During the 1990 fiscal year, this project was transferred to the ONR-ARI on Bubbly Flows. Work completed or initiated during the course of this project to date includes:

(1) Studies of the dynamics of incompressible gas bubbles in time-dependent flows. We have carried out a combination of analytical and numerical studies that have identified conditions for bubble break-up in both steady and time-dependent flows; the influence of bubble deformation on the natural oscillation frequency of various deformation modes; and the onset of chaotic oscillations of shape (that lead to breakup) in both periodic and quasi-periodic flows.

References:

(2) Studies of the dynamics of Rayleigh-Plesset bubbles in time-dependent pressure oscillations. Specifically, we have used a simple dynamical systems approach to identify conditions for transition of an ideal gas bubble from regular periodic oscillations of volume in response to periodic pressure fluctuations, to a fully chaotic response. The corresponding sound produced in the far-field is then characterized by broad-band "noise."

We have initiated studies of the **coupling** between flow, and shape and volume oscillations of an ideal gas bubble. This important topic will include both numerical and analytical studies aimed specifically at understanding conditions for and consequences of resonant coupling between deformation modes and the volume (or "breathing") mode that is responsible for far-field sound. The first comprehensive study of this type has been completed over the past year, using analytical methods to study bubble response to a **pressure impulse**, and a **pressure step**, both in the presence of mean deformation due to flow of the surrounding fluid. We have also worked to refine numerical methods so that they can provide reliable long-time solutions without excessive numerical dissipation.


**Meetings Attended/Presentations 1990-1991**

**Invited Speaker:** Stanley Corrsin Lectureship in Fluid Mechanics, Department of Chemical Engineering, Johns Hopkins University, Baltimore, MD, March 1990.

**Invited Speaker:** Hydromechanics Colloquium, ONR David Taylor Research Center, Bethesda, MD, March 1990.

**Speaker:** ONR Workshop on Dynamics of Bubbly Flows, University of Miami, May 1990.

**Invited Speaker:** NASA Microgravity Fluids Workshop - Cleveland, August 1990.

**Seminar:** Department of Applied Science, University of California, Davis-Livermore, April 1991.