

**Meeting:** 1003, Atlanta, Georgia, AMS CP 1, AMS Contributed Paper Session

1003-65-1573      **Richard W Sharp\*** (rsharp@math.princeton.edu), PACM, Fine Hall, Washington Road, Princeton, NJ 08544, and **Yen-Hsi Tsai** and **Bjorn Engquist**. *Multiple time scale numerical methods for highly oscillatory ODE*.

We present numerical algorithms that compute the average solution of rapidly oscillating ODE systems. The algorithms follow the framework of the heterogeneous multiscale methods proposed by Engquist and E. One illustrative example is an inverted pendulum with rapid periodic forcing at its base. The forcing allows the pendulum to swing periodically above the horizontal axis with a period much longer than that of the forcing. Fully resolving the fast motion in such a system leads to methods that either cannot maintain accuracy over long intervals or are computationally expensive. Our approach defines the state of the system with one set of microscale variables, prescribed by the original ODEs, and a set of macroscale variables defined as the time average of the microscale state. To advance the macroscopic variables the methods estimate an effective force by solving the microscale system over a short time and using a specially designed kernel to average the microscale forces. It is essential to initialize the microscale calculations in a manner consistent with the original ODEs and initial conditions. We give numerical and analytic results for the driven inverted pendulum and extend the method to an autonomous system of stiff springs. (Received October 05, 2004)