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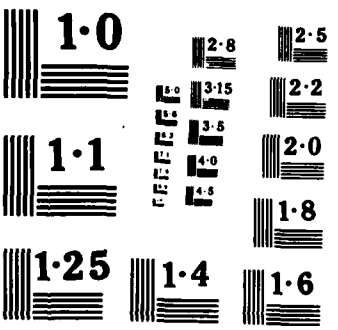
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MECHANICAL, AEROSPACE AND
NUCLEAR ENGINEERING DEPARTMENT
SCHOOL OF ENGINEERING AND APPLIED SCIENCE
LOS ANGELES, CALIFORNIA 90024

January 24, 1985

Director
BMD Advanced Technology Center
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P.O. Box 1500
Huntsville, Alabama 35807

Ballistic Missile Defense Program Office
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AMC Building, 7th Floor
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Alexandria, VA 22333

Defense Technical Information Center
Cameron Station
Alexandria, VA 22314

Dear Sirs:

This constitutes the FINAL TECHNICAL REPORT on our research contract

Advances in Technology Development for
Exoatmospheric Research

Contract No. DASG 60-82-C-0007

Basically, it consists of a listing of the many Technical Reports submitted during this research effort.

1. "Detection of BMD Target Vehicles in Midcourse Through Advances in Signal Processing Techniques for Sensors Such as Focal Plane Arrays," by R.E. Fountain.

2. "Target Detection and Tracking in a Dense BMD Threat Target Environment through Advances in Multi-Object Estimation, An Important Technology Development for Advanced BMD Systems," by O.E. Drummond.

3. "Dynamic Programming Using Singular Perturbations, A New Technique for Control and Guidance and Control of BMD Systems," by K.V. Krikorian and C.T. Leondes.

4. "Advances in Computational Methods for Nonlinear Differential Games and Their Application to Ballistic Missile Defense Systems Problems," by R.M. Vought.

5. "Decentralized Control of Discrete Time Systems With Incomplete Information."

   Presents important new results on coordinated Command and Control for exoatmospheric intercept.

6. "New Smoothing Algorithms For Dynamic Systems With or Without Interface (Decoys)."

   Presents major new results for exoatmospheric filtering in a dense target environment with decoys.

7. "Multistage Stochastic Linear Differential Games With Decision Time Constraint."

   Presents significant new results on exoatmospheric intercept guidance and control laws.

8. "Minimal Order Observer for Linear Stochastic Time Delay Systems."

   Presents results of great importance to the time delay problem so troublesome in past and possibly future exoatmospheric systems.

9. "A Sub-optimum Decoding Based Smoothing Algorithm for Dynamic Systems With or Without Interference (decoys)," by Kerim Demirbas and C.T. Leondes.

   This report presents newly developed significant target detection and tracking techniques in a dense target plus decoys environment, so important to exoatmospheric intercept.

10. "On Discrete Time Riccati Like Matrix Difference Equations With Random Coefficients," by H. Panossian and C.T. Leondes.

    Presents new and fundamentally important techniques for the analysis and synthesis or design of exoatmospheric intercept vehicle systems.

11. "A Stack Sequential Decoding Based Smoothing Algorithm for Dynamic Systems With Interference," (decoys), by Kerim Demirbas and C.T. Leondes.

    Presents powerful new results on dense target plus decoys detection and tracking so important for exoatmospheric intercept.

12. "A Stack Sequential Decoding Based Smoothing Algorithm for Dynamic Systems," by Kerim Demirbas and C.T. Leondes

    This report continues, extends, and supplements the results in reports 9 and 11 above.

13. "New Smoothing Algorithms for Dynamic Systems With or Without Interference (Decoys)," by Kerim Demirbas.

    This rather substantial report presents new and rather powerfully effective techniques for target discrimination in a dense (including decoy, counter measure techniques, etc.) environment.

14. "Estimated Control of Large Scale Systems," by F. Kianfar.

    Command and Control for decentralized but coordinated centers is a major ballistic missile defense systems issue and this report presents a number of significant new results and techniques here.

15. "Developing Practical Filters For Nonlinear Systems Using a New Approach," by Hosam E. Emara-Shabaik.

    The thrust towards NNK mandates the development of

    "0 C.E.P." or "0 Covariance"

    systems in a dynamic maneuvering environment. P_k improvement or CEP reduction is essential, in any event. This very substantial report presents some major new results in this area.

16. "Observer Theory In Optimal Control For Systems With Time Delays," by H. Hashemi and C.T. Leondes.

17. "Sensitivity Analysis of Optimal Ballistic Missile War Strategies."

