivalent strain formulation to be the most accurate method. Kapp [32] reported on experiments to study the combined effects of aggressive environment and mean stress on crack growth. The effect of high-frequency small-amplitude vibration superimposed on a major low frequency stress cycle has been studied in terms of a threshold stress that triggers minor cycles into crack propagation [33].

EQUIVALENCE TECHNIQUES RELEVANT TO RANDOM VIBRATION

Lambert [15] used the premise that, for any given average number of stress cycles, there exists a random rms stress level that will propagate a crack of the same size as does a calculable corresponding sinusoidal stress. He stated that his equations -- developed for median cycles to failure, probability of failure at N cycles, and cycles to first failure for the case of sequentially applied levels of sinusoidal stress -- can be converted to sequentially applied levels of random stress using $\Delta S - \sigma$ equivalence relations derived in earlier papers [34, 35]. In practice the resultant equations are restricted in usefulness to narrow-band response.

An important paper is that of Wirsching and Light [13]. They determined a relation between the damage produced by a broadband random vibration and the narrow band vibration with the same rms stress and same rate of zero crossings. These two parameters can be readily obtained from the spectral density function without simulation of a sample vibration. Narrow band damage can be expressed in closed form; i.e. without simulation. They investigated the relationship

$$D_{\text{wide band}} = \lambda D_{\text{narrow band}}$$

for four completely different spectral shapes. They used rainflow counting of a simulated vibration and Miner's model to determine $D_{\text{wide band}}$ and the closed-form equation for $D_{\text{narrow band}}$. Wirsching and Light were able to show that, from a fatigue point of view, any spectral distribution can be characterized by the irregularity factor – i.e., zero crossings with positive slope/number of peaks; these are easily calculable directly from the spectral density function without simulation -- and that the correction factor λ is determined by this irregularity factor and the exponent of the fatigue SN power law. They gave an expression for λ determined by least-squares curve fitting.

CYCLE COUNTING

The rainflow, range mean pair, and ordered overall range methods of cycle counting identify load cycles in terms of closed stress-strain hysteresis loops and are recognized as superior to other cycle counting methods. They give essentially the same fatigue damage estimates [13]. A disadvantage of the range mean pair method has been that it required a multi-pass treatment of the vibration wave to obtain the count. Fraser [36] described a simple one-pass method as well as a tabular method for recording range pair data in the form of an array of peak and trough loads; the cells of the table were filled with the number of corresponding RMP transitions in the load history.

EFFECTS OF LOADING SEQUENCE

The effects of loading sequence continue to be studied [12, 15, 16, 18, 37]. Sequences of ascending stress usually produce fatigue failure at $\Sigma n_i/N_i > 1$; sequences of descending stress produce failure at

$\Sigma n_i/N_i < 1$. The reverse behavior has been observed in some fiber composites.

EFFECTS OF FREQUENCY

Studies of the effects of frequency on test equivalence require that excitation specifications include the same natural frequencies that exist within the device being tested. The effect of frequency per se on damage rate is also of interest; e.g., in connection with accelerated testing. Valanis [38] investigated the dependence of rate of crack growth on frequency and derived analytically the influence of frequency on number of cycles to failure. Antler and Drozdowicz [39] drew attention to the frequency dependence in fretting due to the effect of exposure time on oxide formation. Pearson [5] dealt with wear of aircraft engine-mounted accessories. He noted that velocity, not frequency, is relevant. He referred to BS4675 Mechanical Vibration in Rotating and Reciprocating Machinery in support and stated that, within a broad frequency band (10-1000 Hz), mechanical faults are likely to develop at or above a certain velocity, independently of vibration frequency. He also stated that measured acceleration data should be integrated to acquire velocity information as the sole and adequate test record.

EQUIVALENCE WITH RESPECT TO CRACK GROWTH RATE

Equivalence with respect to fatigue crack growth rate has been discussed [4]; reference was made to the difficulty of evaluating statistics of crack growth under variable loading. Various equivalent K approaches for random loading -- e.g., using the rms value of ΔK (the stress intensity factor range) in the $da/dN - \Delta K_{eff}$ power law -- were referred to, and a warning was given about assuming that variable-loading K equivalence exists. It has been noted that the crack growth ranking of eight steels under variable amplitude loading was quite different from their ranking under constant amplitude loading [40]. It has also been noted [33] that crack propagation rate da/dN is the sum of a function of $(K_{max})^{n_1}t$ (the creep component) and of a function of $(\Delta K_{eff})^{n_2}$ (the fatigue component).

Donald and Schmidt [41] reported on two experimental methods for acquiring crack growth data. One used computer-programmed K gradients. The other was the more conventional constant-load-amplitude method in which stress intensity increases with increasing crack length. The two methods gave excellent agreement.

Leis and Broek [43] provided an extensive literature survey on the role of similitude between damage states being compared when predicting service life from laboratory specimen tests. They noted that major problem areas include crack initiation and growth in gradient fields, thermal and environmental effects, multiaxial effects, and inelastic fracture mechanics.

EQUIVALENCE WITH RESPECT TO WEAR

Little information is directly relevant to equivalence techniques concerning damage by wear. Books by Fuchs and Stephens [43] and Waterhouse [44] contain some material. Pearson [5] reported that, in such aircraft engine-mounted accessories as pumps and generators, failure usually occurs by malfunction due to wear. He commented that orthogonal acceleration information or test specifications can be misleadingly optimistic because the composite velocity vector is truly relevant. He also commented that forces at different frequencies and different directions can interact to produce complex wear phenomena. Thus pivot bearings would be most likely to fail under combined lateral movement and normal load; the two separately would be unlikely to cause distress. He suggested that a good simulation of the engine environment would be to apply a multifrequency input to a single-plane slip table on which the accessory orientation can be varied.

ACCELERATED TESTING

In a true accelerated test damage proceeds through the same sequence of states and magnitude as in an unaccelerated test, or service condition, but at a faster rate. Lambert [3] referred to Navy Contract N00019-78-C-0407 "Accelerated Fatigue Test Rationale," as applicable to electronic black boxes. He gave two acceleration factor expressions for random vibration. One ignores any initial cracks or flaws; in the other initial cracks (actual or postulated) are considered in a fracture mechanism treatment. The paper ignores the problem of resonance within the black box. The problem is posed by the buildup of stress in at-risk components with increasing external excitation depending -- due to the increase in internal damping at fatigue-inducing stress -- on just what is resonating [45].

Lambert [3] corrected for a difference in stress spectra of the service and test environments. He also derived the cycles-to-failure versus rms stress relationships for various narrow-band random-stress peak distributions [11]. Curtis and Moite [30] investigated the errors in life prediction resulting from curtailment of crest factor and neglect of the existence of an endurance limit.

EQUIVALENCE IN VIBRATION STRESS SCREENING

Vibration screening is an effective way to screen out defects in electronic hardware. Published stress screening guidelines [46] include vibration. Curtis [47] reviewed the status of vibration screens not with the purpose of reproducing the service environment. He reported equivalence between two screening methods in terms of whether they are equally effective in identifying, or precipitating, reliability-relevant faults and equally benign to the non-defective parts of the hardware. Experience has indicated that broadband excitation, not necessarily random, is necessary for efficiency. Curtis suggested that equivalence can be in terms of whether the threshold of flaw precipitation is reached. He stated that a simple threshold definition could take the form of rms acceleration level up to some frequency, possibly multiplied by the time duration to some power and averaged over a number of locations of the hardware to be screened.

Silver and Caruso [48] stressed the importance of vibrating all the internal structures at their critical frequencies. They found that in electronic hardware sheet metal boxes such vibration is not necessarily achieved by conventional orthogonal excitation. Instead they recommended broadband thrusters at two corners of the box to provide diagonal force vectors. Blake [49] has presented an overview on the random vibration screening of six types of avionic computers.

VIBRATION EQUIPMENT

A low-cost pneumatic vibration system that produces a continuous broadband excitation similar to conventional random vibration programmed flat between 20 and 2000 Hz has been described [50]. The effectiveness of pneumatic thrusters for electronic hardware screening has been verified [48]; for screening purposes truncation of the frequency considerably below 2000 Hz had no adverse effect on effectiveness.

Isley [51] described a hydraulic vibration system capable of vibration up to 2000 Hz. Everett used a method of random impact by a small projectile to generate multi-directional random vibration [21]. For reasons of economy and simplicity there has been much interest in meeting random excitation specifications by using taped appropriately equalized noise as input to electrodynamic shakers. Preparation of a tape suitable for acceptance testing that will produce a specified spectrum at the test fixture has been described [52].

CONCLUSION

This paper is a survey of literature published in the period 1980 to 1982 that is relevant to equivalence techniques in vibration testing. Modal testing and acoustic excitation have been excluded. Most of the literature is relevant to fatigue damage; very little is relevant to damage by wear. The area of accelerated testing for wear is particularly deficient; no successful techniques in this field appear to have evolved.

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LITERATURE REVIEW: survey and analysis of the Shock and Vibration literature

The monthly Literature Review, a subjective critique and summary of the literature, consists of two to four review articles each month, 3,000 to 4,000 words in length. The purpose of this section is to present a "digest" of literature over a period of three years. Planned by the Technical Editor, this section provides the DIGEST reader with up-to-date insights into current technology in more than 150 topic areas. Review articles include technical information from articles, reports, and unpublished proceedings. Each article also contains a minor tutorial of the technical area under discussion, a survey and evaluation of the new literature, and recommendations. Review articles are written by experts in the shock and vibration field.

This issue of the DIGEST contains an article about stability problems of rotor systems.

Dr. T. Iwatsubo of Kobe University, Japan has written a review of the literature published from 1980 to 1982 on vibration problems in rotor dynamics, especially instability problems.

STABILITY PROBLEMS OF ROTOR SYSTEMS

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Abstract. *This article is a review of the literature published from 1980 to 1982 on vibration problems in rotor dynamics, especially instability problems. Included are general vibration problems and theoretical and numerical approaches to free and forced vibrations; vibration problems of turbines, compressors, pumps, and bearings; flow-induced forces due to seals and impellers; parametric excitations due to couplings and unsymmetric stiffness of rotor shafts; torsional vibration; gears; monitoring (diagnosis); and control.*

Crandall [1] has provided insight into the destabilizing mechanism of rotor systems. Bently [2] has described the parameters and measurements of destabilizing actions of rotating machines. Relative energy concepts have been used to provide insight into rotating system dynamics [3, 67-69]. Forced backward whirling in aircraft propeller-engine systems has been explained [4]. Vibrations due to thermally-induced interactions between rotor and stator [5, 6], influences of parameter changes on stability behavior of rotors [7, 8], and the effects of unbalance on stability and its influence on nonsynchronous whirling [9] have been investigated. The stability of a flexibly mounted ring-type flywheel system and whirling response have been studied [10, 11].

Vibration problems of turbomachinery during field operation [12-14] and applications of new turbomachinery designs [15] have been reported. Vibration problems of gas turbine rotors and their solutions have been reported [16, 17] as have gas turbine rotor/case structural responses to rotating stall [18].

Field experiences with rotor-dynamic instability caused by flow-induced forces have been analyzed [19-24]. Flow phenomena in compressors have been investigated [25, 26], as have subsynchronous instability of a geared compressor of overhung design [27] and lateral and torsional coupling effects [28]. The exciting forces of compressors due to instability have been discussed [29].

Many vibration problems have been reported with pumps. These include vibration phenomena in boiler feed pumps due to fluid forces [34, 35] and the reduction method [30-33] to evaluate critical speeds while accounting for fluid forces. A method for pump design considering rotor dynamics has been proposed [36].

Vibration problems have been reported with a DC motor used to provide the drive for a paper making machine. The frequency was at the rotor slot number multiplied by rotational speed. Various solutions to the problem were considered [37].

Improved methods for calculating critical speeds include improved accuracy of eigenvalue calculations [38, 39] and use of small computers [40]. Sensitivity analysis of eigenvalues to changes in bearing coefficients and other parameters [41-45] and a technique for modeling rotors from measured vibration data [46] have been studied.

BEARINGS

Many investigations have been concerned with journal bearings, squeeze-film dampers, and bearing/foundation systems; these elements are important in the stability of rotor systems.

Journal bearings. Investigations of journal bearings have been concerned with experimental [47-51] and theoretical [52-55] determinations of oil-film force coefficients. Studies on the stability of rotor/bearing systems include oil whirl detection [56-58], the mechanism of oil whirl instability [59], the influence of shaft flexibility on instability [60], operating

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characteristics of three-lobe and pressure-dam bearings [61, 62], nonlinear behavior of bearings on rotating machines [63-65], and numerical approaches to the stability of rotor/bearing systems [66].

Investigations of multi-span rotor systems include stability analysis using the energy concept [67-69], vibration of a multi-bearing rotor [70, 71], natural frequency of a shaft with periodically placed rotors and bearings [72], influence of support misalignment on stability [73], experimental and analytical research on a full-scale turbine journal bearing [74], modal dynamic simulation of such a bearing [75], and stability analysis of rotor/bearing systems using the component mode method [76, 77]. Optimum designs of a rotor/bearing system involve optimization of bearing type for stability [78] and minimum rotor unbalance response [79] as well as optimum bearing and support damping for stability and unbalance response [80].

Errors in bearing coefficients make necessary the statistical evaluation of eigenfrequency and unbalance response. The influence of these errors on the vibration of rotor/bearing systems has been investigated [81].

Squeeze-film dampers. Studies of the vibration isolation properties of squeeze-film dampers have been theoretical and experimental. Theoretical studies have involved unbalance response of a rigid rotor in a squeeze-film damper [82], isolation properties of noncentric squeeze-film dampers [83], an overhung rotor mounted on a noncentric squeeze-film damper [84], and the effect of journal misalignment in a squeeze-film damper [85]. Experimental studies have involved vibration characteristics of a rotor with flexible, damped supports [86, 87] and of an intershaft squeeze-film bearing [88]. Results of experimental and theoretical studies have been compared with theory [89-91].

Rotor/bearing/foundation systems. The effects of foundation flexibilities on the dynamic response of a tandem coupled rotor/bearing system have been described. The interactions of rotor systems and foundations were investigated theoretically [92-100] and experimentally [101].

Ball bearings. Despite the dependence of critical speed on ball bearing stiffness, the characteristics of the dynamic radial stiffness of rolling element bearings have not yet been verified. Theoretical and experimental approaches to such problems have recently been reported [102, 103]. An analytical model for ball bearing vibration has been devised to predict vibration response. The model has been investigated with a view toward diagnosing rotating machinery problems [104].

SEALS

Investigations of seal forces induced by flow have recently increased because high performance machines are being used. Dynamic characteristics of labyrinth seals, annular seals, and ring seals have been investigated.

Labyrinth seals. Two methods are used to measure the flow-induced spring coefficients of labyrinth seals. The static method measures seal force by deflecting the shaft center statically. The dynamic method is similar to the method for measuring journal bearing coefficients [105-112].

The perturbation method is usually used in theoretical investigations and the results are compared with experimental ones [113-118]. On the other hand, the effects of labyrinth seal forces on instability have been studied theoretically, and the effects of each parameter have been investigated [119, 120].

Annular seals. Stiffness and damping coefficients of annular seal bearings can be obtained experimentally and theoretically when the eccentricity of the rotor against the seal center is zero [121-130]. But no investigations have been reported for parallel groove or spiral groove seals. Dynamic coefficients for these seals must therefore be obtained theoretically.

Ring seals. The influence of high-pressure oil-seal rings on the response and stability of turbocompressors is an important problem. Vibration and destabilizing effects of floating ring seals in compressors have been investigated [131-133].

FLOW-INDUCED FORCES DUE TO IMPELLERS

High-performance centrifugal compressor problems include nonsynchronous dynamic instability of rotors. This phenomenon is caused by flow-induced forces due to the impeller. Hydrodynamic stiffness coefficients for a centrifugal pump impeller have been obtained both experimentally [134-136] and theoretically [137, 138]. Vibration-exciting mechanisms induced by flow have also been studied for turbomachine stages [140]. Experimental investigations have been conducted of rotating stall flow in a centrifugal compressor [141]. Stall and nonstall bending mode flutter have been analyzed in high subsonic flow [142].

COUPLINGS AND GEARS

Hooke's joint angularity causes speed variations and introduces periodic coefficients into the equation of motion for angular rotational displacement. Thus, a rotor driven through Hooke's joint causes parametric resonances. An example of troubleshooting has been reported for a rolling mill [145]. Theoretical approaches to problems of parametric resonance have been published for rotor systems with angular rotational displacement [146, 147] and for buckling of a flexible shaft under torque loads transmitted by Hooke's joint [148]. Problems of the effects on instability of friction in drive couplings [149] and the selection of couplings for engine test beds [150] have been investigated.

Machine trains with a gear sometimes produce torsional or lateral vibration in high performance compressors and pumps. Instability, vibration response, and noise from the gear have been studied [176-181].

ROTOR VIBRATION

Vibration of rotor partially filled with liquid. The perturbation method has been used to assess vibration and stability of an elastically mounted spinning rotor partially filled with liquid and unbalanced [143, 144].

Asymmetric rotors. In a two pole turbogenerator system the generator has an asymmetric shaft stiffness in the principal axis because the two-pole mechanism and the jounal bearing-foundation system have asymmetric rigidities. Parametric instability occurs in such a system. Many analytical approaches [151-158] have been suggested for this problem. Muller [158] dealt with the stability analysis of the most general asymmetric system. Applications of his analysis had to do with design problems involving double frequency vibration [162-164]. Evaluation of the bending stiffness of a shaft or its asymmetry in a two-pole generator is very difficult and includes errors. The influence of this error on stability or vibration has been studied [165].

Cracked rotors. In recent years a number of cracks have occurred in rotor shafts of turbogenerator systems. Methods for detecting such cracks have thus become important, and many vibration analyses for shaft cracks have been reported [166-171]. The techniques used in these analyses are similar to those used to analyze asymmetric rotor vibration. A new monitoring system has been proposed [172].

TORSIONAL VIBRATION

Induction and synchronous machines produce an oscillating torque on startup that causes strong torsional excitations in the machinery connected to it. Bending-torsional coupled vibration can occur; calculation methods have been proposed to deal with these vibrations [173, 174].

Another problem has to do with abnormal impulse torques in the shaft system of turbogenerators; either a sudden short-circuiting condition at the generator terminals or faulty synchronizing can occur. The transient response of turbo-alternator rotor systems under short-circuiting conditions has been studied [175].

MONITORING AND CONTROL

High reliability is necessary in operating rotating machinery as is planned preventive maintenance. Many measuring systmes, analysis procedures, and on-line computer systems have been developed [182-186]. Studies on gearbox monitoring [187-190] and rolling contact bearings [191] have been reported. Randall's work [188], which applied the cepstrum analysis to gearbox diagnosis, is interesting.

Active feedback control has been studied as a means for eliminating or alleviating rotor-dynamic instability [192-196]. This idea is useful for high performance rotor systems, but it will be difficult to develop the control actuator.

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*NASA-CP 2133:	NASA Conference Publication 2133, Rotor Instability Problems in High Performance Turbomachinery, May 1980.
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***NASA-CP 2250:	NASA Conference Publication 2250, Rotordynamic Instability Problems in High-Performance Turbomachinery (May 1982).
****IFTOMM:	International Conference on "Rotordynamic Problems in Power Plants," Rome (Sept - Oct 1982).

BOOK REVIEWS

ENGINEERING PRINCIPLES OF ACOUSTICS: NOISE & VIBRATION CONTROL

D.D. Reynolds
Allyn and Bacon, Inc., Boston, MA
1981, 641 pp

This excellent reference could be used as a textbook for senior undergraduate or graduate courses. Knowledge of differential equations and complex numbers is needed. The coverage is primarily mechanical vibrations, but the author has attempted to blend in acoustics by discussing the production, transmission, and sound absorption produced by acoustic sources. Mathematical treatment is intensive.

One chapter is devoted to human response to noise, subjective factors, noise control, and noise regulations. Other chapters cover harmonic motion, vibration fundamentals, deterministic and random signals, convolution integrals, wave motion, continuous systems, sound propagation outdoors, and three-dimensional acoustic waves. Appendices describe acoustic properties of materials, commonly used standards, and references on the subject.

The book is illustrated with many drawings; typical problems are used to demonstrate equations and associated principles. The book will be compared to Beranek's Noise and Vibration Control and Theoretical Acoustics by Morse and Ingard. The coverage in these two books extends more deeply into the area of architectural acoustics and building noise control, but Reynolds' book has more in-depth mathematical treatment of mechanical phenomena.

This is a good reference book for the practicing mechanical or aerospace engineer. It will be of value to persons wanting to understand underlying principles in acoustics and noise and vibration control.

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NOISE CONTROL SOLUTIONS FOR THE CHEMICAL AND PETROLEUM INDUSTRY

R.K. Miller, W.V. Montone, and M.D. Oviatt
Fairmont Press, Atlanta, GA
1980, 113 pp

This book is part of a collection of texts on noise control solutions for industry. The authors have attempted brief coverage for the chemical and petroleum industry and, on the whole, have not successfully accomplished it. The chapter titles are: General Approaches to Noise Control, OSHA, Overview of Noise Problems in the Chemical and Petroleum Industry, Feasibility, Literature Search, Economic Analysis, Valves and Piping, Fans and Blowers, Compressors, Pumps and Hydraulic Systems, Gas Furnaces, Vents, Flares, Airfin Coolers, Offshore Installations, Material Handling, Steam Leaks, Vibrators, Mills, Fiber Aspirators, Ventilation Fans, Reverberation, Motors, Air Noise, Metal-to-Metal Impact Noise, Acoustical Curtains, Employee Enclosures and Barriers, Acoustical Maintenance, Fire Codes, and Long Term Noise Abatement.

One factor that directly affects the credibility of this work is the omission of work by Putnam and by Strahle on combustion noise.

Not enough information is given on any type of noise source to enable the reader to use the book as a source of information for noise control. A more detailed reference list or bibliography should be included for the reader who wants more information.

There are other problems. The book is poorly edited; some charts and tables, which deserve full-page treatment, have been reduced to the point that they are difficult to read and use. Some of the graphics give the impression that they have been directly removed from books that have been referenced.

This book should provide the beginner with information on the subject of controlling noise for chemical and petroleum processes. The more experienced individual, however, will be disappointed with its content and will not find it very useful.

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OPTIMALITY IN PARAMETRIC SYSTEMS

T.L. Vincent and W.J. Grantham
John Wiley & Sons, Inc., New York, NY
1981, 243 pp, $31.95

The steady states of a variety of engineering systems as well as natural processes can often be identified and characterized by an underlying extremum principle. On the other hand, some sort of minimization or maximization is almost always an integral part of modern engineering design. It is not surprising, therefore, that inquiries into optimization techniques and optimal processes span the history of science and mathematics, as is noted by the authors of this volume.

In recent years, the books written on the subject of optimization either tend to emphasize computer applications or are overburdened by rigorous mathematics. This monograph is a departure from both of these extremes and presents a unified analytical approach to parameter optimization for both static and dynamic systems.

The topics treated include linear and nonlinear programming, vector optimization, continuous games, and parametric dynamic systems. The book is concerned with parametric systems. Problems involving the extremum properties of functionals -- which belong to the domain of calculus of variations -- are not treated. Although the optimality concepts for multiple-objective parametric systems presented in the book represent an introduction to the types of systems explored in optimal control theory, a full chapter on the topic would have certainly been appreciated by the initiated. Nevertheless, the reviewer feels that, in view of the rapidly growing literature concerning various aspects of optimization theory, this omission should be interpreted as a meaningful and in some ways desirable confinement because it enables the authors to maintain a unified treatment throughout the volume. Much of the material covered in the book is not currently available in textbook form.

