Workshop on Discrete Differential Geometry for Multiphase Flow Problems

Friday 23rd - Saturday 24th, April 2010
BS 2003 - Buisiness Building
Indiana University Purdue University Indianapolis (IUPUI)

Invited Speakers

Steven Dong
Purdue University, Mathematics

Enabling Incompressible Flow Simulations with Large Time Step Sizes

Anil Hirani
University of Illinois at Urbana-Champaign, Computer Science

Some PyDEC Applications

(Python software package for Discretization of Exterior Calculus)

Eva Kanso
University of Southern California, Aerospace and Mechanical Engineering

Yiying Tong
Michigan State University, Computer Science and Engineering

On a Variational Fluid Simulator Using Some Differential Geometry Ideas

Zhiliang Xu
University of Notre Dame, Mathematics

Computational Study of Biological Systems Involving Fluid Flow

Organizers

Giovanna Guidoboni, gguidobo@math.iupui.edu
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www.math.iupui.edu/∼adziubek/DDGworkshop

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Multiphase flow problems

Multiphase problems are characterized by the interaction of two or more phases which are separated by deformable interfaces. The interface deformation introduces geometric nonlinearities and topological changes which make the numerical solution of these problems a very challenging task. The traditional approach consists in formulating the model equations first, and then to discretize them using, for example, finite differences, finite elements, or finite volumes. Available methods are either efficient or accurate, but unfortunately not both. A reason may be that the discrete equations inevitably include various approximations and they do not always preserve the essential mathematical properties of the original continuous system

Discrete Differential Geometry

The main idea of discrete differential geometry is to reformulate the original continuous equations in such a way that its discretized version maintains the essential mathematical features of the continuous problem. This area of research is still at its early stages. Some work has been done for the solution of classical fluid flow problems and elasticity problems, but the treatment of problems with interfaces (e.g. fluid-solid interactions) still remains open.

Workshop

This workshop will offer a unique opportunity to explore the capabilities of discrete differential geometry for the solution of multiphase flow problems which, hopefully, will lead to the development of a new generation of both accurate and efficient numerical methods. The workshop will gather scientists with different expertises (engineers, computer scientists and mathematicians) from both IUPUI and other US institutions. In particular we will be discussing fluid-structure interaction problems arising in Medicine and Life Science, such as the interaction between blood flow and compliant vessel walls, and the deformation of red blood cells caused by blood flow.

The workshop is supported by IUPUI Department of Academic Affairs and Department of Mathematical Sciences