Center for Quantum Science and Engineering (CQSE)

Special Seminar
July 14, 2010 (Wed)

TIME	July 14, 14:30 ~ 15:30
TITLE	The Space-time CESE Numerical Framework for High-Performance Simulations with Unstructured Mesh
SPEAKER	Dr. Chau-Lyan Chang NASA Langley Research Center
PLACE	Rm716, CCMS & New Physics Building, NTU

The Space-time CESE Numerical Framework for High-Performance Simulations with Unstructured Mesh

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With the advance of modern high-performance computing technologies, high-fidelity numerical simulations have emerged as a popular tool for many fundamental studies and engineering applications. Large-scale, high-performance simulations on a supercomputer cluster involving thousands of processors are routinely used for exploration of new physics or for component design/validation as part of the system studies. In such simulations, physical laws are simulated by solving a large set of discretized equations formulated on either a structured or unstructured mesh with tens/hundreds of millions or grid points. While structured meshes continue to be widely used for many applications, the trend is moving toward unstructured mesh in new development due to its capability to handle very complex geometries. In this presentation, we focus on an emerging unstructured-mesh numerical framework introduced by Dr. S.-C. Chang of NASA Glenn Research Center, namely, the space-time conservation element, solution element (CESE) method. In contrast to conventional numerical methods, the CESE method was constructed by enforcing fundamental properties of the space-time domain to accurately compute conservation laws without any ad-hoc numerical treatments to circumvent difficulties associated with element interfaces or other eigenvalue disparities. As a result, the method has been shown to resolve continuities and small-scale waves with remarkable accuracy. This talk will be focused on applications to the solution of Navier-Stokes equations along with some preliminary studies on the computations of time-dependent Schrödinger equations. The implementation of the simulation software framework on a multi-core, parallel computing cluster will also be briefly discussed.