Chapter 1 is an introduction to basic concepts developed in the book and contains mathematics required for the rest of the text. Vector spaces, matrices, and related basic theorems are summarized. Chapter 2 provides the theoretical base for the development of many new concepts in parametric optimization -- vector minimization, continuous games, and parametric dynamic systems -- treated in subsequent chapters. Tangent vectors and tangent cones are introduced for the analysis of both first order and second order conditions for the basic nonlinear programming problem. This chapter also explores the Kuhn-Tucker constraint qualification and linear systems as a special case for which the cost function and the constraint equations are linear.

Chapter 3 is a clearly written account of the principal issues in the optimization of vector-valued criterion functions. Various solution concepts and rationales that can be used to approach the vector minimization problem are presented. In addition to the concepts of scalarization and Pareto-minimal solutions (both local and global points), the so-called compromise solutions are also discussed briefly. The authors shift to a more versatile control notation from the classical notation and establish a new formalism in Chapter 4. The results of Chapter 2, including the first and second order conditions for the basic nonlinear programming problem, are expressed in terms of the new notation, and the computational advantage of the new approach is demonstrated.

Following the advantageous reformulation introduced in Chapter 4, the game theory, involving multiple decision makers -- each with its own cost criterion -- is treated in Chapter 5. Nash equilibrium solutions, min-max as well as min-max counter solutions, and Pareto-minimal solutions are some of the concepts explored from a unified viewpoint. An account of the modern conflict analysis, however, is not included.

Chapter 6 is devoted to systems in which the evolution of state variables with time is governed by ordinary differential equations. The control inputs are either constants or specified functions containing control parameters. Because the state of the system is no longer static, cost criteria are generalized to reflect the dynamic nature of the state. This chapter presents several interesting results concerning parametric dynamic systems. Carefully selected illustrative examples are given.

In addition to several applications presented in the text, each chapter contains a set of exercises; answers to selected problems are also provided. The book is an excellent statement of achievements in the area; it could be adopted for a one-semester course in optimization and game theory for senior or graduate students in engineering, mathematics, economics, and such other areas as mathematical biology.

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DESIGN OF EARTHQUAKE RESISTANT STRUCTURES

E. Rosenblueth, editor
John Wiley & Sons, New York, NY
1980, 295 pp

This volume contains chapters written by engineers knowledgeable in some particular phase of design of earthquake-resistant structures. Chapter 1, written by the editor, considers characteristics of earthquakes and introduces seismic waves (primary, P, and secondary, S), accelerograms, and spectra (fourier, fourier amplitude, and response). Ground spectra and methods for obtaining them are considered, as are Newmark-Blume-Kapur spectra, which are used in the design of nuclear power plants. Information on impact, liquefaction, and the modified Mercali-scale are included. The reviewer would have liked to see a relationship established between response spectra and random vibration.

Chapter 2 focuses on design response spectra, modification of spectra, and the dynamic analysis of structures. Modal analysis (mode superposition-method) is the most prevalent design analysis method. The chapter concludes with a consideration of the limitations of equivalent lateral forces and modal analysis procedures.

Chapter 3 has to do with design in general, including structural response, control variables (inelastic response), stiffness, deformation, damage, and energy absorption. Such design principles as the proper type of framing and necessary design requirements for safety criteria are stressed.

Chapter 4 is concerned with design of steel structures. The author outlines causes of premature failure: moment-resistant design of structures, beam behavior (elastic and plastic, beam column design, beam connection, and bracing), brittle fracture, and lamellar tearing.

The topic of Chapter 5 is concrete structures. Included are such factors as strength and ductility (design loads and section strength), stress-strain behaviors of concrete and steel, reinforced concrete members, building frames, and beam columns. Photographs of reinforced concrete shear walls show model failure due to sliding shear. Special provisions for seismic design of flexural members, columns and beam column connections conclude the chapter.

Chapter 6 treats masonry. According to the author, "Masonry doesn't enjoy the reputation for sound performance under seismic loading." This lack of confidence stems from unsatisfactory performance of unreinforced masonry structure during the early part of the century. The author provides details of proper ways to design masonry structures, including mechanical and structural methods and design philosophy. He stresses that masonry units must be well tied into the column core to prevent shedding of masonry.

Chapter 7 treats foundations and soil-surface interactions. A typical floor plan is related to response spectra, soil characteristics, inertial reaction and pile foundation. Various methods and techniques used in foundation analysis are compared.

Nonstructural elements are usually not considered in design. A number of nonstructural elements -- piping systems and cable tray assemblage -- are considered in the final chapter. A table abstracted from the State of California, Title 17, Health & Safety code contains required force factors for essential and nonessential buildings. Seismic hazard exposure groups are discussed as are performance factors, which are required in force equations used in nonstructural element design.

The reviewer would have preferred a table of nomenclature, computer programs explaining design rules, illustrative examples showing relationships of seismic design to nuclear power plants, and applications of seismic response to two frequencies. The reviewer recommends this book to those interested in design of seismic response structures.

H. Saunders
General Electric Company
Building 41, Room 307
Schenectady, NY 12345

SHORT COURSES

SEPTEMBER

12TH ADVANCED NOISE AND VIBRATION COURSE

Dates: September 19-23, 1983
Place: Southampton, England
Objective: The course is aimed at researchers and development engineers in industry and research establishments, and people in other spheres who are associated with noise and vibration problems. The course, which is designed to refresh and cover the latest theories and techniques, initially deals with fundamentals and common ground and then offers a choice of specialist topics. There are over thirty lectures, including the basic subjects of acoustics, random processes, vibration theory, subjective response and aerodynamic noise, which form the central core of the course. In addition, several specialist applied topics are offered, including aircraft noise, road traffic noise, industrial machinery noise, diesel engine noise, process plant noise, environmental noise and planning and laser techniques for non-contact measurements.

Contact: Mrs. Maureen Strickland, ISVR Conference Secretary, The University, Southampton S09 5NH, England - (0703) 559122, Ext. 2310/532.

MODAL TESTING COURSE

Dates: September 20-22, 1983
Place: Washington, D.C.
Objective: Vibration testing and analysis associated with machines and structures will be discussed in detail. Practical examples will be given to illustrate important concepts. Theory and test philosophy of modal techniques, methods for mobility measurements, methods for analyzing mobility data, mathematical modeling from mobility data, and applications of modal test results will be presented.

Contact: Dr. Ronald L. Eshleman, Vibration Institute, 101 W. 55th St., Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254.

DYNAMIC BALANCING

Dates: September 21-22, 1983
October 19-20, 1983
November 16-17, 1983
Place: Columbus, Ohio
Objective: Balancing experts will contribute a series of lectures on field balancing and balancing machines. Subjects include: field balancing methods; single, two and multi-plane balancing techniques; balancing tolerances and correction methods. The latest in-place balancing techniques will be demonstrated and used in the workshops. Balancing machines equipped with microprocessor instrumentation will also be demonstrated in the workshop sessions. Each student will be involved in hands-on problem-solving using the various balancing techniques.

Contact: R.E. Ellis, IRD Mechanalysis, Inc., 6150 Huntley Road, Columbus, OH 43229 - (614) 885-5376.

STRUCTURAL DYNAMICS: COMPUTER-ORIENTED APPROACH WITH APPLICATIONS

Dates: September 26-30, 1983
Place: Los Angeles, California
Objective: The course emphasizes discrete methods, numerical methods, and structural modeling for computer-oriented solution of various structural dynamic problems. Some recent developments in the structural dynamic analysis of parametrically excited systems, rotating systems, and systems in which fluid-structure dynamic interactions occur are also considered.

Contact: Short Course Program Office, UCLA Extension, P.O. Box 24901, Los Angeles, CA 90024 - (213) 825-1295 or 825-3344.

OCTOBER

UNDERWATER ACOUSTICS AND SIGNAL PROCESSING

Dates: October 3-7, 1983
Place: University Park, Pennsylvania

Objective: This course is designed to provide a broad, comprehensive introduction to important topics in underwater acoustics and signal processing. The primary goal is to give participants a practical understanding of fundamental concepts, along with an appreciation of current research and development activities. Included among the topics offered in this course are: an introduction to acoustics and sonar concepts, transducers and arrays, and turbulent and cavitation noise; an extensive overview of sound propagation modeling and measurement techniques; a physical description of the environment factors affecting deep and shallow water acoustics; a practical guide to sonar electronics; and a tutorial review of analog and digital signal processing techniques and active echo location developments.

Contact: Alan D. Stuart, Course Chairman, Applied Research Laboratory, The Pennsylvania State University, P.O. Box 30, State College, PA 16801 - (814) 865-7505.

VIBRATION AND SHOCK SURVIVABILITY, TESTING, MEASUREMENT, ANALYSIS, AND CALIBRATION

Dates: October 17-21, 1983
Place: England
Dates: October 24-28, 1983
Place: Boulder, Colorado
Dates: November 21-25, 1983
Place: Ottawa, Ontario
Dates: November 28 - December 3, 1983
Place: Cincinnati, Ohio
Dates: December 5-9, 1983
Place: Santa Barbara, California

Objective: Topics to be covered are resonance and fragility phenomena, and environmental vibration and shock measurement and analysis; also vibration and shock environmental testing to prove survivability. This course will concentrate upon equipments and techniques, rather than upon mathematics and theory.

Contact: Wayne Tustin, 22 East Los Olivos Street, Santa Barbara, CA 93105 - (805) 682-7171.

ELECTROEXPLOSIVES DEVICES TRAINING COURSE

Dates: October 18-20, 1983
Place: Philadelphia, Pennsylvania

Objective: Topics will include but not be limited to the following: history of explosives and definitions; types of pyrotechnics, explosives and propellants; types of EEDs, explosive trains and systems, fuzes, safe-arm devices; sensitivity and functioning mechanisms; output and applications; safety versus reliability; hazard sources: lightning, static electricity, electromagnetic energy (RF, EMP, light, etc.), heat, flame, impact, vibration, friction, shock, blast, ionizing radiation, hostile environments, human error; precautions, safe practices, standard operating procedures; grounding, shorting, shielding; inspection techniques, system check-out troubleshooting and problem solving; safety devices, packaging and transportation; specifications, documentation, information sources, record keeping; tagging, detection and identification of clandestine explosives; reaction mechanisms, solid state reactions; chemical deactivation, disposal methods and problems, toxic effects; laboratory analytical techniques and instrumentation; surface chemistry.

Contact: E&P Affairs, The Franklin Research Center, 20th and Race Streets, Philadelphia, PA 19103 - (215) 448-1236.

MACHINERY VIBRATION ANALYSIS

Dates: November 15-18, 1983
Place: Chicago, Illinois

Objective: In this four-day course on practical machinery vibration analysis, savings in production losses and equipment costs through vibration analysis and correction will be stressed. Techniques will be reviewed along with examples and case histories to illustrate their use. Demonstrations of measurement and analysis equipment will be conducted during the course. The course will include lectures on test equipment selection and use, vibration measurement and analysis including the latest information on spectral analysis, balancing, alignment, isolation, and damping. Plant predictive maintenance programs, monitoring equipment and programs, and equipment evaluation are topics included. Specific components and equipment covered in the lectures include gears, bearings (fluid film and antifriction), shafts, couplings, motors, turbines, engines, pumps, compressors, fluid drives, gearboxes, and slow-speed paper rolls.

Contact: Dr. Ronald L. Eshleman, Vibration Institute, 101 W. 55th St., Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254.

SCALE MODELING IN ENGINEERING DYNAMICS

Dates: December 5-9, 1983

Place: Washington, D.C.

Objective: The course will begin with a drop test demonstration of damage to model and prototype cantilever beams made from different materials. These tests help to introduce the concepts of similarity and of physical dimensions which are preliminary to any model analysis. Formal mathematical techniques of modeling will then be presented including the development of scaling laws from both differential equations and the Buckingham Pi Theorem. A number of sessions then follow wherein the instructors present specific analyses relating to a variety of dynamic vibrations and transient response problems. The problems are selected to illustrate the use of models as an analysis tool and to give examples of variations on different modeling techniques. Types of problems presented include impact, blast, fragmentation, and thermal pulses on ground, air and floating structures. The schedule in this brochure summarizes the content of the course.

Contact: Wilfred E. Baker, Southwest Research Institute, P.O. Box 28510, San Antonio, TX 78284 - (512) 684-5111, ext. 2303.

Call for Papers

INSTITUTE OF ENVIRONMENTAL SCIENCES' 30TH ANNUAL TECHNICAL MEETING
April 30 - May 3, 1984
Orlando, Florida

"Environmental Integration Technology Today for a Quality Tomorrow" is the theme of the Institute of Environmental Sciences' 30th Annual Technical Meeting.

Technical papers are welcome in the areas of product reliability; design, test and evaluation, including computer applications; energy and the environment; and other related areas. An abstract of 300 words or less must be submitted by September 15, 1983 to insure its consideration. Complete text of technical presentation will be required in the proper format for Proceedings publication by January 20, 1984. Suggestions for session chairmen and panel moderators are also welcome.

Send abstracts to: William Silver II, Technical Program Co-Chairman, Westinghouse Electric Corporation, P.O. Box 746 MS 504, Baltimore, MD 21203 - (301) 765-3902.

Call for Papers

ADVANCES IN PROBABILISTIC STRUCTURAL MECHANICS - 1984
June 17-21, 1984
San Antonio, Texas

A special Symposium on "Advances in Probabilistic Structural Mechanics - 1984" will be held during the American Society of Mechanical Engineers' Pressure Vessel and Piping Conference on June 17-21, 1984, in San Antonio, Texas.

State-of-the-art surveys, original research papers and applications papers on all aspects of probabilistic structural analysis, design and decision-making are solicited. Topics of interest include, but are not limited to load definition/combination, random material property variations, stochastic simulation, random vibration analysis, earthquake engineering, fracture/fatigue analysis, reliability/risk assessment and decision analysis.

Papers accepted for presentation will be published in the Symposium Volume.

Potential authors should submit an abstract or an indication of interest to the Symposium Chairman by September 1, 1983. Full papers are due by December 15, 1983.

All correspondence, abstracts and papers should be sent to: Dr. C. Sundararajan, Symposium Chairman, 288 Whitmore Street, Suite 325, Oakland, CA 94611 - (415) 655-2920.

Call for Papers

13TH SPACE SIMULATION CONFERENCE
October 9-11, 1984
Orlando, Florida

The 13th Space Simulation Conference will be hosted by the Institute of Environmental Sciences (IES) and supported by the American Institute of Aeronautics and Astronautics (AIAA), American Society for Testing and Materials (ASTM), and the National Aeronautics and Space Administration (NASA) through mutual interests in technical activities in the subject area.

The theme of the conference is "The Payload -- Testing for Success." The purpose of the conference is to provide a forum for the review and exchange of information and ideas on current space simulation technology and closely related disciplines as well as projections for testing requirements and technology development for the 1980's.

Papers are being solicited in the following subject areas: space simulation facilities; spacecraft testing; thermal protection; space program trends; unique facilities; remote sensing; facility management issues; life sciences; space physics; vacuum/cryogenics; contamination; shuttle environments; thermal simulation; shuttle payloads.

Papers dealing with subjects other than those listed above will be considered for the conference based on their relatedness to these subject areas. Papers summarizing the results of Shuttle Flights would be of great interest.

Papers for presentation will be selected on the basis of abstracts of approximately 500 words. The abstract should include the description and principal results of the investigation as well as status and extent of the work.

To assure proper consideration of a paper, three copies of the abstract must be submitted before February 17, 1984 to the Technical Program Chairman: Robert P. Parrish, Jr., Martin Marietta Corporation, P.O. Box 179, MS S-0435, Denver, CO 80201.

An accompanying cover letter should provide the complete paper title, the author's name and affiliation, address and phone number. All papers must be unclassified and not previously published.

Authors will be notified of the Program Committee's decision by April 13, 1984. The photo ready manuscripts of accepted papers will be required no later than July 13, 1984 in order to be included in the publication of the conference proceedings.

Call for Papers

SYMPOSIUM ON ADVANCES AND TRENDS IN STRUCTURES AND DYNAMICS
October 22-25, 1984
Washington, D.C.

The purpose of the Symposium is to provide a multidisciplinary medium for communicating recent and projected advances in applied mechanics, applied mathematics, numerical analysis, new computing systems and their impact on the structures and dynamics discipline.

Papers are invited on the impact of development in each of the following areas on structures and dynamics: applied mechanics; numerical analysis; computer science and computer hardware; and optimization techniques.

Authors should submit five copies of an extended abstract of about 1,000 words including sample figures prior to September 23, 1983. Notification of acceptance will be given by November 18, 1983. Five copies of the final manuscript, complete with original drawings or glossy prints will be due by April 6, 1984.

One-page abstracts are also solicited on current research in progress for short presentations at special sessions. A volume of proceedings will be published before the meeting and the papers accepted will also be considered for publication in the Journal of Computers and Structures. For the purpose of advance planning, please contact: Professor Ahmed K. Noor, Mail Stop 246, GWU-NASA Langley Research Center, Hampton, VA 23665 - (804) 865-2897.

ABSTRACTS FROM THE CURRENT LITERATURE

Copies of publications abstracted are not available from SVIC or the Vibration Institute, except those generated by either organization. Government Reports (AD-, PB-, or N-numbers) can be obtained from NTIS, Springfield, Virginia 22151; Dissertations (DA-) from University Microfilms, 313 N. Fir St., Ann Arbor, Michigan 48106; U.S. Patents from the Commissioner of Patents, Washington, DC 20231; Chinese publications (CSTA-) in Chinese or English translation from International Information Service Ltd., P.O. Box 24683, ABD Post Office, Hong Kong. In all cases the appropriate code number should be cited. All other inquiries should be directed to libraries. The address of only the first author is listed in the citation. The list of periodicals scanned is published in issues 1, 6, and 12.

ABSTRACT CONTENTS

MECHANICAL SYSTEMS

ROTATING MACHINES

(Also see Nos. 1570, 1632, 1638, 1647, 1653, 1655, 1657, 1658, 1660)

83-1498

A Theoretical Investigation of an Overhung Flexible Rotor Mounted on Uncentralized Squeeze-Film Damper Bearings and Flexible Supports

R.A. Cookson and Xin-Hai Feng

Cranfield Inst. of Tech., Cranfield, Bedford, UK, J. Engrg. Power, Trans. ASME, 105 (2), pp 361-368 (Apr 1983) 5 figs, 14 refs

Key Words: Rotors, Flexible rotors, Squeeze-film bearings, Squeeze-film dampers, Disks, Turbines

Previous investigations have shown that the uncentralized type of squeeze-film damper is an effective means of reducing the transmission of unbalance forces into the supporting structure. In this theoretical study a more complex model, which includes an overhung fan disk and a noncentral turbine disk, is employed. This model represents the conventional gas turbine somewhat closer than the previously studied single disk system and shows that it is possible to minimize the force transmitted into the surrounding structure by a careful selection of squeeze-film damper characteristics, although it is found that some larger amplitudes of motion accompany the minimized transmissibility.

83-1499

A Note on Rotor-Bearing Stability

M.L. Adams

Dept. of Mech. and Aerospace Engrg., Case Inst. of Tech., Case Western Reserve Univ., Cleveland, OH 44106, J. Sound Vib., 86 (3), pp 435-438 (Feb 8, 1983) 3 figs, 3 refs

Key Words: Rotors, Bearings, Stability

A previously presented unconventional approach to study rotor-bearing stability appears to be considerably more accurate than conventional approaches and overall could significantly enhance study of the subject. However, the experiment that was proposed to implement the approach has since been found to contain a fundamental flaw. This short note has been written primarily to point out that flaw and to propose an experiment in which the approach previously presented is correctly implemented.

83-1500

Secondary Critical Speed of Flexible Rotors with Inertia Slots

M. Sakata, M. Endo, K. Kishimoto, and N. Hayashi

Dept. of Physical Engrg., Tokyo Inst. of Tech., Ookayama, Meguro-ku, Tokyo 152, Japan, J. Sound Vib., 87 (1), pp 61-70 (Mar 8, 1983) 11 figs, 2 tables, 8 refs

Key Words: Rotors, Flexible rotors, Critical speeds, Inertial forces

Rotors of two-pole generators have longitudinal slots for the electric windings and thus have dual flexural rigidity. Second order (or twice per revolution) forced vibrations are excited by the weight of the rotor and the problem of secondary critical speed, at half of the normal critical speed, arises. To overcome this difficulty transverse saw cuts or inertia slots are made in the pole faces in order to restore equality of the flexural rigidity of the rotor. In this paper the critical speeds of rotors with inertia slots are calculated by using the transfer matrix method. The flexural rigidity of the element used in the transfer matrix method is determined by a three-dimensional finite element method. The secondary critical speeds of asymmetric rotors with inertia slots were measured experimentally thus demonstrating the validity of the present analysis.

83-1501

Making Motors Quiet

B. Lakin

Ozark Motor Div., Fasco Industries Inc., Ozark, MO, Mach. Des., 55 (6), pp 65-68 (Mar 24, 1983) 3 figs

Key Words: Rotors, Noise generation

A general description of common machinery noise sources is given. Ball bearing motors and sleeve-bearing motors are discussed in detail.

83-1502

Vibration Analysis of Rotor-Bearing System by Quasi-modal Transformation (Analyses of Complex Eigenvalue and Response History)

O. Matsushita, M. Takagi, and R. Takahashi
Mech. Engrg. Res. Lab. of Hitachi Ltd., 502, Kandatsu-Machi, Tsuchiura-Shi, Ibaraki 300 Japan, Bull. JSME, 26 (213), pp 414-423 (Mar 1983) 17 figs, 9 refs

Key Words: Rotors, Vibration analysis, Eigenvalue problems

For vibration analysis of a rotor-bearing system considering gyroscopic effect and large damping forces due to bearings, a quasi-modal transformation method developed from modal transformation is applied. A complex eigenvalue solution method based upon quasi-modal transformation is described and results of corresponding numerical examples indicate that the solution has a sufficient accuracy. The quasi-modal method is also applied to the response history analysis in nonlinear rotor dynamics. In this analysis a new numerical integration method is introduced.

83-1503
Experimental Investigation of the Unbalance Response of a Rotor on Hydrodynamic Bearings
R.B. Bhat and T.S. Sankar
Dept. of Mech. Engrg., Concordia Univ., Montreal, Quebec, Canada, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 17 pp, 10 figs, 4 refs

Key Words: Rotors, Unbalanced mass response, Bearings, Fluid film bearings

Unbalance response of a single mass rotor supported on hydrodynamic bearings is measured experimentally. The experimental setup consists of a disk at the center of a shaft of circular cross section which is supported at its two ends on two fluid film bearings. Employing two proximity pickups which measure the response in two orthogonal directions, the orbit diagrams are obtained from which the rotor whirl directions are identified. The measured results are compared with those obtained using the theoretical analysis and the agreement is good.

83-1504
System Analysis of Rotors, Supporting Structures and Their Foundations
G. Thomas, M. Simpson, R.D. Winton, and S.D. Robinson
Structural Dynamics Res. Corp., Milford, OH, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 28 pp, 12 figs, 9 refs

Key Words: Rotors, Foundations, Interaction: rotor-foundation, System analysis

System analysis when applied to rotating equipment systems is a methodology for accurately predicting important dynamic characteristics such as rotor critical speeds by properly accounting for the effects of all contributing components inclusive of pedestals and foundations. Recent advances in formulating the system model approach have dispensed with the need for massive computer models and associated costs and have created something which is a viable tool even when operating in a minicomputer environment. This paper demonstrates the applicability of this approach through case histories from both high speed and low speed rotating equipment applications.

