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Mathematics

Take the challenge: domain decomposed compact computations for highly oscillatory waves

Highly oscillatory solutions of wave equations pervade a very wide range of important applications, in particular optical laser devices used in many precision surgeries and medical procedures. The solution of the paraxial Helmholtz equation at high wave numbers is a typical example.

Fast and accurate approximations of highly oscillatory solutions have spawned a large number of recent numerical approaches and strategies. Although many new methods offer higher accuracy or efficiency, rigorous studies of their qualitative properties such as the stability are still in infancy. These have motivated this proposed research. The project focuses at a very challenging issue, that is, domain decomposed compact computations. The marvelous numerical technology achieves an exceptionally high accuracy while limited information from underlying physical systems is needed.

This is particularly meaningful to the design of oscillatory solvers. Since the investigation requires expertise from several different fields, the PI wishes to collaborate on the study. His postdoctoral fellows, Drs. M. A. Beauregard and A. Flachi, and graduate students will also be involved. This proposed research can be viewed as a uninterrupted and collaborated endeavor initiated by the PI in 2011. Supported by his last URC fund, the PI visited internationally well-known experts in important fields. Collaborative investigations were initialized. Concepts of decomposed compact computations were introduced. Interactive parallel/sequential algorithm designs were explored. Two collaborators revisited the PI for task refinements in Fall 2011. One joint research paper has been accepted for publication. This proposed project will continue PI's pursuit of greater discoveries at an optimized teamwork level. It will enable the PI to investigate closely with his international collaborators and experts for an intensive period of time in summer. Existing research agendas will be reinforced and extended for Baylor students. This will contribute to the Strategic Plan of the University to become a world leader in first-class researches.