Abstract Submitted
for the CAL11 Meeting of
The American Physical Society

A Hybrid Stiff Solver for the Rayleigh-Plesset Equation MUTAZ ALSAYEGH, CHUNG-MIN LEE, California State University, Long Beach, PRASAD PERLEKAR COLLABORATION, FEDERICO TOSCHI COLLABORATION — We seek to apply efficient computational algorithms to investigate the locations of bubble concentrations in liquid flow. In flows with large velocities, bubbles tend to form in concentrated areas. Moreover, experiments show that bubbles formed at high velocities release large amount of energy once they collapse causing damage to equipment and objects that are in the path of the flow. To gain more insight on the formation of these bubbles, we will first study the dynamics of a single bubble and assume the bubble is a sphere. The dynamics of the bubble in terms of its radius and the driven pressure is modeled by the Rayleigh-Plesset (RP) equation. The RP equation is a second order nonlinear stiff ordinary differential equation (ode) and theoretically, its solution can be obtained numerically using Finite Difference (FD) methods. However, under large pressure variations, the rate of change of the bubble's radius approaches infinity when the bubble is collapsing. Explicit numerical integration methods require time steps of magnitude of (10^{-12} s) to achieve stable solutions. Iterations under this time scale are highly impractical and require immense CPU time. Therefore, a stiff ode solver is needed to alleviate the computation cost. Therefore, we would like to devise a hybrid algorithm that automatically selects between an explicit method and the stiff ode solver. Once we have a robust implementation, we will use it to process the data and analyze the relations between bubble locations and flow structures.

Mutaz Alsayegh
California State University, Long Beach

Date submitted: 03 Oct 2011 Electronic form version 1.4