83-1505
Dynamics of Rotor Systems Using Finite Elements
A. Craggs and S. Akella
Dept. of Mech. Engrg., Univ. of Alberta, Edmonton, Canada, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 13 pp, 3 figs, 2 tables, 12 refs

Key Words: Rotors, Beams, Timoshenko theory, Turbine components, Finite element technique, Balancing techniques

The paper gives details on the accuracy of a high-order Timoshenko beam finite element which has been modified to simulate a whirling shaft. The element allows for tapered and stepped sections and the gyroscopic moments of attached disks. The use of a finite element model of a turbine shaft-bearing system as an aid to the balancing procedure is discussed.

83-1506
RIT Rotor Vibration Testing. Test Report
Northern Res. and Engrg. Corp., Woburn, MA, Rept.

No. DOE/ET/15426-T23, 27 pp (Sept 27, 1982) DE82021024

Key Words: Rotors, Vibration tests

A radial inflow turbine (RIT) B rotor, including the impeller and shaft, was examined experimentally to determine vibratory characteristics. It was concluded that there are no specific speeds within the operating range with adequate resonance encroachment margins. It is recommended that performance tests be carried out with caution.

83-1507

Recent Results About Fan Noise: Its Generation, Radiation and Suppression

C.E. Feiler

NASA Lewis Res. Ctr., Cleveland, OH, Rept. No. E-1438, NASA-TM-83002, 37 pp (1982) (Pres. at the 19th Ann. Mtg. of the Soc. of Eng. Sci., Rolla, MO, Oct 27-29, 1982)
N83-13939

Key Words: Fan noise, Noise generation, Noise reduction

Fan noise including its generation, radiation characteristics, and suppression by acoustic treatment is studied. In fan noise generation, results from engine and fan experiments, using inflow control measures to suppress noise sources related to inflow distortion and turbulence, are described. Hot wire measurements of a fan rotor wake field are presented and related to the fan's noise signature.

83-1508

Holographic Vibration Measurement of a Rotating Fluttering Fan

P.A. Storey

Rolls-Royce Ltd., Derby, UK, Rept. No. PNR-90119, 11 pp (1982)
N83-13437

Key Words: Fans, Flutter, Holographic techniques, Interferometric techniques, Vibration measurement

The use of holographic interferometry to determine the deflection shape of a rotating aero engine fan undergoing unstalled supersonic flutter is described. A mirror-Abbe image rotator was employed in a double pulse holographic system to compensate for fan rotational motion and maintain correlation between the two resultant holographic images. Errors due to misalignment of the system and unsteady aerodynamics are discussed.

83-1509

Vibration Reduction of Vertical Pumps -- A Case History

M.M. Osman

Ontario Hydro, Power Equipment and Energy Studies Dept., 700 University Ave., H14, Toronto, Ontario M5G 1X6, Canada, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 5 pp, 5 figs, 1 table

Key Words: Pumps, Vibration control, Turbine components, Case histories

Vertical pumps are susceptible to vibration problems partly due to their one-point attachment to the foundation. A case history of high vibrations of a vertical pump and a design modification to remedy it are presented. Vibration measurements are carried out to identify the causes for the high, unacceptable vibration levels and to assess the effectiveness of the proposed design modification.

83-1510

Align Pump Drives Faster by Well-Planned Procedure

J.P. Messina and S.P. D'Alessio

Public Service Electric & Gas Co. of NJ, Power, 127 (3), pp 107-110 (Mar 1983) 3 figs, 3 tables

Key Words: Pumps, Alignment

A calculation program for processing the data for the alignment of pumps and their connected drive units is presented. The calculator compares the first trail alignment of shafts to the desired alignment and then calculates the exact correction required.

RECIPROCATING MACHINES

83-1511

Prediction of the Transient Response of Turbocharged Diesel Engines (Rechnerische Untersuchung des dynamischen Betriebsverhaltens aufgeladener Dieselmotoren)

H. Zellbeck and G. Woschni

MTZ Motortech Z., 44 (3), pp 81-86 (Mar 1983) 10 figs, 2 refs
(In German)

Key Words: Diesel engines, Turbine engines, Transient response

Prediction of the transient response of a turbocharged diesel engine in a power plant or truck is very difficult. Based on a digital calculation method of the diesel cycle, a simulation program is presented here as a useful tool to assist manufacturers and users of TC-diesel engines in predicting load acceptance. Comparisons of calculated results with measured data show good correspondence with respect to generators' power ratings and acceleration of a truck engine. The influence of governor dynamics is described. The differences between a turbocharged engine and a naturally aspirated engine in transient performance are discussed.

83-1512

An Automotive Piston Lubrication Model

D.F. Li, S.M. Rohde, and H.A. Ezzat

General Motors Res. Labs., Warren, MI 48090, ASLE, Trans., 26 (2), pp 151-160 (Apr 1983) 13 figs, 3 tables, 16 refs

Key Words: Reciprocating engines, Pistons

An analytical study of the dynamics of a piston in a reciprocating engine was conducted. The analysis, which incorporates a hydrodynamic lubrication model, was applied to a V-8 automotive spark ignition engine. The variation of piston transverse position and rotation with crank angle, and the piston-skirt frictional power loss were calculated for different wrist pin locations, piston-to-cylinder clearances, and lubricant viscosities.

83-1513

Vibration Analysis of Piston Engines with Application to Noise Control

M.G. Milsted

Univ. of Tech., Dept. of Transport Tech., Loughborough, Leicestershire LE11 3TU, UK, Shock Vib. Dig., 15 (4), pp 3-13 (Apr 1983) 113 refs

Key Words: Reviews, Reciprocating engines, Diesel engines, High frequency response, Noise reduction

Literature from 1958 to early 1982 concerned with high frequency vibration and noise from piston engines is surveyed. Problems associated with characterization of the vibration source, its transmission through the engine structure and the coupling between surface vibration and radiated noise are included.

METAL WORKING AND FORMING

(Also see No. 1613)

83-1514

A Dynamic Photoelastic Study of Flexural Wave Generation in a Model of Percussive Drilling

J.E. Ögren

Univ. of Luleå, S-951 87 Luleå, Sweden, J. Sound Vib., 86 (2), pp 243-252 (Jan 22, 1983) 7 figs, 7 refs

Key Words: Drills, Noise generation, Flexural vibration, Photoelastic analysis

The development of the percussive drilling machine has led to a situation where the drill steel itself has become a major noise source. A qualitative theory for the generation of this noise is presented. In this theory the longitudinal drilling pulse is partially converted to flexural motion by non-symmetric boundary conditions. The technique of stress optics combined with high speed photography is used in conjunction with Araldite models of the drill steel to verify the above conjectures. The models are then used to demonstrate the importance of the clamping conditions in preventing the growth of noise producing motions of the drill steel.

83-1515

Studies on the Wear of Hob (Influence of Face Roughness of Tooth Upon Tool Wear)

K. Hidaka, T. Ueno, and M. Nakae

Sasebo Technical College, 1-1 Okishin-Cho, Sasebo-City, Japan, Bull. JSME, 26 (213) pp 453-460 (Mar 1983) 7 figs, 1 table, 3 refs

Key Words: Machine tools, Hobbing, Surface roughness

In the machining of metals it is believed that the smoother the rake and flank face of the tooth, the less the tool will wear. Tools such as hobs, which demand high accuracy, are ground carefully. In this paper, the relation between hob tooth roughness and tooth wear are examined.

ELECTROMECHANICAL SYSTEMS

83-1516

Torque Vibrations in Three Phase Electrical Machines

E.D. Goodman

Ecole de Technologie Superieure, Montreal, Quebec, Canada, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 19 pp, 9 figs, 12 refs

Key Words: Motors, Torsional vibrations

Electrical machines have torque pulsations, in addition to their useful torque, which can excite the rotating mechanical system causing higher than expected stresses. The pulsations may be transitory, due to switching of the supply, or present in the steady state, due to harmonics in the machine inductances, or in the supply voltage. A d-q axis model, which simplifies the analysis, is presented and a method of measuring the transfer function between the electrical and the shaft torques is described.

83-1517
Effects of Driving Motors on Drive Dynamics – Part II
E.I. Rivin
Wayne State Univ., Detroit, MI, Power Trans. Des., 25 (3), pp 31-32 (Mar 1983) 3 figs

Key Words: Transmission systems, Damping

The effect of the driving motor on mechanical transmission is explained. The damping of the transmission can be enhanced by "fine-tuning" its mechanical part to the electromagnetic system of the motor. The tuning consists of assigning parameters to adjustable compliant members (couplings, belt drives, etc.) and inertia members (flywheel, sheaves, etc.) to achieve the value of partial frequency of the transmission very close to that of the motor.

STRUCTURAL SYSTEMS

BRIDGES

83-1518
Dynamic Response of Highway Bridges
I.A.-S. Hathout
Ph.D. Thesis, Univ. of Waterloo, Canada (1982)

Key Words: Bridges, Beams, Interaction: bridge-vehicle, Moving loads

Efficient techniques for the dynamic analysis of bridges are developed. The bridge is idealized as a continuous beam on rigid supports. The vehicle is represented as one or two rigid bodies supported by two or three tire suspension assemblies. The equations of motion for the bridge are discretized, using the finite difference or the normal mode methods, and solved simultaneously with the vehicle equations of motion. Advanced numerical integrators for solving the bridge-to-vehicles equations are investigated and compared.

BUILDINGS
(Also see No. 1608)

83-1519
Lifetime Cost Earthquake Resistant Design: An Algorithm for Automation
N.D. Walker, Jr.
Kaiser Aluminum & Chemical Corp., Ctr. for Tech., Pleasanton, CA 94566, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 2-(41-47), 3 figs, 6 refs

Key Words: Buildings, Multistory buildings, Minimum weight design, Seismic design, Computer-aided techniques

An automated design methodology is proposed which exploits the principal features of a lifetime cost approach to earthquake resistant design developed in a previous paper. Several examples are presented which explore the lifetime cost formulation and the proposed design algorithm.

83-1520
Drift and Damage Considerations in Earthquake-Resistant Design of Reinforced Concrete Buildings
B.B. Algan
Ph.D. Thesis, Univ. of Illinois at Urbana-Champaign, 506 pp (1982)
DA8302791

Key Words: Buildings, Reinforced concrete, Earthquake resistant structures, Seismic design, Earthquake damage

The importance of considerations related to drift and damage in earthquake-resistant design of medium-rise reinforced concrete building structures is investigated. Simple (linear) methods used to calculate estimates of actual drift can easily be communicated to engineers and architects responsible for design and detailing of a building.

83-1521

Correlation of Inelastic Analysis and Destructive Tests on a Reinforced Concrete Building

M.R. Button, R. Donikian, and E. Crespo

Computech Engrg. Services, Inc., Berkeley, CA, Rept. No. NSF/CEE-82036, 148 pp (Jan 1982) PB83-145938

Key Words: Buildings, Concretes, Reinforced concrete, Seismic response

Results are presented of a study of the dynamic response of a non-seismically designed, eleven-story reinforced concrete building. The analytical response was determined with the use of a linear elastic computer analysis program, and was correlated with its measured response from small amplitude, non-destructive, mechanically induced shaking. The influence of the stairwell, infill panels and foundation flexibility on the dynamic characteristics of the structure was included in the analysis.

TOWERS

83-1522

Optimum Configuration of Transmission Line Towers in Dynamic Response Regime

M.P. Kapoor and K. Kumarasamy

Dept. of Civil Engrg., Indian Inst. of Tech., Kanpur-208016, India, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 10-(13-20), 5 figs, 5 tables, 16 refs

Key Words: Towers, Transmission lines, Optimum design, Dynamic response

This paper addresses itself to the automated optimum design of transmission line towers, modeled as a space truss in dynamic response regime. The basic thrust of the investigation is to achieve the optimum configuration of the tower. The objective is to minimize the total weight of the tower including the weight of the secondary members. The design variables chosen in the present work are the base width and the panel heights in the body of the tower.

FOUNDATIONS

83-1523

Dynamic Behaviour and Design of Turbo-Generator Support System

F. Ellyin

Dept. of Mech. Engrg., Univ. of Alberta, Edmonton, Alberta T6G 2G8, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 15 pp, 11 figs, 9 refs

Key Words: Turbogenerators, Machine foundations, Foundations

Efficiency of a thermo-electric generating station depends on the performance of its turbo-generator set. These rotary machines rest on massive reinforced concrete or steel pedestals. The trend towards larger unit sizes has caused a change in the traditional design of machine foundation systems. The principal design criteria and innovative features of one of the tallest turbo-generator foundation supports is outlined. The parameters which may affect the predicted results are discussed. It is shown that simple models used in the past are insufficient to predict the actual behavior.

83-1524

Influence of Interface Behavior in Dynamic Soil-Structure Interaction Problems

M.M. Zaman

Ph.D. Thesis, Univ. of Arizona, 448 pp (1982) DA8303397

Key Words: Interaction: soil-structure, Finite element technique

Under static of dynamic loadings, the junction (interface) between a structure-foundation system can experience contact, slip, separation and rebonding modes of deformations. Two interface models are proposed for simulation of interface behavior in finite element analysis of dynamic soil-structure interaction problems. Material parameters related to the proposed models are evaluated from the results of sand-concrete interface tests. Accuracy of the proposed models are verified with respect to a number of example problems.

83-1525

The Flexible Volume Method for Dynamic Soil-Structure Interaction Analysis

M. Tabatabaie-Raissi

Ph.D. Thesis, Univ. of California, Berkeley, 298 pp (1982)

DA8300677

Key Words: Interaction: soil-structure, Substructuring methods

A new general substructure method, the flexible volume method, for dynamic analysis of soil-structure systems is developed. The method is formulated in the frequency domain using the complex response method and the finite element technique. Material damping is introduced by the use of complex moduli leading to effective damping ratios which are frequency independent and can vary from element to element. Transient motions are handled by the fast fourier transform technique. The proposed method is superior to other substructuring techniques since it greatly simplifies the solution steps by eliminating the scattering problem and simplifying the impedance problem.

HARBORS AND DAMS

83-1526

Seismic Response of Port and Harbor Facilities

S.D. Werner and S.J. Hung

Agbabian Associates, El Segundo, CA, Rept. No. AA-R-8122-5395, NSF/CEE-82057, 354 pp (Oct 1982)

PB83-145490

Key Words: Harbors, Seismic response, Seismic design

This report evaluates the seismic response characteristics of port and harbor facilities in terms of: the lessons to be learned from the observed behavior of such facilities during earthquakes; the adequacy of their current seismic design provisions; and the use of dynamic analysis to enhance these design provisions.

83-1527

Dynamic Response Analysis of Techi Dam

R.W. Clough, R.M. Stephen, and J. Shaw-Han Kuo

Earthquake Engineering Res. Ctr., California Univ., Berkeley, CA, Rept. No. UCB/EERC-82/11, NSF/CEE-82060, 122 pp (Aug 1982)

PB83-147496

Key Words: Dams, Natural frequencies, Mode shapes, Damping coefficients, Seismic response

This report summarizes the results obtained during an investigation of the dynamic behavior of Techi Dam.

83-1528

Dynamic Analyses of Fluid-Structure Systems

A.A. Rashed

Ph.D. Thesis, California Inst. of Tech., 206 pp (1983)

DA8302619

Key Words: Dams, Interaction: structure-fluid, Underwater structures, Seismic response

Theoretical investigations of the dynamic behavior of some important fluid-structure systems are conducted to seek a better understanding of the hydrodynamic pressures generated in the fluid as a result of both the rigid body and the vibrational motions of the structure, and the effects of the fluid on the dynamic properties of the structure as well as on its response to earthquake ground motions. Explicit formulas are presented for the hydrodynamic pressures generated in fluid domains having boundaries which can be approximated by simple geometries.

POWER PLANTS

(Also see Nos. 1589, 1661)

83-1529

Vibration Engineering Aspects in Diesel Power Generation, Electrical Utility Operation

D. Zita

Northern Canada Power Commission, Edmonton, Alberta, Canada, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada, Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 26 pp, 10 figs

Key Words: Power plants (facilities), Fossil power plants

Linear vibrations of diesel power generation machinery are investigated. The author discusses past and current weaknesses in engineering aspects, installation practices, and operational and maintenance procedures. In-house vibration standards, alternator diesel set-mountings, balancing, and monitoring methods are reviewed. Recommendations for improvements in vibration through systems engineering, manufacturing standards, and operational and maintenance standards are presented.

83-1530
Flow-Induced Vibration for Light Water Reactors. Progress Report, July 1980 - September 1980
M.R. Torres
Nuclear Engrg. Div., General Electric Co., San Jose, CA, Rept. No. GEAP-24368, 75 pp (Sept 1981) DE82013728

Key Words: Nuclear reactors, Fluid-induced excitation

Flow-induced vibration for light water reactors (FIV for LWRs) is a four-year program designed to improve the FIV performance of light water reactors through the development of design criteria, analytical models for predicting behavior of components, general scaling laws to improve the accuracy of reduced-scale tests, and the identification of high FIV risk areas. This progress report summarizes the accomplishments achieved during the period from July 1980 to September 1980.

VEHICLE SYSTEMS

GROUND VEHICLES
(Also see No. 1658)

83-1531
The Dynamics of Road Vehicles
R.S. Sharp
Dept. of Mech. Engrg., Univ. of Leeds, Chartered Mech. Engr., 30 (3), pp 65-66 (Mar 1983) 5 figs

Key Words: Ground vehicles, Steering gear, Suspension systems (vehicles)

The dynamics of road vehicles from the point of view of steerability and suspension systems is considered.

83-1532
Wave Propagation Effects on the Heave Dynamics of Large Air Cushion Platforms
M.J. Hinchey, P.A. Sullivan, and A. Dupuis
Inst. for Aerospace Studies, Toronto Univ., Downsview, Ontario, Canada, Rept. No. UTIAS-TN-234, ISSN-0082-5263, 34 pp (Aug 1982)
N83-13289

Key Words: Ground effect machines

Acoustic effects on the heave dynamics of large air cushion platforms are explored theoretically. The models developed for an axisymmetric geometry show that when the cushion air is fed centrally through an orifice feed hole the stable pressure-flow operating region can be much smaller than that indicated by the commonly used lumped capacitance model which by definition totally ignores acoustic effects.

83-1533
Highway Noise Criteria Study: Technical Summary
S.L. Yaniv and D.R. Flynn
Natl. Engrg. Lab., Natl. Bureau of Standards, Washington, DC, Rept. No. NBSIR-82-2610, 40 pp (Oct 1982)
PB83-149831

Key Words: Traffic noise, Human response

This report summarizes a multifaceted research program carried out by the acoustics staff of the National Bureau of Standards at the request of the Federal Highway Administration. The program was designed to identify and quantify the important physical parameters associated with time-varying highway noise caused by various densities of both free-flowing and stop-and-go traffic conditions; investigate, evaluate and compare measures and computational procedures for rating time-varying noise in terms that are relevant to human response; and determine by means of a laboratory study which among several time-varying rating schemes best predicts acceptability and annoyance caused by traffic noise as heard both outdoors and indoors. The results of this program are briefly described and the implications of the major findings discussed.

SHIPS
(Also see Nos. 1649, 1681)

83-1534
Heave Stability of Air Cushion Vehicles Hovering over Deep Water
M.J. Hinchey
Inst. for Aerospace Studies, Toronto Univ., Downs-

view, Ontario, Canada, Rept. No. UTIAS-TN-236, ISSN-0082-5263, 26 pp (Aug 1982)
N83-13290

Key Words: Surface effect machines, Hydrofoil craft

The heave stability of air cushion vehicles hovering over infinitely deep water is examined theoretically. When applied to the Canadian National Research Council craft, HEX-5, the theory predicts that the volume modulation produced by the spatially averaged deflection of the plenum water free surface would increase the stable operating region relative to overland operation. The air flow modulation produced by deflection of the water free surface at the lip of the plenum on the other hand would cause unstable behavior at low cushion pressures.

83-1535

The Distribution of Hydrodynamic Mass and Damping of an Oscillating Shipform in Shallow Water

W. Beukelman and J. Gerritsma

Lab. voor Scheepshydromechanica, Technische Hogeschool, Delft, The Netherlands, Rept. No. 546, 50 pp (1982)

PB83-138743

Key Words: Ships, Mass coefficients, Damping coefficients

The investigation concerns the comparison of the distribution of hydrodynamic mass and damping, as measured on a segmented ship model in shallow water, with corresponding calculated results using a strip theory method which takes into account the finite water depth.

AIRCRAFT

(Also see Nos. 1544, 1561, 1617)

83-1536

A New Measurement Method for Separating Airborne and Structureborne Noise Radiated by Aircraft Type Panels

M.C. McGary

NASA Langley Res. Ctr., Hampton, VA, Rept. No. L-15481, NASA-TP-2079, 33 pp (Sept 1982)

N83-11838

Key Words: Aircraft noise, Noise measurement

The theoretical basis for and experimental validation of a measurement method for separating airborne and structure borne noise radiated by aircraft type panels are presented. An extension of the two microphone, cross spectral, acoustic intensity method combined with existing theory of sound radiation of thin shell structures of various designs, is restricted to the frequency range below the coincidence frequency of the structure. Consequently, the method lends itself to low frequency noise problems such as propeller harmonics.

83-1537

Digital Calculation of the Propagation in Time of the Aircraft Gust Response Covariance Matrix

H.L. Jonkers, F.K. Kappetijn, and J.C. van der Vaart

Dept. of Aerospace Engrg., Technische Hogeschool, Delft, The Netherlands, Rept. No. LR-266, 111 pp (Sept 1981)

PB83-144303

Key Words: Aircraft, Wind-induced excitation

A description is presented of a method to calculate the covariance matrix, as a function of time, of a linear system perturbed by a number of random noise signals. Using basic principles of modern system theory it allows the computation of variances or rms values of aircraft variables in the case where system dynamics and statistical properties of the disturbing signals are a function of time. A brief summary of properties of transient and steady-state covariance response and a description of the required format of aircraft and turbulence filter equations are given.

83-1538

Bending-Torsion Flutter of a Highly Swept Advanced Turboprop

O. Mehmed, K.R.V. Kaza, J.F. Lubomski, and R.E. Kielb

NASA Lewis Res. Ctr., Cleveland, OH, Rept. No. E-1404, NASA-TM-82975, 24 pp (1981) (Pres. at the 1982 Aerospace Congr. and Exposition, Anaheim, CA, Oct 25-28, 1982. Spons. by Soc. of Automotive Engr.)

N83-11514

Key Words: Flutter, Aircraft engines, Turbojet engines, Experimental test data

Experimental and analytical results are presented for a bending-torsion flutter phenomena encountered during wind-tunnel testing of a ten-bladed, advanced, high-speed propeller (turboprop) model with thin airfoil sections, high blade sweep, low aspect ratio, high solidity and transonic tip speeds. The data was correlated with analytical results which include aerodynamic cascade effects and good agreement was found.

83-1539

A Study of Analytic Modeling Techniques for Landing Gear Dynamics

S.M. Batill

Dept. of Aerospace and Mech. Engrg., Notre Dame Univ., IN, Rept. No. AFWAL-TR-82-3027, 82 pp (May 1982)

AD-A122 312

Key Words: Landing gear, Aircraft, Taxiing effects

The ability to accurately predict the dynamic response of an aircraft while it is operating in the taxi mode depends, in part, on the correct modeling of the dynamic characteristics of the landing gear system. This report documents a brief review of the state of the art of gear modeling. A study was then conducted to evaluate important model parameters, using a simple cantilevered gear computer simulation. Also included is the development of a technique for the experimental determination of important gear system parameters.

83-1540

A Study of Helicopter Rotor Noise, with Special Reference to Tail Rotors, Using an Acoustic Wind Tunnel

H. Tadghighi and I.C. Cheeseman

Dept. of Aeronautics and Astronautics, Univ. of Southampton, Southampton S09 5NH, UK, Vertica, 7 (1), pp 9-32 (1983) 31 figs, 10 refs

Key Words: Helicopter noise, Rotors

A moderately high speed model rotor (tip Mach number of 0.75) has been developed to investigate tail rotor noise in forward flight conditions. The model rotor noise data is found to correlate well with full scale helicopter rotor values. Simultaneously recorded aerodynamic performance of the model rotor (blade loading, steady thrust, torque and trimmed moments) has been compared with theoretical aeroacoustic treatments. This report discusses the selected theoretical models and compares this prediction with the experimental results.

