



Lilia Krivodonova

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Professor Krivodonova's research interests lie in the area of numerical analysis and scientific computing. The aim of her research is to develop, analyze, and implement novel numerical techniques for solving hyperbolic partial differential equations. Such equations describe a variety of physical phenomena in nature and have diverse applications in fluid dynamics, aeroacoustics, electromagnetism, and optics.

Professor Krivodonova is particularly interested in discontinuous Galerkin methods (DGMs). DGMs are finite-element-type schemes that have attracted much attention in recent years. As high-order schemes, they have the potential to be highly efficient, and thus capable of solving problems that are beyond the scope of low-order schemes. The goal of Professor Krivodonova's research is to make DGMs more suitable for practical engineering applications. Algorithms proposed by Professor Krivodonova are implemented in several large-scale research and engineering codes.

Examples of Professor Krivodonova's work include her efficient algorithm for imposing boundary conditions for simulating flows around complex objects such as airplanes. Accurate representa-

tion of the numerical solution near curved walls is crucial for ensuring the overall accuracy of the method and for accurately computing important aerodynamic quantities such as the lift and drag coefficients. The proposed algorithm is computationally simple, results in a high-order accurate solution, and can be applied to realistic computational meshes.

Professor Krivodonova has also worked on stabilization techniques for the numerical solution of hyperbolic conservation laws. The solutions of such problems often develop shocks: narrow regions in which the solution varies rapidly. Numerical solutions develop spurious oscillations near shocks and other discontinuities that make it impossible to solve such problems on a computer. This is a fundamental difficulty for all numerical schemes aimed at solving hyperbolic equations. Professor Krivodonova has proposed a high-order limiter, a technique to suppress spurious oscillations, that stabilizes solutions near shocks without destroying accuracy away from them.

Her current interests are focused on adaptive strategies for DGMs. Adaptive schemes provide a computational advantage over uniform mesh computations by allocating resources in regions where they are most needed. The computational mesh can be refined or the order of the scheme can be modified to better resolve the solution features. Thus, fewer computational cells and less computing time are needed to achieve the prescribed accuracy. This is a continuation of her previous work on error estimation techniques that are used to identify the regions where the accuracy is not sufficient and so additional resources need to be committed.

Representative Publications

L. Krivodonova. Limiters for high-order discontinuous Galerkin methods. *Journal of Computational Physics*, 226(1):879–896,

2007.

L. Krivodonova and M. Berger. High-order accurate implementation of solid wall boundary conditions in curved geometries. *Journal of Computational Physics*, 221:492–512, 2006.

L. Krivodonova, J. Xin, J.-F. Remacle, and J.E. Flaherty. Shock detection and limiting with discontinuous Galerkin methods for hyperbolic conservation laws. *Applied Numerical Mathematics*, 48:323–338, 2004.

L. Krivodonova and J.E. Flaherty. Error estimation for discontinuous Galerkin solutions of multidimensional hyperbolic problems. *Advances in Computational Mathematics*, 19:57–71, 2003.