    A unique analysis of many issues fundamental to the definition, analysis, and design of ballistic missile defense systems.

18. "Game Theoretic Missile War Strategies."

    A unique analysis/report of many issues fundamental to the definition, analysis, and design of Ballistic Missile Defense systems.

19. "Suboptimal Control of Linear Tracking Systems with Delays."

    A perennial problem in ballistic missile defense systems and this report presents a number of results essential to the analysis, synthesis, guidance and control, etc., of such systems.

20. "Application of Observer Theory to a Track-While-Scan Problem in a (Dense) Multi-Target Environment."

    Substantive results in a perennial ballistic missile problem area, target detection and tracking in a possible dense (decoy, etc.) environment.

21. "Target Tracking in the Presence of Interference."

22. "An Identification Algorithm for Linear Stochastic Systems with Time Delays."

23. "Advances in Technology for Command and Control/Battle Management Through the Development of Advances in Decentralized but Coordinated Control Systems" -- (Large Scale Systems: Performance Evaluation Under Decentralization), by Dr. Massoud Sinai.

24. "Advances In BMD Systems Performance Improvement Through P_k Improvement, That Is, BMD System Covariance Matrix Minimization" -- (A New Discrete Nonlinear Filter With Convergence Analysis When It Is Used as a Parameter Estimator), by Dr. Yves Masse.

25. "Advances in BMD Control Systems Design When the BMD System's Parameters are a Function of the System's State and Control Vector" - (Optimal Adaptive Stochastic Control of Linear Dynamical Systems with Multiplicative and Additive Noise), by Dr. H.V. Panossian.

26. "Advances in Techniques to Significantly Improve the P_k of Advanced Intercept Vehicles and Directed Energy Intercept Systems," by Hosam E. Emara-Shabaik and C.T. Leondes.

27. "Advances in Technology for the Analysis and Synthesis of Advanced Intercept Vehicles and Directed Energy Intercept Systems Through Dynamic Programming Using Singular Perturbations," by K.V. Krikorian and C.T. Leondes.

28. "Application of Singular Perturbations to Optimal Control in Order to Develop Simpler Very Highly Effective Advanced Intercept Vehicles and Directed Energy Intercept Systems," by Kapriel V. Krikorian.

29. "Advances in Techniques for the Control of Intercept Vehicles and Directed Energy Intercept Systems Whose Parameters Depend Stochastically on the State and Control Vectors," by Hagop Panossian and C.T. Leondes.

30. "A Differential Game Approach to Optimal Strategies in a Ballistic Missile War -- A fundamental Issue in the Definition of Effective Ballistic Missile Defense Systems."

31. "Advances in Techniques for Dynamic Detection & Sequential Allocation of Intercept Vehicles, an Issue of Fundamental Importance to Battle Management Issues in Ballistic Missile Defense Systems.

32. "Advances in the Technology for Detection in Centralized and Decentralized Systems; A Fundamental Issue in Surveillance Issues for the SDI Program."

33. "Predictive Guidance for Systems with Controllability Index N; A Technology Advance of Fundamental Importance for the Guidance & Control of DE or Intercept Vehicle Systems in Ballistic Missile Defense.

34. "Ongoing Deadbeat Observers for Linear-Time Varying Systems; A Technology Advance in Computationally Attractive Design Methods for Advanced Guidance and Control Systems for Ballistic Missile Defense Systems.

35. "The Design of a Class of Robust Observers for Use in Parameter Estimation; An Essential Technology Advance for Guidance & Control for Ballistic Missile Defense Systems Parameter Estimation for Systems Whose Entire State Cannot be Measured."

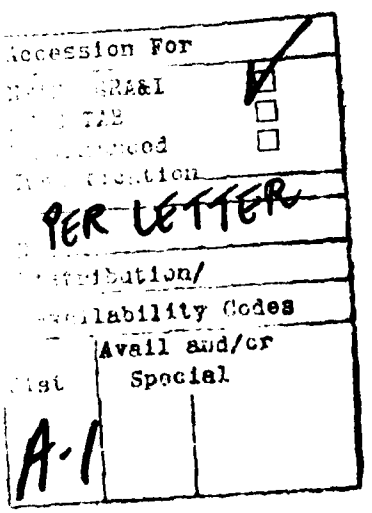
36. "Implementing Given Compensators in Estimator-Controller Form; A Technology Advance of Fundamental Importance for Guidance and Control as Well as Command & Control in Ballistic Missile Defense Systems."

Thank you very much.

Sincerely,

C.T. Leondes
Professor of Engineering and
Applied Science

CTL:jcp
cc: Hardy Dhillon
Catherine W. Higdon



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