83-1541

Should Helicopter Noise Be Measured Differently from Other Aircraft Noise. A Review of the Psychoacoustic Literature

J.A. Molino

Wyle Labs./Wyle Research, Arlington, VA, Rept. No. WR-82-19, NASA-CR-3609, 90 pp (Nov 1982)

N83-13937

Key Words: Helicopter noise, Noise measurement, Reviews

A review of 34 studies indicates that several factors or variables might be important in providing a psychoacoustic foundation for measurements of the noise from helicopters. These factors are phase relations, tail rotor noise, repetition rate, crest level, and generic differences between conventional aircraft and helicopters. Particular attention is given to the impulsive noise known as blade slap.

MISSILES AND SPACECRAFT

(Also see No. 1684)

83-1542

Structural Dynamics Payload Loads Estimates

R.C. Engels

Martin Marietta Aerospace, Denver, CO, Rept. No. MCR-81-602, NASA-CR-170680, 43 pp (Aug 1981)

N83-13494

Key Words: Spacecraft, Shuttles (spacecraft), Dynamic structural analysis

The development of a full scale payload integration method which reduces the cost of a load cycle is discussed. The method solves the coupled booster/payload system equations and does not involve additional approximations as compared to the standard transient analysis. The method is cost effective and directly applicable to the shuttle payload design case.

83-1543

Structural Dynamics Payload Loads Estimates

R.C. Engels

Martin Marietta Aerospace, Denver, CO, Rept. No. MCR-82-601, NASA-CR-170681, 146 pp (Sept 1982)

N83-13495

Key Words: Spacecraft, Dynamic structural analysis

Methods for the prediction of loads on large space structures are discussed. Existing approaches to the problem of loads calculation are surveyed. A full scale version of an alternate numerical integration technique to solve the response part of a load cycle is presented, and a set of short cut versions of the algorithm developed. The implementation of these techniques using the software package developed is discussed.

BIOLOGICAL SYSTEMS

HUMAN

83-1544
Laboratory Studies of Scales for Measuring Helicopter Noise
J.B. Ollerhead
Wyle Labs., Inc., El Segundo, CA, Rept. No. WR82-12, NASA-CR-3610, 123 pp (Nov 1982)
N83-11839

Key Words: Helicopter noise, Aircraft noise, Human response

The adequacy of the effective perceived noise level procedure for rating helicopter noise annoyance was investigated. Recordings of 89 helicopters and 30 fixed wing aircraft flyover sounds were rated with respect to annoyance by groups of approximately 40 subjects.

ANIMAL

(See No. 1533)

MECHANICAL COMPONENTS

ABSORBERS AND ISOLATORS

83-1545
Optimization for Vibration Isolation
W.V. Nack
Embry-Riddle Aeronautical Univ., Daytona Beach, FL, Rept. No. AFOSR-TR-82-1019, 50 pp (Aug 1982)
AD-A122 259

Key Words: Vibration isolation, Optimization

Algorithms have been developed which minimize the forced vibrational response of structural systems. The constraints which can be used are displacements or accelerations and natural frequencies. The design variables are linear changes to mass, stiffness or damping matrices. The constraints can be expressed in either the time or frequency domain and the cumulative constraint is used to measure the amount of constraint violation.

83-1546
The Vibro-Mass Gyroscope
J.S. Burdess
Dept. of Mech. Engrg., Univ. of Newcastle upon Tyne, Newcastle upon Tyne, NE1 7RU, UK, J. Dynam. Syst., Meas. Control, Trans. ASME, 105 (1), pp 18-23 (Mar 1983) 5 figs, 9 refs

Key Words: Gyroscopes, Dynamic vibration absorption (equipment)

The paper examines the performance of a new two axis dynamically tuned gyroscope. Two types of feedback loop are described. In the first design the control force maintains the sensitive element in a near null position and provides a direct measure of the applied rate. Errors arising because of mistuning and damping are evaluated. The second design is constructed using regulator theory and the performance of the gyro is shown to be robust with respect to the parameters defining the gyro and its control system.

83-1547
Seismic Energy Absorption in Simple Structures
T.F. Zahrah
Ph.D. Thesis, Univ. of Illinois at Urbana-Champaign, 228 pp (1982)
DA8303034

Key Words: Energy absorption, Earthquake response, Seismic excitation

The energy absorption in, and the inelastic behavior of, simple structures during strong earthquake excitation are investigated. The purposes of the investigation are to evaluate the performance of structures during various types of ground motion, and to attempt to identify more succinctly than at present the factors that influence structural deformation and damage.

83-1548

Inverse Methods in the Reconstruction of Acoustical Impedance Profiles

H. Schwetlick
Dept. of Theoretical and Appl. Mech., Cornell Univ., Ithaca, NY 14853, J. Acoust. Soc. Amer., 73 (4), pp 1179-1186 (Apr 1983) 10 figs, 13 refs

Key Words: Acoustic impedance

Three methods for the reconstruction of inhomogeneities in a one-dimensional lossless medium from incident and reflected wave signals are presented: the method of characteristics, the Gel'fand-Levitan method, and the newly developed method of iterative local regulization. Reconstructed results from numerical experiments are compared with emphasis on inversion in the presence of noise, and on general excitations. An error analysis and a study of computation requirements are also presented.

83-1549

Propagation of Sound in Highly Porous Open-Cell Elastic Foams

R.F. Lambert
Dept. of Electrical Engrg., Inst. of Tech., Univ. of Minnesota, Minneapolis, MN 55455, J. Acoust. Soc. Amer., 73 (4), pp 1131-1138 (Apr 1983) 4 figs, 1 table, 11 refs

Key Words: Sound attenuation, Foams

Theoretical predictions and experimental measurements of attenuation and progressive phase constants of sound in open-cell, highly porous, elastic polyurethane foams are presented. The analysis is specialized to highly porous foams which can be efficient sound absorbers at audio frequencies.

83-1550

Surface Acoustic Admittance of Highly Porous Open-Cell, Elastic Foams

R.F. Lambert
Dept. of Electrical Engrg., Univ. of Minnesota, Minneapolis, MN 55455, J. Acoust. Soc. Amer., 73 (4), pp 1139-1146 (Apr 1983) 6 figs, 1 table, 7 refs

Key Words: Sound attenuation, Foams

This work presents a comprehensive study of the surface acoustic admittance properties of graded sizes of open-cell foams that are highly porous and elastic. The intrinsic admittance as well as properties of samples of finite depth were predicted and then measured for sound at normal incidence over a frequency range extending from about 35-3500 Hz. The agreement between theory and experiment for a range of mean pore size and volume porosity is excellent. The implications of fibrous structure on the admittance of open-cell foams is quite evident from the results.

83-1551

Non-Linear Effects in the Support Motion of an Elastically Mounted Slider Crank Mechanism

I. Davidson
Dept. of Mech. Engrg., Univ. of Dundee, Dundee DD1 4HN, Scotland, J. Sound Vib., 86 (1), pp 71-83 (Jan 8, 1983) 7 figs, 1 table, 5 refs

Key Words: Supports, Slider crank mechanism

A study is made of an in-line slider crank mechanism in which the sliding mass is elastically supported. The ratio of crank length to connecting rod length is not assumed small and relatively large displacements of the support are allowed. Ordinary and parametric nonlinear terms are thus retained in the equations of motion. It is shown that the presence of parametric terms gives rise to additional conditions for resonance in the support motion. Approximate solutions are obtained for the fundamental and half subharmonic steady state responses and the effect of the nonlinear and parametric terms examined.

SPRINGS

83-1552

Analysis of a Damped Pneumatic Spring

B.I. Bachrach and E. Rivin
Ford Motor Co., Dearborn, MI 48121, J. Sound Vib., 86 (2), pp 191-197 (Jan 22, 1983) 4 figs, 8 refs

Key Words: Springs, Pneumatic springs, Damped structures, Dynamic stiffness

The complex dynamic stiffness of a damped spring is determined. The damping is produced by transient pressure feedback from an auxiliary tank connected by a capillary to the spring cylinder. From the complex stiffness, the damping and stiffness are determined as functions of excitation frequency. The behavior of a compound spring, consisting of a damped pneumatic spring in parallel with a stiffer linear spring, is also examined.

TIRES AND WHEELS

(See No. 1638)

BLADES

(Also see Nos. 1498, 1647, 1653)

83-1553

Tuning of Turbine Blades: A Theoretical Approach

P. Gudmundson
Brown Boveri Res. Ctr., CH-5405 Baden, Switzerland, J. Engrg. Power, Trans. ASME, 105 (2), pp 249-255 (Apr 1983) 11 figs, 5 tables, 11 refs

Key Words: Blades, Turbine blades, Rectangular beams, Natural frequencies, Geometric effects, Perturbation theory, Tuning

A perturbation method is described which predicts the changes in eigenfrequencies resulting from geometrical changes of a structure. This dependence is represented by dimensionless functions, one for each eigenfrequency, which vary over the surface of the structure. The functions are presented for each eigenfrequency as isoline plots.

83-1554

Structural Dynamics Analysis for Turbomachinery Bladed Disks

N.A.M. Khader
Ph.D. Thesis, Rensselaer Polytechnic Inst., 137 pp (1982)
DA8303069

Key Words: Blades, Turbomachinery blades, Aircraft engines

The research presented here deals with the structural dynamics problem of a bladed disk with 24 hollow titanium blades. In the analysis, in addition to disk flexibility, shaft and bearing flexibilities are accounted for by considering rigid disk translations in the rotor plane, and rigid disk rotations with respect to the same plane. The analysis includes not only the out-of-plane displacements, but also the radial and tangential ones.

83-1555

The Influence of Coriolis Forces on Gyroscopic Motion of Spinning Blades

F. Sisto, A. Chang, and M. Sutcu
Dept. of Mech. Engrg., Stevens Inst. of Tech., Hoboken, NJ 07030, J. Engrg. Power, Trans. ASME, 105 (2), pp 342-347 (Apr 1983) 7 figs, 5 refs

Key Words: Blades, Turbomachinery blades, Coriolis forces, Gyroscopic effects

Turbomachine blades on spinning and precessing rotors experience gyroscopically induced instabilities and forcing. With vehicle-mounted turbomachines, either constant or harmonic precession occurs, depending on vehicle or mount motion. Responses of uniform cantilever beams at arbitrary stagger, subjected to the noted rotor motion, are predicted in both self-excited and forced-excitation modes taking into account Coriolis acceleration.

83-1556

Comparison of Beam and Shell Theories for the Vibrations of Thin Turbomachinery Blades

A.W. Leissa and M.S. Ewing
Ohio State Univ., Columbus, OH 43210, J. Engrg. Power, Trans. ASME, 105 (2), pp 383-392 (Apr 1983) 4 figs, 3 tables, 36 refs

Key Words: Blades, Turbomachinery blades, Vibration analysis, Beams, Shells

A great deal of published literature exists which analyzes the free vibrations of turbomachinery blades by means of one-dimensional beam theories. Recently, a more accurate, two-dimensional analysis method has been developed based upon shallow shell theory. The present paper summarizes the two types of theories and makes quantitative comparisons of frequencies obtained by them. Numerical results are presented for cambered and/or twisted blades of uniform thickness. Significant differences between the theories are found to occur, especially for low aspect ratio blades. The causes of these differences are discussed.

83-1557

Dry Friction Damping Mechanisms in Engine Blades

A.V. Srinivasan and D.G. Cutts

United Technologies Res. Ctr., East Hartford, CT 06108, J. Engrg. Power, Trans. ASME, 105 (2), pp 332-341 (Apr 1983) 21 figs, 11 refs

Key Words: Blades, Jet engines, Coulomb friction, Vibration damping

In the context of jet engines, significant vibration damping due to dry friction can occur at shroud interfaces of fans and the platform of turbine blades fitted with platform dampers. Analytical and experimental studies in regard to this important source of nonaerodynamic damping of blade vibration are presented. Comparisons between results from analytical models and laboratory test data are made and discussed.

83-1558

On Tuned Bladed Disk Dynamics: Some Aspects of Friction Related Mistuning

A. Muszynska and D.I.G. Jones

Univ. of Dayton Res. Inst., Dayton, OH, J. Sound Vib., 86 (1), pp 107-128 (Jan 8, 1983) 18 figs, 32 refs

Key Words: Blades, Disks, Turbomachinery components, Fatigue life, Flutter, Tuning

A discrete multi-degree of freedom model of a tuned disk is considered. The hysteretic material damping and interblade and blade-to-disk friction forces are included. It is shown that the irregularities of the friction forces and of the harmonic excitation pattern cause mistuning of the system.

83-1559

Method of Calculating Optimum Angular Blade Pitches in Fan with Unequally Pitched Blades

Y. Segawa, K. Shiohata, and F. Fujisawa

Mech. Engrg. Res. Lab., Hitachi, Ltd. 3-1-1 Saiwai-cho, Hitachi-shi, Japan, Bull. JSME, 26 (213), pp 351-355 (Mar 1983) 6 figs, 5 refs

Key Words: Blades, Fan blades, Fan noise, Noise reduction, Optimum design

A method is devised to calculate the optimum angular pitches of blades in a high-speed fan that has unequal angular pitches in order to reduce the level of tonal annoying noise. The influence coefficient- and least-squares methods are used in iterative calculations in which the harmonic spectrum associated with the angular blade pitches is made to converge with a target harmonic spectrum.

83-1560

The Influence of Blade Tip Geometry on the Unsteady Pressure Distribution of a Rotor Blade. Part 1: Rectangular Tip

K. Kienappel

Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Goettingen, Fed. Rep. Germany, Rept. No. DFVLR-FB-82-11, 72 pp (Mar 1982)

N83-11091

Key Words: Blades, Propeller blades, Helicopters, Geometric effects

The influence of various blade tip geometries on the tip vortex of a harmonically oscillating helicopter was investigated experimentally. The basic shape is a common rectangular tip. An introduction to the problem is given as well as a description of the experimental test setup and the measurement technique. The experimental results of the basic configuration are discussed.

83-1561

Noise of the 10-Bladed, 40 Deg Swept SR-6 Propeller in a Wind Tunnel

J.H. Dittmar, G.L. Stefko, and R.J. Jeracki

NASA Lewis Res. Ctr., Cleveland, OH, Rept. No. E-1357, NASA-TM-82950, 46 pp (Sept 1982)

N83-11840

Key Words: Blades, Propeller blades, Noise generation, Aircraft noise

The noise generated by supersonic helical-tip-speed propellers is a likely cabin environment problem for future airplanes powered by these propellers. Three propeller models with different tip sweeps -- SR-1M, SR-2, and SR-3 -- designed for 244 m/sec (800 ft/sec) tip speed at a flight Mach number of 0.8 were previously tested. In order to investigate another design point condition, the SR-6 propeller was designed for 213 m-sec (700 ft/sec) tip speed at a flight Mach number of 0.8. The noise data from this propeller are reported herein.

83-1562

A Design Calculation Procedure for Shock-Free or Strong Passage Shock Turbomachinery Cascades

S.S. Tong and W.T. Thompkins, Jr.

Massachusetts Inst. of Tech., Cambridge, MA 02139, J. Engrg. Power, Trans. ASME, 105 (2), pp 369-376 (Apr 1983) 11 figs, 10 refs

Key Words: Blades, Rotor blades (turbomachinery), Cascades, Aerodynamic characteristics, Design techniques

A previously described, inviscid design technique has been substantially improved to allow the generation of either shock-free, weak-shock or low total pressure loss supersonic rotor cascade designs. Improvements have been introduced in inflow-outflow boundary conditions, imposition of geometric constraints and in shock pressure rise specifications. Calculation examples are presented for precompression type rotor designs.

83-1563

Influence of Blade Tip Clearance on Aerodynamically Induced Vibration

J.L. Bettner

Detroit Diesel Allison Div., General Motors Corp., Indianapolis, IN, Rept. No. DDA-EDR-11257, AFOSR-TR-82-1086, 67 pp (Oct 1982)
AD-A123 125

Key Words: Blades, Fluid-induced excitation

An experimental investigation to demonstrate the influence of rotor blade tip clearance effects on the dynamic pressure induced on a downstream vane, was conducted in a large, low speed, single-stage research compressor. The blade tip clearance was 0.48% span. The rig was heavily instrumented with dynamic pressure gages on the vane hub, mean, and tip section suction and pressure surfaces.

BEARINGS

(Also see Nos. 1651, 1656)

83-1564

Static and Dynamic Analysis of Hydrodynamic Bearings in Laminar and Superlaminar Flow Regimes by Finite Element Method

D.V. Singh, R. Sinhasan, and S.C. Soni

Univ. of Roorkee, Roorkee-247672, India, ASLE, Trans. 26 (2), pp 255-263 (Apr 1983) 12 figs, 14 refs

Key Words: Bearings, Turbulence, Finite element technique

Adopting the nonlinear, turbulent lubrication theory of Elrod and Ng, the classical Navier-stokes equations in cylindrical coordinates have been suitably modified. These modified equations have been solved by finite element method using Galerkin's technique and a suitable iteration scheme. Performance characteristics of a finite circular hydrodynamic journal bearing have been studied in terms of Sommerfeld number, attitude angle, stiffness and damping coefficients, and critical journal mass at various eccentricities for Reynolds numbers up to 13 300. Computed results have been compared with the published results obtained by linearized theory of Ng and Pan.

83-1565

Problems in Bearings and Lubrication

AGARD, Neuilly-sur-Seine, France, Rept. No. AGARD-CP-323, 466 pp (Aug 1982) (Pres. at the Symp. of the AGARD Propulsion and Energetics Panel (59th), May 31 - June 3, 1982, Ottawa, Canada)
AD-A122 168

Key Words: Bearings, Monitoring techniques

Although dramatic advances have been made in bearing and lubrication technology during the past few decades, there continue to be problems, both in performance prediction and in performance limitations. These problems are manifest in the life and durability of engines and transmissions in current use, and also in the limits they place on the design of future engines and transmissions. Subjects covered: rolling element bearings - design, materials and lubrication; gear lubrication; elastohydrodynamics; hydrodynamic, hydrostatic and hybrid bearing design and lubrication; squeeze film dampers; lubricant deposition studies; gas film bearings; magnetic bearings; diagnostics and health monitoring of lubrication systems; rotor dynamics; engine lubrication system design, and helicopter transmission efficiency as influenced by lubricant composition.

83-1566

Stiffness and Damping of Externally Pressurized Gas Journal Bearings with Porous Inserts

B.C. Majumdar

Dept. of Mech. Engrg., Indian Inst. of Tech., Kharagpur, India, Instn. Mech. Engrs., Proc., 197 (Part C), pp 25-29 (Mar 1983) 5 figs, 2 tables, 7 refs

Key Words: Bearings, Journal bearings, Gas bearings

A theoretical analysis on stiffness and damping of externally pressurized gas journal bearings with porous inserts as restrictors is presented. The effect of stiffness and damping on squeeze number, supply pressure, feeding parameter and L/D ratio is investigated.

83-1567

Frequency Effects in Tilting-Pad Journal Bearing Dynamic Coefficients

J.K. Parsell, P.E. Allaire, and L.E. Barrett

Univ. of Virginia, Charlottesville, VA 22901, ASLE, Trans., 26 (2), pp 222-227 (Apr 1983) 11 figs, 13 refs

Key Words: Bearings, Journal bearings, Tilting pad bearings, Damping coefficients, Stiffness coefficients

This paper examines the effects of damped vibrational frequencies on the linear reduced dynamical stiffness and damping coefficients of tilting-pad journal bearings. The frequency ratio (damped frequency/running speed) can be used to judge the accuracy of employing synchronously reduced linear coefficients in rotordynamic stability analyses. The use of these coefficients can result in simpler formulations of the system dynamical equations of motion and solution techniques as well as reduced computational and analysis time.

GEARS

(Also see No. 1570)

83-1568

Study on Welded Structure Gears (4th Report, Effects of Web Arrangements on Gear Vibrations)

S. Oda, T. Sayama, T. Koide, and M. Uekubo

Tottori Univ., 4-101 Minami, Koyama-cho, Tottori, Japan, Bull. JSME, 26 (213), pp 446-452 (Mar 1983) 12 figs, 2 tables, 4 refs

Key Words; Gears, Webs (supports), Welded joints

The effects of web arrangements on vibration of welded structure gears are investigated. The circumferential, radial and axial vibration accelerations of various types of welded gears are measured under various running conditions.

COUPLINGS

83-1569

A Fitness Plan for Flexible Couplings

T. Wireman

Armco, Inc., Middletown, OH, Power Transm. Des., 25 (4), pp 20-22 (Apr 1983) 4 figs

Key Words: Couplings, Flexible couplings, Monitoring techniques

Flexible couplings are capable of accommodating a small amount of misalignment that develops during the life of the installation, but they should not be used to compensate for deliberate misalignment. This article deals with the four main coupling problems -- misalignment, poor installation and removal practices, lack of preventive maintenance, and drive overloads. By following the maintenance hints provided, many coupling problems can be eliminated.

FASTENERS

83-1570

The Effect of Torsional Clearance on the Operation of Drive Systems with Form-Fitting Shaft-Hub Connections (Einfluss von Verdrehspiel auf das Betriebsbehalten von Antriebssystemen mit formschlussigen Welle-Nabe-Verbindungen)

R. Grewatsch and J. Muller

Kombinat Forschrift Landmaschinen Gustrow, Fed. Rept. Germany, Maschinenbautechnik, 31 (5), pp 218-221 (May 1982) 9 figs, 9 refs

(In German)

Key Words: Joints (junctions), Gears, Shafts, Torsional vibration, Clearance effects

The effect of torsional clearance on the operation of shaft systems connected by gear and spline profiles is investigated experimentally. The results show that even the torsional clearance provided for mounting in the original condition and the alternating moments affect the excitation of the shaft. Wear in the connections further increases torsional clearance and thus excitation. Consequently, torsional clearance significantly affects the natural frequency of the system. Contact impact, causing torsional clearance, is reduced in soft systems.

83-1571

Moment-Rotation Characteristics of Semi-Rigid Steel Beam-Column Connections

W.G. Altman, Jr., A. Azizinamini, J.H. Bradburn, and J.B. Radziminski

Dept. of Civil Engrg., South Carolina Univ., Columbia, SC, Rept. No. NSF/CEE-82044, 157 pp (June 1982)

PB83-145318

Key Words: Joints (junctions), Beams, Columns, Seismic response, Cyclic loading, Dynamic tests

The potential of semi-rigid beam-to-column connections in contributing to the integrity of steel frame building structures in an earthquake is evaluated. Experimental studies were conducted on bolted connections comprised of top and seat beam flange angles and double web angles to determine moment-rotation behavior under static loading and to measure energy absorption capability under cyclic loading. The cyclic tests consisted of subjecting the beam-column connections to several stages of full reversal, controlled amplitude displacements of progressively increasing magnitude.

LINKAGES

83-1572

An Approach for Dynamic Analysis of Mechanical Systems with Multiple Clearances Using Lagrangian Mechanics

B.M. Bahgat and M.O.M. Osman

Dept. of Mech. Engrg., Concordia Univ., Montreal, Canada, Instn. Mech. Engrs., Proc., 197 (Part C), pp 17-23 (Mar 1983) 12 figs, 18 refs

Key Words: Slider-crank mechanisms, Clearance effects

A general procedure is developed for the dynamic analysis of planar mechanisms with multiple clearance. The analysis mainly relies on determining the clearance angles β_i at mechanism revolutes for each phase of the analysis. The governing equations of each clearance angle are developed using Lagrangian mechanics. The solution is obtained in the form of sufficient number of harmonic terms and used to evaluate systematically kinematic and dynamic quantities of the mechanism. A slider-crank mechanism with three revolute clearances is analyzed to illustrate the procedure.

