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LSU CCT Research Targets Mathematical Equations for Fully Nonlinear Second Order PDEs

Michael J. Neilan, postdoctoral research fellow at the LSU Center for Computation & Technology, has received an award from the National Science Foundation to focus on fully nonlinear second order PDEs. Titled "Novel discretization schemes for fully nonlinear partial differential equations," the award is for $127,184 for a three year period.

Partial differential equations (PDEs) are ubiquitous. Arising in a variety of physical, biological, and social phenomena, PDEs play a crucial role in the understanding and predicting of various real-world problems including modeling weather phenomena, determining the initial shape of the universe, optimal reflector design, differential geometry, optimal transport, mathematical finance, image processing, and mesh generation. However, even for simple models, PDEs cannot be solved by simple mathematical formulas, and therefore the need for accurate and efficient computational methods become necessary.

"This research is based on my recent discovery that Lagrange finite element methods and discontinuous Galerkin methods can be used to approximate the Monge-Ampére equation--the prototypical fully nonlinear second order equation," said Neilan. "As these methods are simple to implement, the computation of the highly nonlinear problem can be performed efficiently and accurately. This project will expand on these latest findings to obtain simple, efficient, and accurate numerical schemes for a general class of fully nonlinear equations."

The completion of the proposed research will produce three stages of results. The first consists of the abstract theory, various discretization methods and theoretical tools for fully nonlinear second order equations. The second will consist of the resulting application impacts of the theoretical results. As the computational aspects of these problems are still in their infancy, any progress in solving the governing equations will have an immediate impact on advancing these application areas. The third outcome is the resulting computer programs and software for implementing the methods of algorithms.

For more information on the research activities of the LSU Center for Computation and Technology, visit: http://www.cct.lsu.edu/home.

Publish Date:
08-08-2011

Center for Computation & Technology
2003 Digital Media Center • Telephone: +1 225/578-5890 • Fax: +1 225/578-8957