VALVES

83-1573

Aerodynamic Study on Noise and Vibration Generated in High Pressure Gas Valves. Part 2: Fluid Thrust Related to Flow Patterns of Supersonic Air Flow Discharged through Conical Valve Plugs into Atmosphere

M. Nakano, K. Tajima, and E. Outa

School of Science and Engrg., Waseda Univ., Bull. JSME, 26 (213), pp 372-379 (Mar 1983) 13 figs, 5 refs

Key Words: Valves, Fluid-induced excitation, Shock wave propagation

Characteristics of fluid thrust acting on valve stem are studied by experiment in close relation to flow patterns of a supersonic air flow expanding through a valve of simplified geometries. The valve consists of a conical plug and a plane seat, and is mounted at a nozzle exit of a blow-down facility. The experimental pressure ratio is up to twenty.

STRUCTURAL COMPONENTS

STRINGS AND ROPES

83-1574

Longitudinal Vibrations in Violin Strings

A.R. Lee and M.P. Rafferty

Physics Dept., Univ. College, Cardiff, Wales, UK, J. Acoust. Soc. Amer., 73 (4), pp 1361-1365 (Apr 1983) 12 figs, 6 refs

Key Words: Strings, Violins, Musical instruments, Longitudinal vibration

The observation of longitudinal vibrations in violin strings excited by bowing is reported. These vibrations are detected from the rocking motion of the top of the bridge in the direction longitudinal to the strings, with the aid of a photoelectric device. The frequencies of these waves are approximately three octaves above the respective fundamental frequencies of the transverse string vibrations, in line with expectation.

83-1575

Non-Linear Resonance in Strings under Narrow Band Random Excitation, Part 1: Planar Response and Stability

K. Richard and G.V. Anand

Dept. of Electrical Communication Engrg., Indian Inst. of Science, Bangalore-560012, India, J. Sound Vib., 86 (1), pp 85-98 (Jan 8, 1983) 5 figs, 25 refs

Key Words: Strings, Random excitation

Non-linear planar response of a string to planar narrow band random excitation is investigated. A response equation for the mean square deflection σ^2 is obtained under a single mode approximation by using the equivalent linearization technique.

CABLES

83-1576

Non-Stationary Random Response of a Finite Cable

F.P. Alberti

Dept. of Mech. Engrg., Univ. of Lowell, Lowell, MA 01854, J. Sound Vib., 86 (2), pp 227-233 (Jan 22, 1983) 10 refs

Key Words: Cables, Random response

Numerous problems of current concern involve the designs of aerodynamic systems which either travel at high speeds or contain structural elements which are excited by moving pressure fluctuations. In a number of recent papers responses of dynamic systems to random excitation have been considered. The appropriate theory for calculating the mean square response of linear systems to both stationary and non-stationary random excitation is well known. In this paper, the mean square response of a finite cable to non-stationary random excitation is considered.

83-1577

Vortex Shedding from a Vibrating Cable with Attached Spherical Bodies in a Linear Shear Flow

R.D. Peltzer

Naval Res. Lab., Washington, DC, Rept. No. NRL-MR-4940, 132 pp (Oct 27, 1982)
AD-A120 586

Key Words: Cables, Vibrating structures, Vortex shedding, Underwater structures, Fluid-induced excitation

The present study, which employs hot wire anemometry as the principal investigative tool, was undertaken to examine the behavior in the near wake of a flexible, helically wound, high aspect ratio (L/d = 107) marine cable in a linear shear flow (steepness parameter beta = 0.0053) at centerline Reynolds numbers between 2.0 x 1000 < or = Rec 4.2 x 1000. Particular attention was paid to lock-on or synchronization related changes associated with uniform and sheared flow past the cable when it was forced to vibrate in the first mode. The study was extended to include an analysis of the effects on vortex shedding synchronization phenomena generated by placing spherical bluff bodies along the cable span.

BARS AND RODS

83-1578

Vibration of a Free Rectangular Parallelepiped

J.R. Hutchinson and S.D. Zillmer

Univ. of California, Davis, CA 95616, J. Appl. Mech., Trans. ASME, 50 (1), pp 123-130 (Mar 1983) 10 figs, 15 refs

Key Words: Rods, Prismatic bodies, Rectangular bodies, Natural frequencies

A series solution of the general equations of linear elasticity is used to determine accurate natural frequencies for the vibrations of a rectangular parallelepiped with traction-free surfaces. The series solution is found to converge to accurate frequencies with the use of very few terms. Resulting frequences are tabulated for comparison with previous experimental results and are shown graphically for comparison with elementary rod, beam, and plate solutions. The comparisons with elementary solutions show good agreement, and comparisons with the experiment results shows excellent agreement.

83-1579

Bond Resistance of Deformed Bars, Plain Bars and Strands under Impact Loading

E. Vos and H.W. Reinhardt

Stevin Lab., Technische Hogeschool, Delft, The

Netherlands, Rept. No. 5-80-6, 86 pp (Aug 1981)
PB83-141994

Key Words: Bars, Bonded structures, Impact tests

The main objective of the test program was to study the influence of the loading rate on bond resistance of plain bars (d = 10 mm), deformed bars (d = 10 mm) and prestressing strands (3/8 inch) for several concrete compressive strengths (23, 45 and 55 N/square millimeters).

BEAMS

(Also see Nos. 1556, 1578, 1634, 1675)

83-1580

Torsional-Flexural Waves in Thin-Walled Open Beams

P. Muller

Laboratoire de Mécanique Théorique associé au C.N.R.S., T66, Université P. et M. Curie, 75230 Paris Cedex 05, France, J. Sound Vib., 87 (1), pp 115-141 (Mar 8, 1983) 5 figs, 27 refs

Key Words: Beams, Torsional vibration, Flexural vibration, Coupled response

A one-dimensional theory is developed for coupled torsional-flexural waves in thin-walled elastic beams of arbitrary open cross-section. Complex kinematical effects are fully taken into account with emphasis on consistency. Exact equations of motion are obtained in terms of generalized stresses and generalized displacements defined by an averaging procedure. Constitutive relations accounting for flexural-torsional couplings are proposed.

83-1581

Dynamic Responses of Graphite/Epoxy Laminated Beam to Impact of Elastic Spheres

C.T. Sun and T. Wang

Composite Materials Lab., Purdue Univ., Lafayette, IN, Rept. No. CML-82-4, NASA-CR-165461, 59 pp (Sept 1982)
N83-13173

Key Words: Beams, Layered materials, Impact response

Wave propagation in laminates of a graphite/epoxy composite due to impact of a steel ball was investigated experimentally and by using a high order beam finite element. Dynamic strain responses at several locations were obtained using strain gages. The finite element program which incorporated statically determined contact laws was employed to calculate the contact force history as well as the target beam dynamic deformation.

83-1582

Dynamic Stability of Thin Walled Beams under Traveling Follower Load Systems

T. Aida

Dept. of Construction Engrg., Faculty of Engrg., Yamaguchi Univ., Ube, Japan, J. Sound Vib., 86 (2), pp 265-277 (Jan 22, 1983) 9 figs, 3 refs

Key Words: Beams, Follower forces, Parametric excitation

It is found that the perturbation equation of motion of a thin walled beam under a traveling follower load system becomes Hill's equation and that parametrically excited unstable coupled vibration occurs. The boundary frequency equations of the simple parametric resonance, from which the unstable regions are estimated, are obtained by Bolotin's method. Stability maps of a simply supported beam are shown taking into account the effects of load mass and damping.

83-1583

Foremast Vibrations on HMAS Parramatta

A. Goldman and P.M. Cox

Aeronautical Res. Labs., Melbourne, Australia, Rept. No. ARL/STRUC-TM-348, 76 pp (Oct 1982)
AD-A122 978

Key Words: Beams, Ships, Mode shapes, Resonant frequencies, Computer programs

As part of a refit program, a new lattice was fitted to HMAS Parramatta. The mast was constructed, generally, from aluminum alloy tubing and carries radar, radio, and other navigation equipment. Aeronautical Research Laboratories was requested to measure the resonant frequencies and mode shapes of the mast in the frequency range 0 to 20 hertz. The general construction of the mast is shown and major dimensions are provided. The PAFEC computer program was used to model the mast and compare the results with those measured on the physical mast.

83-1584

A Note on Transverse Vibrations of Continuous Beams Subject to an Axial Force and Carrying Concentrated Masses

P.A.A. Laura, P. Verniere de Irassar, and G.M. Ficcadenti
Inst. of Appl. Mech., Puerto Belgrano Naval Base, 8111-Argentina, J. Sound Vib., 86 (2), pp 279-284 (Jan 22, 1983) 4 tables, 4 refs

Key Words: Beams, Flexural vibration, Axial excitation

Polynomial co-ordinate functions are used in order to obtain an approximate solution to the title problem. The algorithmic procedure is quite simple, leads to adequate engineering accuracy, and can be easily extended to the case of several intermediate supports.

83-1585

Optimal Design of Thin Walled I Beams for Extreme Natural Frequency of Torsional Vibrations

C. Szymczak
Dept. of Civil Engrg., Technical Univ. of Gdansk, 80-952 Gdansk, Poland, J. Sound Vib., 86 (2), pp 235-241 (Jan 22, 1983) 4 figs, 11 refs

Key Words: Beams, Natural frequencies, Torsional vibration, Optimum design

The optimal design of thin-walled I beams to extremize the natural frequency of torsional vibration is considered. It is assumed that only one dimension of the cross-section, except for the web height, may be variable in given limits, along the axis of the beam. The optimality condition for the variable dimension is settled by means of Pontryagin's maximum principle. The effect of the constant, axial loads is also included. The solution of the problem formulated is generally found in an iterative way. Some numerical examples of optimization of the I beam with variable width of flanges are given.

83-1586

Effects of Variation in Load History on Cyclic Response of Concrete Flexural Members

T.-H. Wang
Ph.D. Thesis, Univ. of Illinois at Urbana-Champaign, 253 pp (1982)
DA8302893

Key Words: Beams, Cantilever beams, Reinforced concrete, Cyclic loading

Eleven reinforced concrete cantilever beam specimens were constructed and subjected to different load histories to study the effect of load history on the total energy dissipation capacity of flexural members under inelastic cyclic loading. Major variables included in this study were load history and maximum shear stress applied to the members. Four different load histories and three levels of maximum shear stress were used.

83-1587

Lagrange-Type Formulation for Finite Element Analysis of Non-Linear Beam Vibrations

B.S Sarma and T.K. Varadan
Structures Div., Defence Res. and Dev. Lab., Hyderabad, India, J. Sound Vib., 86 (1), pp 61-70 (Jan 8, 1983) 2 figs, 7 tables, 15 refs

Key Words: Beams, Finite element technique, Nonlinear vibration, Flexural vibration

A Lagrange-type formulation for finite element analysis of nonlinear vibrations of immovably supported beams is presented. Two equations of motion coupled in axial and transverse displacements are derived using Lagrange's equations. By neglecting the in-plane inertial effects, these equations are written in terms of the transverse displacement alone.

83-1588

Coupled Vibrations of Beams -- An Exact Dynamic Element Stiffness Matrix

P.O. Friberg
Div. of Solid Mech., Chalmers Univ. of Tech., Gothenburg, Sweden, Intl. J. Numer. Methods Engrg., 19 (4), pp 479-493 (Apr 1983) 6 figs, 2 tables, 39 refs

Key Words: Beams, Coupled response, Stiffness methods, Matrix methods

A uniform linearly elastic beam element with non-coinciding centers of geometry, shear and mass is studied under stationary harmonic end excitation. The Euler-Bernoulli-Saint Venant theory is applied. The frequency-dependent 12x12 element stiffness matrix is established by use of an exact method. The translational and rotational displacement functions are represented as sums (real) of complex exponential terms where the complex exponents are numerically found.

CYLINDERS

83-1589

Flow-Induced Vibration of Cylindrical Structures: A Review of the State of the Art

M.P. Paidoussis

Dept. of Mech. Engrg., McGill Univ., Montreal, Quebec, Canada, Rept. No. MERL-82-1, 26 pp (Aug 1982)

N83-13492

Key Words: Cylinders, Fluid-induced excitation, Reviews, Nuclear reactor components

Two classes of vibration problems encountered in reactors and reactor peripherals are considered: vibration of cylindrical structures induced by cross flow and by axial flow. A historical perspective is given, in which the milestone contributions that advanced the state of the art are highlighted. Developments in the last decade are discussed with emphasis on those in the last three years.

83-1590

A Study on the Increase in Drag on Cylinders Due to Vortex Induced Vibrations

S T.H. Fleischmann

Ph.D. Thesis, Univ. of Maryland, 199 pp (1982)

DA8301393

Key Words: Cylinders, Vortex-induced vibration, Fluid-induced excitation

An experimental and supporting theoretical study of the drag on long slender cylinders which vibrate transverse to the free-stream due to vortex shedding is presented. An existing model which predicts the drag of vibrating cylinders was modified to include experimentally observed changes in the near wake due to cylinder vibration. Good agreement is obtained when the experimental results for locked-in vibrations are compared to this model.

83-1591

An Empirical Model for Vortex-Induced Vibrations

D.L. R. Botelho

Ph.D. Thesis, California Inst. of Tech., 119 pp (1983)

DA8302599

Key Words: Cylinders, Vortex-induced vibration, Periodic response

Through an analytical-empirical approach, the vortex-excited transverse oscillations of flexibly-mounted circular cylinders in a uniform flow is studied. A new model is derived, assuming spanwise constant flow velocity within the subcritical range of Reynolds numbers and using only experimental data obtained from forced cylinders in water. The steady-state response of flexibly-mounted cylinders is obtained as a function of the structural system and flow parameters and its stability is analyzed. Several characteristics observed experimentally and also present in the model response are discussed.

COLUMNS

83-1592

Minimum Weight Design within a Bound on Eigenvalues

N. Kikuchi and J.E. Taylor

Univ. of Michigan, Ann Arbor, MI 48109, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 1-(19-21), 8 refs

Key Words: Columns, Optimum design, Minimum weight design

For the optimally designed Euler column with clamped-ends and where stiffness is proportional to the square of cross-sectional area, the lowest eigenvalue is a double root. The first-published solution to this problem is incorrect; however, a correct interpretation for the problem was provided in 1977. The clamped-column case provides an example from among such design problems, where the prediction of optimal design requires consideration of nonunique or multimodal measures of response. Governing equations (necessary conditions) for the optimal design problem are stated through applications of formal results and interpretations are given for unique and multimodal solutions.

FRAMES AND ARCHES

(See No. 1675)

MEMBRANES, FILMS, AND WEBS

83-1593

The Green Function of an Infinite, Fluid Loaded Membrane

D.G. Crighton

Dept. of Applied Mathematical Studies, Univ. of Leeds, Leeds LS2 9JT, UK, J. Sound Vib., 86 (3), pp 411-433 (Feb 8, 1983) 2 figs, 24 refs

Key Words: Membranes (structural members), Fluid-induced excitation, Green function

In this paper the response of a fluid loaded plane structure (a membrane) to a concentrated line force excitation is considered in great detail.

83-1594
Bounds on Natural Frequencies of Composite Circular Membranes: Integral Equation Methods
J.P. Spence and C.O. Horgan
College of Engrg., Michigan State Univ., East Lansing, MI 48824, J. Sound Vib., 87 (1), pp 71-81 (Mar 8, 1983) 1 fig, 3 tables, 16 refs

Key Words: Membranes (structural members), Circular membranes, Natural frequencies, Eigenvalue problems

This paper is concerned with finding upper and lower bounds for the natural frequencies of vibration of a circular membrane with stepped radial density. Such problems, involving discontinuous coefficients in the differential equation, may be treated by using classical variational methods. However, it is shown here that eigenvalue estimation techniques based on an integral equation formulation are more effective. Integral equation methods provide more accurate upper bounds, for a comparable amount of effort, and supply improvably lower bounds as well.

PLATES
(Also see No. 1578)

83-1595
Non-Linear Free Vibrations of Buckled Plates with Deformable Loaded Edges
H. Pasic and G. Herrmann
Faculty of Mech. Engrg., The Univ. of Sarajevo, 71000 Sarajevo, Yugoslavia, J. Sound Vib., 87 (1), pp 105-114 (Mar 8, 1983) 7 figs 1 table, 15 refs

Key Words: Plates, Free vibration, Dynamic buckling

In the great majority of papers dealing with nonlinear dynamic buckling of plates it is assumed that the edge at which the in-plane load is applied is not deformable (rigid). In those few references in which buckling with deformable edges is examined normally a variational approach is used, based on trial functions for the in-plane displacements, which approach often leads to incorrect results. In this paper an exact form of the solution is found for the in-plane displacements, assuming that the membrane force is, at all times, exactly equal to the load applied at the corresponding loaded edge.

83-1596
Vibrations of Mindlin's Circular Plates with Variable Thickness
K. Suzuki, T. Yamaguchi, Y. Hirano, T. Kosawada, and S. Takahashi
Faculty of Engrg. Yamagata Univ., Yonezawa, Japan, Bull. JSME, 26 (213), pp 424-431 (Mar 1983) 10 figs, 1 table, 17 refs

Key Words: Plates, Circular plates, Variable cross section, Rotatory inertia effects, Transverse shear deformation effects, Natural frequencies, Mindlin theory

The vibrations of circular plates with variable thickness are studied by the method of Mindlin's thick plate theory. An exact solution of circular plates with holes is obtained. The effects of some parameters on frequencies are discussed and the present theory is compared with the classical theory.

83-1597
Transient Waveform from a Baffled Circular Plate
I. Nakayama and A. Nakamura
Inst. of Scientific and Industrial Res., Osaka Univ., 8-1, Mihogaoka, Ibaraki, Osaka, 567 Japan, J. Sound Vib., 86 (1), pp 129-141 (Jan 8, 1983) 9 figs, 8 refs

Key Words: Plates, Baffles, Circular plates, Acoustic pulses, Time domain method

The transient waveform radiated from a thin elastic clamped circular plate set in a baffle is investigated when the plate is excited by a plane single triangular sound pulse at normal incidence. The expression for the transient waveform at any point in the far field is obtained in the time domain. Some numerical calculations are made for a circular plate of duralumin, and the directional deformation of the waveform is discussed. The calculated waveform obtained is verified experimentally by generating a plane triangular sound pulse using a computer-controlled loudspeaker.

83-1598

Vibrational Frequencies of Clamped Plates of Variable Thickness

J.R. Kuttler and V.G. Sigillito
Milton S. Eisenhower Res. Ctr., Appl. Phys. Lab., The Johns Hopkins Univ., Johns Hopkins Rd., Laurel, MD 20707, J. Sound Vib., 86 (2), pp 181-189 (Jan 22, 1983) 2 figs, 2 tables, 15 refs

Key Words: Plates, Variable cross section, Vibration analysis

A method is presented for computing lower and upper bounds for vibrational frequencies of clamped plates with general thickness variations. The method is illustrated for plates with linear tapers.

83-1599

Natural Frequencies of Transverse Vibration of Polar Orthotropic Variable Thickness Annular Plates

D.G. Gorman
Dept. of Mech. Engrg., Queen Mary College, Univ. of London, London E1 4NS, UK, J. Sound Vib., 86 (1), pp 47-60 (Jan 8, 1983) 8 figs, 2 tables, 14 refs

Key Words: Plates, Annular plates, Natural frequencies, Flexural vibration, Variable cross section

The method of annular finite elements is applied to the case of varying thickness annular discs constructed of materials exhibiting polar orthotropic characteristics. The numerical convergence of the method is tested and comparisons are made with the corresponding results obtained in other studies. The method is applied specifically to polar orthotropic annular discs of linearly varying thickness profile for various transverse boundary conditions, aspect ratios and values of the parameter describing the thickness profile. The results are plotted and conclusions drawn.

83-1600

Identification and Control of Rotating Disk Vibration

C.J. Radcliffe and C.D. Mote, Jr.
Michigan State Univ., East Lansing, MI 48824, J. Dynam. Syst., Meas. Control, Trans. ASME, 105 (1), pp 39-45 (Mar 1983) 7 figs, 2 tables, 11 refs

Key Words: Disks, Flexural vibration, Active vibration control, Vibration control

Small amplitude, transverse vibration of a circular disk can be viewed as a superposition of traveling waves, each wave corresponding to a particular vibration mode. When the plate damping is small, the transverse motion of the plate is often dominated by response in one mode. The active control method discussed here used an on-line FFT analysis of the rotating disk displacement to periodically identify the dominant mode of the disk response in a changing operating environment. Active control forces were applied electromagnetically to the disk to suppress the amplitude of that particular mode.

SHELLS

(Also see No. 1556)

83-1601

Numerical Perturbation Solutions for the Vibrations of Prestressed, Clamped Cylindrical Shells

D.E. Killian, M.P. Kamat, and A.H. Nayfeh
Nuclear Power Generation Div., Babcock and Wilcox Co., Lynchburg, VA 24505, J. Sound Vib., 86 (1), pp 9-22 (Jan 8, 1983) 2 figs, 4 tables, 8 refs

Key Words: Shells, Cylindrical shells, Prestressed structures, Perturbation theory

A perturbation technique is used to reduce the eighth-order vibration problem for prestressed, clamped cylindrical shells to an equivalent sixth-order membrane problem. In the transformation to a membrane problem composite expansions are utilized, uniformly valid over the length of the shell, to formulate modified boundary conditions that account for the effects of bending near the shell ends. By solving the simpler modified membrane problem numerically, one can demonstrate the effectiveness of the method against eighth-order bending solutions.

83-1602

Approximate Analysis of Natural Frequencies of a Circular Cylindrical Tank

H. Kondo and Y. Yamamoto
Ishikawajima-Harima Heavy Industries Co., Ltd., 135-91, 3-1-15, Toyosu, Koto-ku, Tokyo, Japan, Bull. JSME, 26 (213), pp 432-438 (Mar 1983) 3 figs, 2 tables, 22 refs

Key Words: Tanks (containers), Shells, Cylindrical shells, Fluid-induced excitation, Natural frequencies, Approximation methods

This report deals with a method of evaluating coupled natural frequencies of a circular cylindrical tank. Starting from a variational principle, the authors obtain a functional relating to coupled oscillations between a linear elastic body of infinitesimal deformations and a perfect fluid of small wave heights. Numerical examples show satisfactory coincidence between exact natural frequencies and approximate ones in the case of sloshing modes, and tolerable error of the approximation in the case of lower bulging modes.

83-1603

Doubly Asymptotic Approximations for Vibration Analysis of Submerged Structures

T.L. Geers and C.A. Felippa

Lockheed Palo Alto Res. Lab., 3251 Hanover St., Palo Alto, CA 94304, J. Acoust. Soc. Amer., 73 (4), pp 1152-1159 (Apr 1983) 13 figs, 23 refs

Key Words: Submerged structures, Doubly Asymptotic Approximation, Periodic response, Spherical shells, Shells

Doubly Asymptotic Approximations (DAAs) are differential equations for boundary-element analysis of the interaction between a complex structure and a surrounding infinite medium. In this paper, the use of first- and second-order DAAs for steady-state vibration analysis of submerged structures is examined. The governing discrete-element equations for the general problem are set down and discussed. The accuracy of three DAA forms is studied through the generation of numerical results for a submerged spherical shell.

83-1604

Theory of Viscoplastic Shells for Dynamic Response

R.S. Atkatsh, M.P. Bieniek, and I.S. Sandler

Weidlinger Associates, New York, NY 10001, J. Appl. Mech., Trans. ASME, 50 (1), pp 131-136 (Mar 1983) 6 figs, 11 refs

Key Words: Shells, Viscoplastic properties, Computer programs

A viscoplastic shell model is formulated that utilizes the shell membrane strains and curvatures as the kinematic variables and the shell stress resultants (membrane forces and moments) as the dynamic variables. The viscoplastic shell model combines the concepts of Perzyna's viscoplastic constitutive equations with Bieniek's shell stress resultant formulation. The model is incorporated into the Elastoplastic Shell Analysis code for the analysis of shells in an acoustic medium subjected to dynamic loadings that produce moderately large elastoviscoplastic deformations in the shell. An example is presented to demonstrate the effect of material rate dependence on structural response.

83-1605

An Optimized Configuration of an Enclosure Structure for Safe Containment of Internal Blasts

A.D. Gupta and H.L. Wisniewski

U.S. Army Ballistic Res. Lab., Aberdeen Proving Ground, MD 21005, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 4-(47-51) 11 refs

Key Words: Optimization, Shells, Containment structures, Blast response

Large deflection elastic-plastic response of a hemispherical containment shell configuration clamped to a horizontal rigid foundation and subjected to an internal blast was analyzed using a finite-difference structural response code PETROS 3 5. Optimization study was conducted based on a minimum amount of material required to elastically contain the first pressure pulse from a specified explosive charge subject to workspace constraints.

RINGS

83-1606

Radial Vibrations of Eccentric Rings

T.P. Valkering and T. Charnley

Dept. of Physics, Loughborough Univ. of Tech., Loughborough LE11 3TU, UK, J. Sound Vib., 86 (3), pp 369-393 (Feb 8, 1983) 2 figs, 10 tables, 9 refs

Key Words: Rings, Vibration analysis

The radial extensional and inextensional modes of vibration of an eccentric circular ring with a rectangular cross section have been studied by perturbation calculations and by measurements on five rings with various eccentricities. In agreement with the theory, only the k = 1 extensional mode was markedly non-degenerate. Formulae for calculating the frequencies are given.

PIPES AND TUBES

83-1607

Stability and Vibrations of Spinning Tubes Subjected to Uniform Radial Pressure

A. Ertepinar
Dept. of Engrg. Sciences, Middle East Tech. Univ., Ankara, Turkey, J. Sound Vib., 86 (3), pp 343-351 (Feb 8, 1983) 5 figs, 8 refs

Key Words: Tubes, Cylinders, Rotating structures, Vibration analysis, Stability

The theory of small motions superposed on large, elastic, static deformations is used to investigate the stability and small vibrations of circular cylindrical tubes of arbitrary wall thickness. The tube is assumed to rotate about its axis with constant angular speed and be simultaneously subjected to a uniform radial pressure. The material of the tube is of Mooney-Rivlin type which is elastic, isotropic, homogeneous and incompressible. The effect of angular speed on the frequency of small vibrations and the buckling pressure is illustrated with several examples.

83-1608

An Approximate Dynamic Analysis of Tube Structures

P.C.P. Chang
Ph.D. Thesis, Univ. of Illinois at Urbana-Champaign, 291 pp (1982)
DA8302825

Key Words: Tubes, Buildings, Multistory buildings, Seismic design

In the design of high-rise structures, the tube concept has been widely accepted as an effective means to resist lateral loads arising from earthquakes or wind. Because finite element analyses of these structures are costly and time-consuming, an approximate method of analysis is needed. The object of this investigation is to develop a model for the approximate analysis of tube buildings that can replace the discrete beams and columns of a building by an equivalent continuum.

83-1609

Seismic Reliability Assessment of Structural Systems and Lifeline Networks

M. Moghtaderi-Zadeh
Ph.D. Thesis, Univ. of California, Berkeley, 107 pp (1982)
DA8300593

Key Words: Lifeline systems, Seismic design

Efficient and accurate methods for assessing the seismic reliability of engineering systems are developed. An improved fault-rupture model, which considers the rupture area produced by an earthquake on the fault plane, describes the seismic environment. Using this model, the study presents an integrated approach for assessing the reliability of engineering systems consisting of interdependent subsystems. The approach is a blend of structural- and systems-reliability methods. It can account for physical or functional dependencies among subsystems. Using this approach, a simple method for assessing the seismic reliability of a general system is formulated. An efficient method for assessing the seismic reliability of lifeline networks is also developed.

DUCTS

83-1610

The Attenuation of Sound in a Randomly Lined Duct

M.S. Howe
Faculty of Mathematical Studies, Univ. of Southampton, Southampton S09 5NH, UK, J. Sound Vib., 87 (1), pp 83-103 (Mar 8, 1983) 9 figs, 24 refs

Key Words: Ducts, Acoustic linings, Sound attenuation

The kinetic theory of wave propagation in random media is applied to assess the relative merits of the peripherally segmented, axially segmented and checkerboard configured acoustic duct treatments proposed by Mani.

BUILDING COMPONENTS

83-1611

Effect of Size on Measurements of the Sound Reduction Index of a Window or a Pane

N. Michelsen
Danish Acoustical Inst., c/o Technical Univ. of Denmark, Bldg. 352, DK-2800 Lyngby, Denmark, Appl.

Acoust., 16 (3), pp 215-234 (1983) 18 figs, 1 table, 7 refs

Key Words: Windows, Noise reduction

The variation in the sound reduction index as a function of the size of a test specimen was investigated. Five different sizes of one particular hinged window were tested. In addition, tests were carried out with a sound insulating double glazing and a laminated pane mounted in normal wooden frames.

83-1612
Prediction of the Seismic Responses of R/C Frame-Coupled Wall Structures
A.E. Aktan, V.V. Bertero, and M. Piazza
Earthquake Engrg. Res. Ctr., Univ. of California, Berkeley, CA, Rept. No. UCB/EERC-82/12, NSF/CEE-82061, 200 pp (Aug 1982)
PB83-149203

Key Words: Walls, Seismic design

This is the second report summarizing the progress of continuing research on the seismic resistant design of R/C coupled structural walls. The present report documents the analytical investigations carried out within the integrated analytical and experimental research program, and assesses the state of the art in the analytical seismic response simulation of R/C frame-wall/coupled wall structural systems, and the state of the practice (code) in guiding the designer to achieve an optimum seismic design of these systems.

DYNAMIC ENVIRONMENT

ACOUSTIC EXCITATION

(Also see Nos. 1533, 1548, 1549, 1550)

83-1613
Establishment of Multiple Input Modeling Techniques for Transient Noise Source Identification: With Application to Structural Sources of Forge Hammer Noise
M.W. Trethewey
Ph.D. Thesis, Michigan Technological Univ., 419 pp (1981)
DA8302468

Key Words: Noise source identification, Forging machinery

The application of multiple input modeling techniques to physical systems for source identification are established and then applied to production forge hammers to identify the principal sources of transient structural noise. To establish the modeling technique as a viable analysis tool, the difficulties experienced in previous applications are first investigated and the corrective steps determined. A series of controlled laboratory experiments is performed to determine the practical limitations and operating requirements of the technique. The derived model terms are interpreted to show their physical significance in relation to the system. Provided the procedure is implemented properly, the technique is shown to be capable of separating the source contributions for either uncorrelated or highly correlated sources within 1 dB of the measured source contribution energy.

83-1614
Dynamic Elastic Constant Determination Via Measurement of the Acoustic Field Scattered by a Spherical Elastomer: Theory
J.C. Piquette
Naval Res. Lab., Washington, DC, Rept. No. NRL-MR-4873, 38 pp (Sept 15, 1982)
AD-A120 418

Key Words: Acoustic scattering, Elastomers, Spheres, Least squares method

A technique is presented whereby dynamic elastic constants may be calculated by solving the inverse scattering problem of an infinite plane wave incident on a spherical elastomer. A least-squares approach is used to find the best values for the elastic constants that are consistent with measured scattered pressures. Relationships are provided that allow approximate calculation of the bulk and shear moduli to be performed using only the first few scattering constants. Difficulties and limitations in experimentally implementing the method herein described are discussed, and potential resolutions of these difficulties are presented.

83-1615
Flow-Excited Resonances in Covered Cavities
J.J. Keller and M.P. Escudier

Brown Boveri Res. Centre, CH-5405 Baden, Switzerland, J. Sound Vib., 86 (2), pp 199-226 (Jan 22, 1983) 24 figs, 17 refs

Key Words: Acoustic resonance, Fluid-induced excitation, Cavities

Results are presented of an investigation of flow-excited acoustic resonance in covered cavities. It is shown that energy is drawn from the mean flow entering a cavity and fed into the acoustic wavefield as a result of impingement of the inflowing jet against a solid boundary. It is also shown that if the exit duct has the characteristics of a diffuser it, too, can have an active influence on the resonance cycle. The conclusions reached are based upon fluctuating pressure measurements and visualization of the flow in a series of two-dimensional and axisymmetric cavity configurations.

83-1616

Cavity Resonances in Engine Combustion Chambers and Some Applications

R. Hickling, D.A. Feldmaier, F.H.K. Chen, and J.S. Morel

Engrg. Mech. Dept., General Motors Res. Labs., Warren, MI 48090-9055, J. Acoust. Soc. Amer., 73 (4), pp 1170-1178 (Apr 1983) 23 figs, 1 table, 18 refs

Key Words: Engine noise, Combustion noise, Cavity resonators

Current knock detection systems are tuned to the frequency band of the lowest cavity resonance in the combustion chamber. It is shown that higher order resonances can also be detected by a knock vibration sensor on the surface of the engine. Another use for the cavity resonances is to determine the bulk temperature of the gas in the combustion chamber as a function of crank angle. This technique is demonstrated for a heavy-duty two-stroke diesel. The results of several fundamental investigations of cavity resonances in engine combustion chambers are reported briefly.

83-1617

On the Interaction of a Sound Pulse with the Shear Layer of an Axisymmetric Jet, II: Heated Jets

A. Bayliss and L. Maestrello

Courant Inst., New York Univ., New York, NY 10012, J. Sound Vib., 86 (3), pp 395-409 (Feb 8, 1983) 10 figs, 23 refs

Key Words: Jet noise

The fluctuating field of a heated jet excited by a sound pulse is simulated numerically. The fluctuations in both the flow field and the far field are studied. The results provide a partial explanation in terms of stability theory of experimentally observed properties of the noise of heated jets.

83-1618

Some Remarks on Source Coherence Affecting Jet Noise

A. Michalke

Hermann-Fottinger-Institut fur Thermo- and Fluid-dynamik, Technische Universitat Berlin, D-1000 Berlin 12, Germany, J. Sound Vib., 87 (1), pp 1-17 (Mar 8, 1983) 7 figs, 19 refs

Key Words: Jet noise, Sound propagation

The influence of axial and azimuthal source coherence on noise radiation is investigated. For jet noise at small Helmholtz numbers results of a theoretical source model are compared with measured data.

83-1619

On the Prediction of Impact Noise, IV: Estimation of Noise Energy Radiated by Impact Excitation of a Structure

J.M. Cuschieri and E.J. Richards

Inst. of Sound and Vib. Res., Univ. of Southampton, Southampton S09 5NH, UK, J. Sound Vib., 86 (3), pp 319-342 (Feb 8, 1983) 20 figs, 1 table, 15 refs

Key Words: Impact noise, Noise prediction

This series of papers sets out to provide a practical method of predicting the noise radiated by a machinery-type structure as a result of an impact upon it. As such noise energy may vary from 10^{-8} to 10^{-3} of the mechanical energy used in the machine, it is necessary to validate the accuracy of the energy accountancy equation which has been developed to permit this prediction in terms of those items which can be measured; viz., the force derivative during impact, the point response term, the calculated modified radiation efficiency, the damping factor, and the average thickness of the machinery components. To do so, and to represent typically a gearbox casing, it is necessary to calculate, measure and compare the noise radiated from a damped plate, held rigidly in a frame, the impact being produced by a sphere (whose natural frequencies are well above those being examined) striking the plate either directly, through a lumped mass which is either attached directly to the center of the plate, or through a resilient and damped interlayer.

83-1620

Noise Attenuation in Factories

E.A. Lindqvist
Chalmers Univ. of Tech., Dept. of Bldg. Acoustics, 41296 Goteborg, Sweden, Appl. Acoust., 16 (3), pp 183-214 (1983) 10 figs, 1 table, 10 refs

Key Words: Industrial facilities, Noise generation, Noise reduction

The cost of reducing noise levels in factories by covering large surfaces with sound absorbents is high. It is therefore important to be able to calculate in advance the effectiveness of absorbents and to determine how absorbents may be chosen and distributed for maximal noise reduction for the invested capital. For this purpose a mathematical model of sound propagation and attenuation in factories has been developed on certain simplifying assumptions. The interrelationship between the different parameters is found to be rather intricate and the mathematical model must be evaluated using a computer program.

83-1621

Propagation of Sound Over Grassland and Over an Earth Barrier

B.A. de Jong, A. Moerkerken, and J.D. van der Toorn
Inst. of Appl. Physics TNO-TH; Delft Univ. of Tech., Stieltjesweg 1, 2638 CK Delft, The Netherlands, J. Sound Vib., 86 (1), pp 23-46 (Jan 8, 1983) 23 figs, 22 refs

Key Words: Traffic noise, Noise barriers

A model for the calculation of effects of ground and a screen or a wedge shaped barrier on the transmission of sound has been tested by comparing calculated transmission losses with losses measured in real situations. With the model presented in this paper, the effect of a homogeneous ground with a finite or an infinite impedance, the effect of diffraction at a discontinuity in the impedance of the ground (e.g., the transition between road surface and adjacent grassland), and the combined effect of ground surface and a barrier with a finite or an infinite surface impedance can be handled.

83-1622

Spectral Theory of Sound Propagation in an Ocean Channel with Weakly Sloping Bottom

A. Kamel and L.B. Felsen
Dept. of Electrical Engrg. and Computer Science, Microwave Res. Inst., Polytechnic Inst. of NY, Farmingdale, NY 11735, J. Acoust. Soc. Amer., 73 (4), pp 1120-1130 (Apr 1983) 4 figs, 8 refs

Key Words: Underwater sound, Sound propagation

Spectral representations based on the theory of characteristic Green's functions (resolvents) have been used effectively for studying sound propagation in a coordinate separable ocean environment. Such representations are here generalized to accommodate weak nonseparability as represented by a homogeneous water channel separated from a homogeneous sediment by a gradually and monotonically sloping bottom. The generalization involves the use of adiabatic invariants for the spectral integration variable and of symmetrizing factors in order to insure that the Green's function, so expressed, reduces by residue calculus to the conventional adiabatic trapped mode expansion whenever that is valid.

83-1623

Propagation of Spherical Waves Above Ground

R. Seznec, M. Berengier, and V. Legeay
Laboratoire Central des Ponts et Chaussees, Les Bauches du Desert, BP19, 44340 Bouguenais, France, Appl. Acoust., 16 (3), pp 163-168 (1983) 4 figs, 1 table, 4 refs

Key Words: Spherical waves, Wave propagation, Sound propagation

A new methodology is developed for the problem of sound propagation above ground. The respective advantages of pure tones generated by a pressure driver with a $\lambda/4$ tube and impulsive noises issued from an 8 mm alarm pistol with a double cavity absorbing silencer, are analyzed. Use is made of minimum phase linear systems for which the modulus and phase of the transfer function are related by an Hilbert transform. The different parameters of a locally reacting model are calculated using a nonlinear fitting procedure and the specific impedance values of the tested ground are estimated from the attenuations experimentally measured under grazing or oblique incidence.

SHOCK EXCITATION

(Also see Nos. 1519, 1685, 1688)

83-1624

Three-Dimensional Oblique Shock Diffraction over a Rectangular Parallelepiped: Computational/Experimental Comparison

R.E. Lottero, J.D. Wortman, B.P. Bertrand, and C.W. Kitchens, Jr.

Ballistic Res. Lab., Army Armament Res. and Dev. Command, Aberdeen Proving Ground, MD, Rept. No. ARBRL-TR-02443, SBI-AD-F300 134, 68 pp (Nov 1982)

AD-A122 254

Key Words: Shock waves, Wave diffraction

Three-dimensional, unsteady finite-difference calculations with the HULL hydrocode are used to describe the shock diffraction process resulting from a shock wave striking the front of a scaled model of an S-280 electrical equipment shelter at oblique incidence. The numerical calculations are discussed and evaluated by comparison with experimental pressure measurements taken in shock tube tests on a scale-model shelter.

83-1625

An Evaluation of the Inelastic Behaviour of Two Degree of Freedom Structures under Earthquake Loading

J.F. Bagget and J.B. Martin

Cape Town Univ., South Africa, Rept. No. TR-9, 35 pp (Oct 1981)

N83-12258

Key Words: Two degree of freedom systems, Seismic response

Two degree of freedom systems were studied. An accelerogram, from an artificially generated motion with a maximum acceleration of about 0.3 g was used. It is in fact the strong motion portion of a longer record, and was limited to 5 seconds duration to reduce the use of computer time.

VIBRATION EXCITATION

(Also see Nos. 1687, 1694)

83-1626

Low Frequency Flows through an Array of Airfoils

T.F. Balsa

General Electric Corporate Res. and Dev., Schenectady, NY 12301, J. Sound Vib., 86 (3), pp 353-367 (Feb 8, 1983) 2 figs, 13 refs

Key Words: Airfoils, Fluid-induced excitation

The linearized flow through a finite array of airfoils undergoing arbitrary motion is investigated analytically. The key assumptions are that motion is at low frequencies and that the interference between the airfoils is weak; both of these assumptions are defined precisely. An important ingredient of the analysis is the enforcement of the Kutta condition and the treatment of the unsteady wakes. Two examples illustrate the power of the present approach.

83-1627

An Experimental Study of Dynamic Stall on Advanced Airfoil Sections. Volume 2. Pressure and Force Data

K.W. McAlister, S.L. Pucci, W.J. McCroskey, and L.W. Carr

NASA Ames Res. Ctr., Moffett Field, CA, Rept. No. NASA-TM-84245-VOL-2, 646 pp (Sept 1982)

AD-A121 598

Key Words: Airfoils, Periodic response, Experimental test data

Experimentally derived force and moment data are presented for eight airfoil sections that were tested at fixed and varying incidence in a subsonic two-dimensional stream. Airfoil incidence was varied through sinusoidal oscillations in pitch over a wide range of amplitude and frequency.

83-1628

Laser Induced Structural Vibration

L.L. Koss and R.C. Robin

Monash Univ., Clayton, Victoria 3168, Australia, J. Sound Vib., 86 (1), pp 1-7 (Jan 8, 1983) 6 figs, 5 refs

Key Words: Lasers, Vibration excitation

A technique is described for exciting structural vibration by using a focused laser beam to vaporize materal from a target attached to the structure. The rapid ejection of material results in an impulsive reaction to the target which is transmitted to the structure.

83-1629
Scuffing under Cyclic Loading -- Unexpected Effect of Frequency
A.G.D. Smith and A. Cameron
Imperial College, London SW7 2BX, UK, ASLE,
Trans., 26 (2), pp 236-239 (Apr 1983) 4 figs, 1 table, 5 refs

Key Words: Disks, Gears, Wear

A study is made to determine if a pulsating load affects the scuffing of disks and if so, whether it is frequency dependent. Using the hydrostatic "disk" (or ring) machine developed in the authors' laboratory, a fluctuating load of ±5 percent was superimposed on a steady load. At about 15 Hz the load-carrying capacity dropped by 40 percent compared with the steady value. It returned to its original value at about 60 Hz. The friction (and surface temperature) rose as the load-carrying capacity dropped. In one set of tests, the pitting life dropped from 13 hours to 30 minutes. The drop did not seem to depend on waveform and no sign of a machine resonance was found despite a careful search. The most likely explanation of the effect was thought to be a modification of the film shape due to the squeeze-film component.

83-1630
Statistical Flow-Oscillator Modeling of Vortex-Shedding
H. Benaroya and J.A. Lepore
Weidlinger Associates, 333 Seventh Ave., New York, NY 10001,
J. Sound Vib., 86 (2), pp 159-179 (Jan 22, 1983) 1 table, 18 refs

Key Words: Interaction: structure-fluid, Vortex shedding, Fluid-induced excitation

The very important engineering problem of modeling the fluid-structure interaction occurring during the shedding of vortices has defied, and will probably continue to defy, a closed form exact solution for the foreseeable future. Therefore, an attempt must be made to extract relevant information about the process in order to be able to have a basic understanding of it for the purpose of analysis. A useful method involves the flow-oscillator concepts of Hartlen and Currie redefined here for stochastic processes.

83-1631
Application of Zimmerman Flutter-Margin Criterion to a Wind Tunnel Model
R.M. Bennett
NASA Langley Res. Ctr., Hampton, VA,
Rept. No. L-15508, NASA-TM-84545, 30 pp (Nov 1982)
N83-12070

Key Words: Flutter, Wind-tunnel testing

The Zimmerman flutter margin criterion was studied by applying it to data obtained from a wind tunnel model. The sensitivity of the flutter margin parameter was explored with a parametric trend study and by calculation of the derivatives with respect to the input frequency and damping parameters. The criterion is simple in concept and application, and it serves as a good flutter onset predictor because it gives a nearly linear variation with dynamic pressure.

83-1632
Stable Periodic Vibroimpacts of an Oscillator
N. Popplewell, C.N. Bapat, and K. McLachlan
Dept. of Mech. Engrg., Univ. of Manitoba, Winnipeg, Canada R3T 2N2,
J. Sound Vib., 87 (1), pp 41-59 (Mar 8, 1983) 10 figs, 1 table, 33 refs

Key Words: Impact-pairs, Experimental test data

The asymptotically stable vibrations of a loaded oscillator colliding periodically with a rigid mass are described. Comparison of the numerical results with the few existing examples is encouraging but inconclusive. Better overall agreement is demonstrated with fairly comprehensive measurements from a specially built experimental rig.

83-1633
Stable Periodic Motions of an Impact-Pair
C.N. Bapat, N. Popplewell, and K. McLachlan
Univ. of Manitoba, Winnipeg, Canada R3T 2N2,
J. Sound Vib., 87 (1), pp 19-40 (Mar 8, 1983) 13 figs, 55 refs

Key Words: Impact pairs

The asymptotically stable motion of two rigid masses separated by a clearance is formulated most generally when the masses collide periodically. Predictions are shown to agree satisfactorily with comprehensive experimental results. Difficulties encountered in the practical application of this and similar stability theories are discussed with the help of empirical data. A technique is proposed for determining a clearance's dimensions in situ which could provide a basis for detecting progressive wear in mechanisms such as gear trains.

DAMPING

(Also see No. 1557)

83-1634

Optimum Distribution of Additive Damping for Vibrating Beam Structures

R. Lunden and B. Akesson

Chalmers Univ. of Tech., S-412 96 Gothenburg, Sweden, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 2-(21-26) 6 figs, 9 refs

Key Words: Optimum design, Minimum weight design, Beams, Viscoelastic damping

Cost and weight effectiveness of concentrated and distributed additive damping are studied for linear systems (discrete and continuous) under prescribed harmonic loads and/or displacements. Increases in stiffness and mass due to the additive damping are included. Redistribution of an initially uniformly applied additive damping (viscoelastic layer) is numerically and experimentally investigated for beam structures.

FATIGUE

83-1635

Load-Shedding Techniques for Fatigue-Threshold Determination

A.F. Blom

The Royal Inst. of Tech., Stockholm, Sweden, Exptl. Techniques, 7 (5), pp 15-18 (May 1983) 4 figs, 10 refs

Key Words: Fatigue life, Fatigue tests

Recently an extensive source of information on fatigue thresholds, ΔK_{th}, was published. Notable in this and other pertinent sources is the lack of a single consistent test method for determination of threshold and near-threshold fatigue-crack-growth data. The aim of this paper is to briefly describe effects which are of importance for threshold testing and to discuss advantages and disadvantages of proposed experimental techniques for determination of ΔK_{th}.

83-1636

Temperature Effects on Fatigue Thresholds and Structure Sensitive Crack Growth in a Nickel-Base Superalloy

M.A. Hicks and J.E. King

Intl. J. Fatigue, 5 (2), pp 67-74 (Apr 1983) 9 figs, 2 tables, 40 refs

Key Words: Fatigue life, Crack propagation

Fatigue thresholds and slow crack growth rates have been measured in a powder formed nickel-base superalloy from room temperature to 600°C. Two grain sizes were investigated. It is shown that the threshold increases with grain size, and the difference is most pronounced at room temperature. The results are discussed in terms of surface roughness and oxide-induced crack closure, the former being critically related to the type of crystallographic crack growth, which is in turn shown to be both temperature and stress intensity dependent.

83-1637

Low Cycle Fatigue Behaviour of Cast Nickel-Base Superalloy IN738LC at Room Temperature

G. Jianting and D. Ranucci

Inst. of Metal Res., Academia Sinica, Wenhua Rd., Shenyang, China, Intl. J. Fatigue, 5 (2), pp 95-97 (Apr 1983) 7 figs, 1 table, 8 refs

Key Words: Fatigue life, Fatigue (materials)

The cyclic stress/strain response and the low cycle fatigue life of cast nickel-base superalloy IN738LC were studied. Fully reversed strain-controlled tests were performed at room temperature and at two different strain rates. Optical and electron microscopy were used to study the processes of deformation and cracking during cycling.

83-1638

Fatigue Crack Propagation Behaviour of Rotor and Wheel Materials Used in Steam Turbines

C. Poon, D. Vitale, M. Singh, and D. Hoeppner

Dept. of Mech. Engrg., Univ. of Toronto, Canada, Intl. J. Fatigue, 5 (2), pp 87-93 (Apr 1983) 11 figs, 3 tables, 12 refs

Key Words: Rotors, Wheels, Fatigue life, Fatigue (materials), Crack propagation

The fatigue crack propagation characteristics of several rotor and wheel materials that are commonly used in rotating components of steam turbines were investigated. Particular emphasis was placed on the behavior at near-threshold growth rates. The effects of load ratio on the fatigue crack growth rates were examined, as well as the tensile, Charpy V-notch and fracture toughness properties of the rotor and wheel materials. The relationship between fatigue crack propagation behavior and fractographic features was examined.

83-1639

Prediction of Constant Amplitude Fatigue Lives of Precracked Specimens from Accelerated Fatigue Data

P.K. Poulose and D.L. Jones

George Washington Univ., School of Engrg. and Appl. Science, Washington, DC 20052, Intl. J. Fatigue, 5 (2), pp 99-103 (Apr 1983) 10 figs, 6 refs

Key Words: Fatigue tests, Aluminum

The feasibility of using an accelerated fatigue test program to predict constant amplitude fatigue lives of precracked specimens was examined. An analytical basis for the fracture mechanics approach was developed by modifying earlier work that had been applied to unnotched specimens. A load program involving a linearly increasing load with cycle number was used for the accelerated tests.

83-1640

Dynamic Singular Stresses for a Griffith Crack in a Soft Ferromagnetic Elastic Solid Subjected to a Uniform Magnetic Field

Y. Shindo

Tohoku Univ., Sendai 980, Japan, J. Appl. Mech., Trans. ASME, 50 (1), pp 50-56 (Mar 1983) 5 figs, 12 refs

Key Words: Wave diffraction, Cracked media

The problem of the diffraction of normally incident longitudinal waves on a Griffith crack located in an infinite soft ferromagnetic elastic solid is considered. It is assumed that the solid is a homogeneous and isotropic one and is permeated by a uniform magnetostatic field normal to the crack surfaces. Fourier transforms are used to reduce the problem to two simultaneous dual integral equations.

EXPERIMENTATION

MEASUREMENT AND ANALYSIS

(Also see Nos. 1659, 1669, 1690, 1691, 1692)

83-1641

Improved Resonance Technique for Materials Characterization

W.M. Madigosky and G.F. Lee

Naval Surface Weapons Ctr., White Oak, Silver Spring, MD 20910, J. Acoust. Soc. Amer., 73 (4), pp 1374-1377 (Apr 1983) 5 figs, 9 refs

Key Words: Measuring instruments, Resonance tests

An improved resonance apparatus for materials characterization is described. The apparatus accurately determines the propagation constants of an extensional acoustic wave by exciting a bar of material at one end with a noise source, while the other end is allowed to move freely. Miniature accelerometers measure the acceleration at two locations and their output signals are analyzed by a dual channel FFT spectrum analyzer. The apparatus was found to be a fast and reliable method to determine dynamic constants.

83-1642

Variational Analysis of a Model for a Piezoelectric Polymer Flexural Plate Hydrophone

P.A.A. Laura and D. Avalos

Inst. of Appl. Mech., Puerto Belgrano Naval Base, 8111 Argentina, J. Acoust. Soc. Amer., 73 (4), pp 1378-1383 (Apr 1983) 8 figs, 2 tables, 4 refs

Key Words: Hydrophones, Rectangular plates, Piezoelectricity, Variational methods

An approximate solution for the mathematical model of the piezoelectric polymer flexural plate hydrophone is presented. The case where sheets of polymer are attached to air-backed rectangular flexural plates is treated. This study constitutes an extension of Ricketts' recent treatment in the sense that dynamic effects are now taken into account and simply supported, clamped, or elastically restrained edges are now considered.

83-1643

A Simple Technique to Count the Fringes in a Dynamic-Photoelastic Oscillogram

V.G. Idichandy and G. Venkata Rao

Indian Inst. of Tech., Madras, India, Exptl. Techniques, 7 (5), pp 26-28 (May 1983) 3 figs, 7 refs

Key Words: Oscilloscopes, Photoelastic analysis, Measuring instruments

The photometric or intensity method of data acquisition, both in static and dynamic photoelasticity, has been in use for quite some time. Basically the method consists of sensing the light-intensity variations at a point in a photoelastic model with the help of a photoelectric transducer. These sensors convert variations in light intensity into variations in electrical potential or resistance. With the help of a suitable signal conditioner, these variations can be displayed or recorded in a convenient form in a storage oscilloscope or high-speed recorder. Many investigators who have used this technique reported that counting of fringes in the intensity-time oscillogram is difficult as the optical output is non-discriminatory. This paper explains a simple technique to count the number of fringes in such an oscillogram.

83-1644

Response Tests of a Sputtered Gage Pressure Transducer

E.W. McCauley, W.M. Shay, Jr., W.S. Filler, and P.M. Aronson

Lawrence Livermore Natl. Lab., CA, Rept. No. UCID-19466, 62 pp (Sept 1982)

DE83001541

Key Words: Transducers

This report describes procedures used and findings derived from a short term experimental investigation made into the dynamic response characteristics of the CEC 1000 sputtered gage pressure transducer. These transducers feature a narrow diameter, integral, reentrant tube in front of the gaged diaphragm. The study was done in two parts.

83-1645

Measurement of Veritcal Alignment Variations in Working Turboalternator Shafts (Mesure des Variations d'Alignement Vertical des Paliers de Turbo-Alternateurs en Fonctionnement)

A. Clapis, G. Possa, and T. Rossini

Centro Informazioni Studi Esperienze, Milan, Italy, Rept. No. CISE-1777, 30 pp (1982)

N83-13469

(In French)

Key Words: Measuring instruments, Displacement measurement, Shafts

The application of an electronic differential altimeter to the measurement of vertical alignment of rotating machinery shafts is discussed. The instrument is based on the communicating vessels principle and measures continuously the vertical displacement with a 10 micrometer precision. In addition, the oil pressure in a significant bearing location is also continuously measured. The instrument was tested for over a year on working turboalternators of up to 660 MW. In several cases it was possible to analyze the causes of incidents, using instrument recording. Two of these cases are described.

83-1646

Effect of Measurement-System Phase Response on Shock-Spectrum Computation

P.L. Walter

Sandia Natl. Labs., Albuquerque, NM, Rept. No. SAND-82-1284C, CONF-821040-1, 16 pp (1982)

DE82022170

Key Words: Measuring instruments, Shock response spectra

Measurement system design is frequently based upon amplitude response considerations with phase response ignored. In structural testing, nonlinear phase response in measurement systems results in distorted transient data being recorded for analysis with resultant error in the computed shock spectra. Design guidelines are provided to preclude these errors from occurring.

83-1647

The Determination of Axial Motion of a Saw Blade by Means of a Corotating Accelerometer (Bestimmung der Axialbewegung eines Sageblattes mit Hilfe mitrotierender Beschleunigungsaufnehmer)

J. Jendryschik

Industrie Anzeiger, 105 (25), pp 33-34 (Mar 1983) (In German)

Key Words: Measurement techniques, Vibration measurement, Rotating structures, Disks, Blades, Saws

A method for the measurement of vibrating disks under unfavorable external conditions is described. Using a saw blade as an example, it is shown which type of signals should be investigated, and how inertia forces change the properties of structures.

DYNAMIC TESTS

83-1648

An Experimental Investigation of Rotating Characteristics of Instrument Bearings

R.M. Kanapenas and R. Stankevicius

Kaunas Politechnical Institute, Kaunas, Lithuanian SSR, Vibrotechnika, 4 (34), pp 79-84 (1981) 5 figs, 2 refs

(In Russian)

Key Words: Test facilities, Bearings, High frequencies

An experimental mounting for the investigation of moment of friction of precision plain bearings under high frequency vibration is described. The characteristics of the moment of friction depending on the direction, frequency and acceleration of the vibration are analyzed.

83-1649

Description of the Planar Motion Mechanism (PMM)

C.N.J. Gommers and P. Vanoossanen

Maritiem Res. Inst., Wageningen, The Netherlands, Rept. No. 42685-6-IS, 16 pp (Oct 1981)

N83-13126

(In Dutch)

Key Words: Vibrators (machinery), Test models, Submarines

An oscillating device for submarine models was built in order to test hydrodynamical model characteristics. The device is equipped with a hydraulic driving system in order to allow oscillations with different time dependent functions (sinusoidal, triangular and block form).

83-1650

Development of New Nondestructive Testing Techniques for Use in Bladed-Disk Dynamics Research

K.G. Harding and J.S. Harris

Res. Inst., Dayton Univ., OH, Rept. No. UDR-TR-82-46, AFWAL-TR-82-2081, 135 pp (Sept 1982)

AD-A122 403

Key Words: Nondestructive tests, Testing techniques, Blades, Disks

This program investigated the feasibility of using moire, speckle interferometry, and multiple wavelength contouring in conjunction with the real-time optical derotation system currently in use.

83-1651

Dynamic Testing with the NSWC Three-Degree-of-Freedom Gas Bearing

F.J. Regan

Naval Surface Weapons Ctr., Silver Spring, MD, Rept. No. NSWC/TR-81-491, SB1-AD-F500 085, 138 pp (Mar 8, 1982)

AD-A120 828

Key Words: Bearings, Gas bearings, Test facilities

This report presents the design, construction and operational procedures of the NSWC three-degree-of-freedom-gas-bearing. The data reduction technique that is used with angular measurements from this support is developed and applied to measured wind tunnel data. These wind tunnel data were obtained from non-ablating and ablating models undergoing dynamic motion in the NSWC hypersonic wind tunnel. Test results are compared with earlier experiments with dynamic ablating models and theoretical speculations.

DIAGNOSTICS

83-1652

A Review of Spike Energy Measurement - 1979 to 1982

K.G. Braithwaite

IRD Mechanalysis Ltd., 333 Barton Street E., Stoney Creek, Ontario, Canada, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc.

Comm. on Propulsion, Natl. Res. Council Canada, 10 pp, 5 figs, 6 refs

Key Words: Spike energy method, Diagnostic techniques, Diagnostic instrumentation

A battery-operated periodic checking instrument to measure spike energy in machinery diagnostics is presented. Spike energy detection circuits which are built into the instrument are designed to sense the amplitude of the microsecond range pulses caused by impacts between bearing elements with microscopic flaws. A bearing severity chart aids in translating meter readings into a measurement of condition. A survey of Canadian industries using the instrument is also included.

83-1653
Diagnosis and Correction of Vibration Problems in Rotating Machinery Systems
N.F. Rieger
Stress Technology Inc., Rochester, NY, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 40 pp, 23 figs, 7 tables, 13 refs

Key Words: Diagnostic techniques, Torsional vibration, Rotors, Blades, Case histories

This paper contains information and guidance based on practical experience for the solution of vibration problems of rotating machinery. The principal problem areas of rotating machinery are classified as rotor vibrations, torsional vibrations, and blading vibrations. For convenient referral, causes of such problems are arranged with typical cures in tabular form. The characteristics in common of each problem area are discussed. A case history drawn from practice is presented for each problem area, to demonstrate that a general methodology exists for diagnosis and correction of such problems.

BALANCING

(Also see Nos. 1505, 1686)

83-1654
High Speed Balancing at P & WC
Y. Caron
Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 16 pp, 9 figs

Key Words: Balancing techniques

Some rotors in new engine designs require high speed balancing. The procedure and the facility that were developed for this purpose are explained. Some test results are shown that indicate the success of the technique in practice.

83-1655
Dynamic Balancing Flexible Rotors in Soft Bearing Balance Stands
S. Mugford
Kadon Electro Mechanical Services Ltd., Calgary, Alberta, Canada, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 16 pp, 4 figs

Key Words: Balancing techniques, Dynamic balancing, Flexible rotors

Techniques used in solving resonance vibration problems, in particular flexible shaft dynamic balancing, are identified.

MONITORING

(Also see No. 1686)

83-1656
Bearing Lubricant Interface Monitoring Using Composite Signature Analysis
H.E. Hunter and D.C. Hunter
ADAPT Service Corp., Reading, MA, Rept. No. ADAPT-82-5, 124 pp (Sept 1982)
AD-A122 146

Key Words: Monitoring techniques, Aircraft engines, Signature analysis

This report presents the results of the feasibility phase or Phase I of a defense small business advance technology program (DESAT). The ultimate objective of the program is to improve and simplify engine failure prediction. This is to be accomplished by developing a series of objective algorithms which can use the results of standard engine monitoring measurements applicable to the bearing lubricant interface to detect, identify and estimate the remaining life of worn engine components.

83-1657
Shaft Crack Detection

A. Muszynska

Bently Nevada Corp., Minden, NV 89423, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 48 pp, 32 figs, 25 refs

Key Words: Shafts, Crack detection, Monitoring techniques

The paper suggests the on-line monitoring of 1x and 2x vibrations of rotors as a method of shaft crack detection. The analytical relationships for nonsymmetrical shafts (affected by gaping or breathing cracks), rotating in nonsymmetrical pedestals were compared with the experimental results, performed on a rotor rig with a shaft saw cut, simulating a crack. The conclusion concerning applicability of the mathematical models is drawn: the simplified model which includes only symmetric pedestal characteristics describes the observed phenomena with sufficient accuracy. Basic relationships between the maximum 1x or 2x response amplitudes and the shaft stiffness ratio (with damping as a parameter) are given.

83-1658
A Review of Rolling Element Bearing Health Monitoring (I)

P.Y. Kim and I.R.G. Lowe

Engine Lab., Natl. Res. Council Canada, Ottawa, Ontario, Canada, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 34 pp, 11 figs, 57 refs

Key Words: Monitoring techniques, Rotors, Bearings, Railway wheels, Axles

The objective of this report is to conduct a literature survey and make recommendations as to the most effective of current rolling-element-bearing health monitoring techniques and to outline problems associated with the application of these techniques to railway axle bearings. A research program to verify or develop suitable techniques for the railway environment is outlined.

83-1659
Cost Effective Continuous Monitoring of General Purpose Rotating Machinery

D.E. Bently and R.G. Harker

Bently Nevada Corp., Minden, NV, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 10 pp, 13 figs, 2 tables

Key Words: Monitoring techniques, Transducers, Signal processing techniques, Data processing

Some economically viable options of continuous monitoring of general purpose machinery are explored. They include the areas of transducers, signal treatment, monitoring and data acquisition.

83-1660
Machinery Vibration Limits and Dynamic Structural Response

B.C. Howes

Beta Machinery Analysis Ltd., Calgary, Canada, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 23 pp, 21 figs, 5 refs

Key Words: Monitoring techniques, Rotors, Case histories

Changes in case vibration readings are used to monitor rotating machinery condition. Absolute levels of vibration are indications of condition except where structural resonances (bearing housings or motor bases) amplify vibrations at certain frequencies (usually integer multiples of shaft speed). Dynamic response at vibration test points can be measured on new installations to assist in establishing standards for absolute vibrations. Case histories are included.

83-1661
Hydroelectric Generating Unit Vibration Monitor for Bearing Protection and "Rough Load Zone" Indication

D.E. Franklin

B.C. Hydro and Power Authority, 12388 88th Ave., Surrey, BC V3W 7R7, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 25 pp, 7 figs

Key Words: Monitoring techniques, Power plants (facilities), Hydroelectric power plants

A monitoring system for the determination and identification of rough operating zone of a vertical shaft Francis type hydraulic turbine is presented. A secondary function of the monitoring system is to provide dynamic data for a preventive maintenance program.

namics and output disturbances were investigated. The class of adaptive algorithms considered are those commonly referred to as model reference adaptive control algorithms, self-tuning controllers, and dead beat adaptive controllers, developed for both continuous-time systems and discrete-time systems. A unified analytical approach was developed to examine the class of existing adaptive algorithms.

ANALYSIS AND DESIGN

ANALYTICAL METHODS

(Also see No. 1671)

83-1662

Dynamic Stress Concentration Around a Circular Hole in an Infinite Elastic Strip

S. Itou
Dept. of Mech. Engrg. and Energy, Hachinohe Inst. of Tech., Hachinohe 031, Japan, J. Appl. Mech., Trans. ASME, 50 (1), pp 57-62 (Mar 1983) 4 figs, 2 tables, 8 refs

Key Words: Strips, Elastic properties, Hole-containing media

Transient response of an infinite elastic strip with a circular hole is investigated in this study. A normal stress is suddenly applied and maintained at the hole. The boundary condition equations are satisfied in the Laplace transformed domain. A numerical Laplace inversion technique is then used to recover the time dependence of the solution.

83-1663

Adaptive Control in the Presence of Unmodeled Dynamics

C.E. Rohrs
Lab. for Information and Decision Systems, Massachusetts Inst. of Tech., Cambridge, MA, Rept. No. LIDS-TH-1254, NASA-CR-169525, 409 pp (Nov 1982)
N83-13865

Key Words: Algorithms, Control equipment

Stability and robustness properties of a wide class of adaptive control algorithms in the presence of unmodeled dy-

83-1664

Control Systems Design for Uncertain Dynamical Systems

D.H. Owens and A. Chotai
Dept. of Control Engrg., Sheffield Univ., UK, Rept. No. RR-189, 10 pp (May 1982)
N83-13867

Key Words: Control equipment, Design techniques, Computer-aided techniques, Graphic methods

The use of approximate plant models for computer-aided controller design for multivariable systems with uncertain or unknown dynamic model is considered. The techniques incorporate observed differences in plant/model time-response characteristics into the design process using graphical techniques similar to the inverse Nyquist array. The techniques were used to design loop controllers for a two input-two output liquid storage system and proportional controllers for a four intput-four output boiler furnace system, using a diagonal approximate model.

83-1665

Singular Perturbations and a Mapping on an Interval for the Forced Van der Pol Relaxation Oscillator

J. Grasman, H. Nijmeijer, and E.J.M. Veling
Mathematisch Centrum, Amsterdam, The Netherlands, Rept. No. MC-TW-221/82, 32 pp (Mar 1982)
N83-13893

Key Words: Van der Pol method

The Van der Pol relaxation oscillator with a large sinusoidal forcing term is discussed. By using singular perturbation techniques, asymptotic solutions of such a system are constructed. These asymptotic approximations are locally valid and take the form of a two time scale expansion in one region and a boundary layer type of solution in the next region. Integration constants are determined by averaging and matching conditions. From these local solutions, a difference equation is constructed.

83-1666

Analysis of Periodic Oscillators Using a Time Transformation Approach

M.N.J. Hamdan
Ph.D. Thesis, Washington State Univ., 140 pp (1982)
DA8301306

Key Words: Nonlinear systems, Single degree of freedom systems, Periodic response

The advantages and limitations of a recently devised quantitative method for the analysis of periodic nonlinear systems are explored. The basic idea of the method is to seek a transformation T(t) of the time t such that in the T domain the motion is simple harmonic, with the result that the dependent variable power series expansion used in the classical perturbation methods is obviated. The method has been successfully generalized and applied to the analysis of both weakly and strongly nonlinear phenomena of the following types: free oscillation of conservative single degree of freedom systems, limit cycling of nonconservative single degree of freedom systems and response of single degree of freedom systems to step and harmonic loading.

83-1667

Dynamical Systems of Classical Mechanics with Hidden Symmetry

A.M. Perelomov
Gosudarstvennyi Komitet po ispol'zovaniyu Atomnoi Energii USSR, Moscow. Inst. Teoreticheskoi i Eksperimental'noi Fiziki, Rept. No. ITEF-822, 55 pp (1981)
DE82701377
(In Russian)

Key Words: Dynamic systems

Theory of dynamical systems of classical mechanics, having a hidden symmetry is considered. Systems with a large number of motion integrals are considered. It is shown that the use of the theoretically-group approach permits in a number of cases to obtain explicit solutions.

83-1668

Dynamics of Asymmetric Nonconservative Systems

D.J. Inman
Dept. of Mech. and Aerospace Engrg., State Univ. of New York at Buffalo, Buffalo, NY 14260, J. Appl. Mech., Trans. ASME, 50 (1), pp 199-203 (Mar 1983) 14 refs

Key Words: Lumped parameter method, Asymmetry

This work examines a linear, asymmetric lumped parameter system. Results on the qualitative behavior of a certain subclass of such systems are presented. In particular, necessary and sufficient conditions for the existence of a linear transformation that transforms an asymmetric system into an equivalent symmetric system are derived. Results on the stability and instability of such systems are presented and stated in terms of the original asymmetric system's coefficient matrices.

83-1669

Natural Frequencies of the Dynamic Models of Machinery with Variable Parameters

V. Veytz, N. Vitalyeva, and A. Kochura
VTUZ pri proizvodstvennom obedinenii "Leningradskorii metallicheskii zavod," USSR, Vibrotechnika, 4 (34), pp 41-48 (1981) 3 figs, 5 refs
(In Russian)

Key Words: Spectrum analysis, Variable material properties

Natural frequencies of multidimensional dynamic models of machinery with variable elasto-inertial parameters is considered. An algorithm for calculating the natural frequencies of machinery, obtained by varying the coefficient of inertia and the stiffness coefficient of one of the concentrated masses, is proposed.

83-1670

Dynamic Response of Linear Structures to Correlated Random Impulses

R. Iwankiewicz and K. Sobczyk
Inst. of Civil Engrg., Technical Univ. of Wroclaw, Wybrzeze Wyspianskiego 27, 50-370 Wroclaw, Poland, J. Sound Vib., 86 (3), pp 303-317 (Feb 8, 1983) 7 figs, 2 tables, 17 refs

Key Words: Modal analysis, Linear systems, Random excitation

A systematic analysis of the dynamic response of linear continuous structures to randomly arriving impulses is presented. A counting (or point) process characterizing the considered stream of impulses is described by the product

density functions of degree one and two. By making use of a normal mode approach and assuming specific forms for the product densities (characterizing the expected arrival rate of the impulses and their correlation) the formulae for the variances and cross-covariances of modal responses are derived. The variance of the plate response is obtained and discussed for different practical situations and the results are shown graphically.

NONLINEAR ANALYSIS

83-1671

A General Solution Strategy for Large Scale Static and Dynamic Nonlinear Finite Element Problems Employing the Element-by-Element Factorization Concept

I. Levit
Ph.D. Thesis, California Inst. of Tech., 135 pp (1983) DA8302610

Key Words: Finite element technique, Nonlinear systems

It is proposed to solve large-scale finite-element equation systems arising in structural and solid mechanics by way of an element-by-element approximate factorization technique which obviates the need for a global coefficient matrix. The procedure has considerable operation count and I/O advantages over direct elimination schemes and it is easily implemented. Numerical results demonstrate the effectiveness of the method and suggest its potential for the analysis of large-scale systems.

83-1672

Component Mode Analysis of Nonlinear, Nonconservative Systems

B.H. Tongue and E.H. Dowell
Dept. of Mech. and Aerospace Engrg., Princeton Univ., Princeton, NJ 08544, J. Appl. Mech., Trans. ASME, 50 (1), pp 204-209 (Mar 1983) 5 figs, 1 table, 9 refs

Key Words: Nonlinear theories, Periodic response, Transient response

A method for attacking coupled linear-nonlinear problems is developed. This method allows one to express the equations of motion with a number of equations proportional to the number of nonlinear constraints on the system rather than to the number of linear modes of the system. Both steady state and transient solutions are investigated for a system possessing cubic nonlinearities.

NUMERICAL METHODS

83-1673

Damping and Phase Analysis for Some Methods for Solving Second-Order Ordinary Differential Equations

I. Gladwell and R.M. Thomas
Dept. of Mathematics, Univ. of Manchester, Manchester, UK, Intl. J. Numer. Methods Engrg., 19 (4), pp 495-503 (Apr 1983) 1 fig, 11 refs

Key Words: Numerical analysis, Damping coefficients, Phase data

Numerical methods are considered for initial value problems for second-order systems of ordinary differential equations. Conditions are discussed which ensure an oscillatory numerical solution and the desirability of such a property. Conditions which ensure that the numerical forced oscillation is in phase with the true forced oscillation are derived. To illustrate the theory the damping and phase properties of some frequently used methods are considered.

OPTIMIZATION TECHNIQUES

(Also see Nos. 1545, 1592, 1634, 1683)

83-1674

Optimal Design of a Structure for System Stability for a Specified Eigenvalue Distribution

N.S. Khot
Structures and Dynamics Div., Flight Dynamics Lab., Wright-Patterson Air Force Base, OH 45433, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 1-(3-10), 2 figs, 9 tables, 13 refs

Key Words: Optimum design

A method based on the optimality criterion approach is presented to design a minimum weight structure with constraints on system stability. The stability constraints are

stated with the requirement that the critical eigenvalues be seperated by a specified interval and the critical buckling mode be the preselected one. The use of the method is illustrated by solving sample problems.

83-1675
Optimum Structural Designs in Dynamic Response
H. Yamakawa
Science and Engrg. Faculty, Waseda Univ., Tokyo, Japan, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1982, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 2-(1-9), 18 figs, 3 tables, 20 refs

Key Words: Optimum design, Beams, Framed structures, Dynamic response

Two methods of optimum structural design in dynamic response are presented and the validity and effectiveness of the methods are revealed by several numerical examples.

83-1676
Structural Optimization on Geometrical Configuration and Element Sizing with Statical and Dynamical Constraints
J.H Lin, W.Y. Che, and Y.S. Yu
Engrg. Mech. Inst., Dalian Inst. of Tech., Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 2-(11-19), 6 figs, 4 tables, 18 refs

Key Words: Optimum design, Minimum weight design, Dynamic response

A bi-factor α-β algorithm based on Kuhn-Tucker criteria about the minimal weight design of a structure under statical and dynamical constraints is presented. Among the constraints, frequency prohibited band is a new formulation which demands any characteristic frequency of the structure not to fall into a given frequency region.

83-1677
An Iterative Eigenvector Technique for Optimization Analysis
P.S. Jensen
Lockheed Palo Alto Res. Lab., 5233/255, 3251 Hanover St., Palo Alto, CA 94304, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 2-(27-31), 9 refs

Key Words: Optimization, Eigenvalue problems

Certain structural optimization analyses require the repeated generation of sparse, symmetric linear systems of equations for which a few eigenpairs (eigenvalues and corresponding eigenvectors) are to be determined. Typically, these linear systems have similar spectra. Consequently, eigenpairs for one system tend to be reasonably close approximations to those of another next linear system. An iterative eigenvector analysis technique that utilizes the available approximate eigenpairs in order to reduce computation costs is described. It is based on Rayleigh quotient iteration with a Lanczos type iterative equation solver.

83-1678
Optimum Structural Design under Dynamic Forces with Uncertainties
K. Matsui, K. Yamamoto, Y. Kikuta, and Y. Niinobe
Tokyo Denki Univ., Hatoyama, Hiki, Saitama 350-03 Japan, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 2-(33-40), 13 figs, 3 tables, 27 refs

Key Words: Optimum design, Dynamic response

An optimization algorithm is presented on a structure which sustains a time dependent force from an indefinite direction. Stresses and displacements are given by parametric forms of both time and direction of force. The direction is treated as an uncertainty and is referred to as an environmental parameter. The optimization procedure consists of two alternating processes of maximization and minimization. The maximization is carried out analytically and the minimization process by a gradient projection method. As example problems three truss structures are considered.

83-1679
Interactive Optimal Design of Dynamically Loaded Structures Using the OPTNSR Software System
R. Balling, M.A. Bhatti, V. Ciampi, and K.S. Pister

Dept. of Civil Engrg., Univ. of California, Berkeley, CA 94720, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 12-(9-17), 12 figs, 1 table, 8 refs

Key Words: Optimum design, Dynamic response, Computer programs

Some typical applications of optimization techniques to the design of nonlinear structures subjected to dynamic loadings are presented. The applications are based on the use of the interactive software system OPTNSR, described in a companion paper.

83-1680
Optimal Finite Element Discretization -- A Dynamic Programming Approach
Y. Seguchi, M. Tanaka, and Y. Tomita
Dept. of Systems Engrg., Kobe Univ., Rokkodai, Nada, Kobe 657, Japan, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22, 1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 13-(13-19), 8 figs, 2 tables, 11 refs

Key Words: Optimization, Finite element technique, Dynamic programming

An investigation from the topological aspect of the optimal finite element idealization is carried out for the linear elastic system. The criterion for the topological optimization is based on the minimization of the total potential energy, the Rayleigh quotient, and the energy quotient for the static equilibrium, free vibration, and Euler buckling problems, respectively.

DESIGN TECHNIQUES
(See No. 1681)

COMPUTER PROGRAMS
(Also see Nos. 1679, 1693)

83-1681
A Revision of the Dynamic Design-Analysis Method (DDAM) in NASTRAN
M.M. Hurwitz
David W. Taylor Naval Ship Res. and Dev. Ctr., Bethesda, MD, Rept. No. DTNSRDC-82/107, 26 pp (Dec 1982)
AD-A122 566

Key Words: DDAM (computer program), Computer programs, Finite element technique, Design techniques, Shipboard equipment response, Shock resistant design

This report describes the theory, implementation, and use of the dynamic design-analysis method (DDAM) in the NASTRAN finite element structural analysis computer program. DDAM is the procedure used in the shock design of shipboard equipment. Since such equipment is also frequently analyzed with NASTRAN, the inclusion of DDAM in NASTRAN greatly enhances the efficiency of the design-analysis process.

83-1682
WONDY V: A One-Dimensional Finite-Difference Wave-Propagation Code
M.E. Kipp and R.J. Lawrence
Sandia Natl. Labs., Albuquerque, NM, Rept. No. SAND-81-0930, 222 pp (June 1982)
DE82019807

Key Words: Computer programs, Wave propagation, Finite difference technique

WONDY V solves the finite difference analogs to the Lagrangian equations of motion in one spatial dimension (planar, cylindrical, or spherical). Simulations of explosive detonation, energy deposition, plate impact, and dynamic fracture are possible, using a variety of existing material models. In addition, WONDY has proven to be a powerful tool in the evaluation of new constitutive models. This document provides a description of the equations solved, available material models, operating instructions, and sample problems.

83-1683
An Interactive Software System for Optimal Design of Statically and Dynamically Loaded Structures with Nonlinear Response
M.A. Bhatti, V. Ciampi, K.S. Pister, and E. Polak
Univ. of California, Berkeley, CA 94720, Optimum Structural Design, Proc. of Intl. Symp., the 11th ONR Naval Structural Mechanics Symp., Oct 19-22,

1981, Tucson, AZ. Spons. by U.S. Office of Naval Res. and Univ. of Arizona, pp 12-(1-8), 2 figs, 17 refs

Key Words: Computer programs, Graphic methods, Optimum design, Dynamic response

The paper describes an interactive software system, OPTNSR, for optimal design of structures. It permits one to stop, restart or modify any of the parameters as the computation progresses. This results in substantial savings, not only in computing time, but also in overall time needed to carry out a design. An additional advantage of an interactive system using computer graphics is that it can be used as a tool to familiarize designers with optimization techniques.

83-1684

Structural Dynamics Payload Loads Estimates: User Guide

T.G. Shanahan and R.C. Engels

Martin Marietta Aerospace, Denver, CO, Rept. No. MCR-82-602, NASA-CR-170682, 179 pp (Sept 1982)

N83-13496

Key Words: Computer programs, Launch vehicles

This user guide gives an overview of an integration scheme to determine the response of a launch vehicle with multiple payloads. Chapter II discusses the software package associated with the integration scheme together with several sample problems. A short cut version of the integration technique is also discussed. The guide concludes with a list of references and the listings of the subroutines.

GENERAL TOPICS

CONFERENCE PROCEEDINGS

83-1685

Proceedings of the International Symposium on Shock Tubes and Waves (13th), Niagara Falls, July 6-9, 1981

C.E. Treanor and J.G. Hall

Calspan Advanced Technology Ctr., Buffalo, NY, Rept. No. AFOSR-TR-82-1031, 864 pp (July 1981)

AD-A122 200

Key Words: Proceedings, Shock waves, Shock wave propagation, Shock tube testing

This volume contains six invited papers and ninety-two contributed papers presented at the XIII International Symposium on Shock Tubes and Waves, which was held in Niagara Falls, NY, July 6-9, 1981. Professor I.I. Glass of the University of Toronto presented the Paul Vieille Memorial Lecture. This paper and five other invited papers form Part I of the Proceedings. The contributed papers are presented in Parts II through VII, divided according to subject matter. The typical broad range of interests associated with shock waves is demonstrated in both the invited and and contributed papers, with subject material covering viscous aerodynamics, explosions, chemistry, optics, and energy-related processes. It is intended that this volume provide an up-to-date accounting of international progress in these fields insofar as shock-wave phenomena are involved.

83-1686

Machinery Dynamics Seminar

Proc. of the 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. by Machinery Dynamics Sub-Committee, Assoc. Committee on Propulsion, Natl. Res. Council of Canada

Key Words: Machinery, Proceedings, Balancing techniques, Monitoring techniques, Diagnostic techniques, Standards and codes

At the seminar particular emphasis was placed on the following topics: rotor dynamics and balancing, vibration standards and monitoring practices, and vibration modeling and diagnosis.

TUTORIALS AND REVIEWS

(Also see No. 1513)

83-1687

Introduction to Structural Dynamics with Applications

D.W. Coats, R.C. Murray, and T.A. Nelson

Lawrence Livermore Natl. Lab., Livermore, CA,

Rept. No. UCID-19408, 150 pp (May 1982)
DE82016326

Key Words: Vibration analysis, Reviews

The basic principles used in dynamic analysis of structures are developed. The topics covered range from free vibration of single-degree-of-freedom systems to forced vibration response of multi-degree-of-freedom systems. Example problems are presented to illustrate various solution techniques and show how they may be applied to practical problems. The text is made to accompany a course in structural dynamics given by the authors at the Lawrence Livermore National Laboratory.

83-1688
Digital Synthesis of Response-Design Spectrum Compatible Earthquake Records for Dynamic Analyses
P.-T. D. Spanos
Univ. of Texas at Austin, TX 78712, Shock Vib. Dig., 15 (3), pp 21-30 (Mar 1983) 4 figs, 50 refs

Key Words: Reviews, Earthquake resistant structures, Digital simulation

Methods of digital synthesis (simulation) of earthquake records that are compatible with a target (specified) response-design spectrum are reviewed. The target spectrum can be specified either deterministically or stochastically. Some aspects of this problem that could receive additional attention are presented. The usefulness of a target spectrum-based approach to the design of earthquake resistant structures is addressed.

83-1689
Finite Difference Methods in Vibration Analysis
R. Ali
Dept. of Transport Tech., Univ. of Tech., Loughborough, Leicestershire LE11 3TU, UK, Shock Vib. Dig., 15 (3), pp 3-7 (Mar 1983) 22 refs

Key Words: Reviews, Finite difference technique, Beams, Plates, Shells

Literature concerned with the application of the finite difference technique to the analysis of natural vibration of engineering components is reviewed. The review covers the period from 1978 to 1982 and concentrates on the analysis of beams, plates, and shells. A brief introduction to the finite difference technique is included.

83-1690
Dynamic Applications of Piezoelectric Crystals. Part I: Fundamentals
M.C. Dokmeci
Istanbul Technical Univ., P.K. 9, Istanbul, Turkey, Shock Vib. Dig., 15 (3), pp 9-20 (Mar 1983) 173 refs

Key Words: Reviews, Piezoelectricity

This paper presents a review of current open literature pertaining to the dynamic applications of piezoelectric crystals. Representative theoretical and experimental papers cover waves and vibrations in piezoelectric one-dimensional and two-dimensional structural elements. New trends of research are pointed out for future applications of piezoelectric crystals.

83-1691
Dynamic Applications of Piezoelectric Crystals. Part II: Theoretical Studies
M.C. Dokmeci
Istanbul Technical Univ., P.K. 9, Istanbul, Turkey, Shock Vib. Dig., 15 (4), pp 15-26 (Apr 1983) 173 refs

Key Words: Reviews, Piezoelectricity

This paper presents a review of current open literature pertaining to the dynamic applications of piezoelectric crystals. Representative theoretical and experimental papers cover waves and vibrations in piezoelectric one-dimensional and two-dimensional structural elements. New trends of research are pointed out for future applications of piezoelectric crystals.

CRITERIA, STANDARDS, AND SPECIFICATIONS

(Also see No. 1686)

83-1692
Vibration Standards
G. Rasmussen
Bruel & Kjaer, 2850 Naerum, Denmark, Machinery Dynamics Seminar, Proc. 7th, Oct 4-5, 1982, Edmonton, Canada. Spons. Machinery Dynamics Sub-Committee, Assoc. Comm. on Propulsion, Natl. Res. Council Canada, 10 pp, 2 tables

Key Words: Standards and codes, Vibration measurement, Measurement techniques, Shock response

The object of standardization is according to ISO to facilitate exchange of goods and services. It is furthermore an important link in the development of mutual cooperation in the sphere of intellectual, scientific, technological and economic activity. This is especially true when we are dealing with international standardization. A list of current national and international standards within the area of vibration and shock measurements is presented.

BIBLIOGRAPHIES

83-1693

Structural Mechanics Software: NASTRAN. 1970 - 1982 (Citations from the NTIS Data Base)

NTIS, Springfield, VA, 284 pp (Dec 1982)
PB83-857664

Key Words: Computer programs, Bibliographies

This bibliography contains 250 citations concerning NASA's structural analysis technology. Computer software implementation and evaluation, transient analysis of linear and nonlinear structural dynamic systems, and mathematical modeling for structural mechanics are discussed. Applications include the space shuttle, turbofan engine blades, motor component vibrations, missiles and non-aerospace related analyses.

83-1694

Vibrational Analysis of Structures: Computer Applications. 1972 - 1982 (Citations from the International Aerospace Abstracts Data Base)

NTIS, Springfield, VA, 305 pp (Dec 1982)
PB83-858159

Key Words: Vibration analysis, Bibliographies

This bibliography contains 316 citations concerning structural engineering analyses of various shapes and bodies. Topics discuss various problems confronting engineers in the field of design, elasticity, and structural limitations, along with the use of computer technology to provide solutions and optimization. Mathematical models and available computer programs are included.

USEFUL APPLICATIONS

83-1695

Frequency Response Analysis of an Ocean Wave Energy Converter

M. Masubuchi and R. Kawatani

Dept. of Mech. Engrg. for Industrial Machinery, Faculty of Engrg., Osaka Univ., Osaka, Japan, J. Dynam. Syst., Meas. Control, Trans. ASME, 105 (1), pp 30-38 (Mar 1983) 8 figs, 13 refs

Key Words: Water waves, Energy conversion, Frequency response

A theoretical analysis is presented for the dynamic behavior and energy conversion efficiency of a wave energy converter which is oscillating and absorbing power in an incident sinusoidal wave train. The energy converter consists of two floating bodies which have different configuration and are connected by a rigid link. Basic equations governing the floating bodies contained in the energy converter are obtained by assuming two dimensional motions and by considering the interactions between the two bodies and hydrodynamic and damping forces, and they have been solved numerically by using Lewis form as the configuration of the floating bodies.

AUTHOR INDEX

TECHNICAL NOTES

S.M. Dickinson, S. Ilanko, and E.K.H. Li
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J. Sound Vib., 86 (1), pp 151-157 (Jan 8, 1983) 6 tables, 7 refs

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M.S. Hundal
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J. Sound Vib., 86 (3), pp 439-441 (Feb 8, 1983) 1 fig, 1 table, 3 refs

R. Parker
A Note on Frequency Ratios for Acoustic Resonances of Flat Plate Cascades with Plate Spacing Less than Half the Longitudinal Wavelength
J. Sound Vib., 86 (4), pp 594-596 (Feb 22, 1983) 2 figs, 3 refs

N. Popplewell, Y. Muzyka, C.N. Bapat, and K. McLachlan
Stable Periodic Motion of Multiple-Unit Impacting Mechanisms
J. Sound Vib., 86 (4), pp 587-593 (Feb 22, 1983) 3 figs, 13 refs

T. Irie, G. Yamada, and M. Sonoda
Natural Frequencies of Epicycloidal Plates
J. Sound Vib., 87 (3), pp 519-523 (Apr 8, 1983) 2 figs, 2 tables, 7 refs

CALENDAR

SEPTEMBER 1983

11-13 Petroleum Workshop and Conference [ASME] Tulsa, OK *(ASME Hqs.)*

11-14 Design Engineering Technical Conference [ASME] Dearborn, MI *(ASME Hqs.)*

12-15 International Off-Highway Meeting & Exposition [SAE] Milwaukee, WI *(SAE Hqs.)*

14-16 International Symposium on Structural Crashworthiness [University of Liverpool] Liverpool, UK *(Prof. Norman Jones, Dept. of Mech. Engrg., The Univ. of Liverpool, P.O. Box 147, Liverpool L69 3BX, England)*

25-29 Power Generation Conference [ASME] Indianapolis, IN *(ASME Hqs.)*

28-30 Rotating Machinery Vibration Symposium [Vibration Institute] Worcester, MA *(Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 W. 55th St., Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254)*

OCTOBER 1983

3-7 Advances in Dynamic Analysis and Testing [SAE Technical Committee G-5] SAE Aerospace Congress and Exposition, Long Beach, CA *(Roy W. Mustain, Rockwell Space Transportation and Systems Group, Mail Sta. AB97, 12214 Lakewood Blvd., Downey, CA 90241)*

3-7 SAE Aerospace Congress and Exposition [SAE] Long Beach, CA *(SAE Hqs.)*

17-19 Stapp Car Crash Conference [SAE] San Diego, CA *(SAE Hqs.)*

17-20 Lubrication Conference [ASME] Hartford, CA *(ASME Hqs.)*

18-20 54th Shock and Vibration Symposium [Shock and Vibration Information Center, Washington, DC] Pasadena, CA *(SVIC, Naval Research Lab., Code 5804, Washington, DC 20375)*

31-Nov 4 John C. Snowdon Vibration Control Seminar [Applied Research Lab., Pennsylvania State Univ.] University Park, PA *(Mary Ann Solic, 410 Keller Conference Center, University Park, PA 16802 - (814) 865-4591)*

NOVEMBER 1983

7-10 Truck and Bus Meeting and Exposition [SAE] Cleveland, OH *(SAE Hqs.)*

7-11 Acoustical Society of America, Fall Meeting [ASA] San Diego, CA *(ASA Hqs.)*

13-18 American Society of Mechanical Engineers, Winter Annual Meeting [ASME] Boston, MA *(ASME Hqs.)*

15-17 12th Turbomachinery Symposium [Turbomachinery Labs.] Houston, TX *(Dr. Peter E. Jenkins, Turbomachinery Laboratories, Dept. of Mechanical Engineering, Texas A&M University, College Station, TX 77843)*

FEBRUARY 1984

27-Mar 2 International Congress and Exposition [SAE] Detroit, MI *(SAE Hqs.)*

MARCH 1984

13-15 12th Symposium on Explosives and Pyrotechnics [Applied Physics Lab. of Franklin Research Center] San Diego, CA *(E&P Affairs, Franklin Research Center, Philadelphia, PA 19103 - (215) 448-1236)*

20-23 Balancing of Rotating Machinery Symposium [Vibration Institute] Philadelphia, Pennsylvania *(Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 W. 55th St., Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254)*

APRIL 1984

9-12 Design Engineering Conference and Show [ASME] Chicago, IL *(ASME Hqs.)*

9-13 2nd International Conference on Recent Advances in Structural Dynamics [Institute of Sound and Vibration Research] Southampton, England *(Dr. Maurice Petyt, Institute of Sound and Vibration Research, The University of Southampton, S09 5NH, England - (0703) 559122, ext. 2297)*

MAY 1984

7-11 Acoustical Society of America, Spring Meeting [ASA] Norfolk, VA *(ASA Hqs.)*

CALENDAR ACRONYM DEFINITIONS AND ADDRESSES OF SOCIETY HEADQUARTERS

AHS: American Helicopter Society
1325 18 St. N.W.
Washington, D.C. 20036

AIAA: American Institute of Aeronautics and Astronautics
1290 Sixth Ave.
New York, NY 10019

ASA: Acoustical Society of America
335 E. 45th St.
New York, NY 10017

ASCE: American Society of Civil Engineers
345 E. 45th St.
New York, NY 10017

ASME: American Society of Mechanical Engineers
345 E. 45th St.
New York, NY 10017

ASTM: American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103

ICF: International Congress on Fracture
Tohoku University
Sendai, Japan

IEEE: Institute of Electrical and Electronics Engineers
345 E. 47th St.
New York, NY 10017

IES: Institute of Environmental Sciences
940 E. Northwest Highway
Mt. Prospect, IL 60056

IMechE: Institution of Mechanical Engineers
1 Birdcage Walk, Westminster,
London SW1, UK

IFToMM: International Federation for Theory of Machines and Mechanisms
U.S. Council for TMM
c/o Univ. Mass., Dept. ME
Amherst, MA 01002

INCE: Institute of Noise Control Engineering
P.O. Box 3206, Arlington Branch
Poughkeepsie, NY 12603

ISA: Instrument Society of America
400 Stanwix St.
Pittsburgh, PA 15222

SAE: Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, PA 15096

SEE: Society of Environmental Engineers
Owles Hall, Buntingford, Hertz.
SG9 9PL, England

SESA: Society for Experimental Stress Analysis
21 Bridge Sq.
Westport, CT 06880

SNAME: Society of Naval Architects and Marine Engineers
74 Trinity Pl.
New York, NY 10006

SPE: Society of Petroleum Engineers
6200 N. Central Expressway
Dallas, TX 75206

SVIC: Shock and Vibration Information Center
Naval Research Lab., Code 5804
Washington, D.C. 20375