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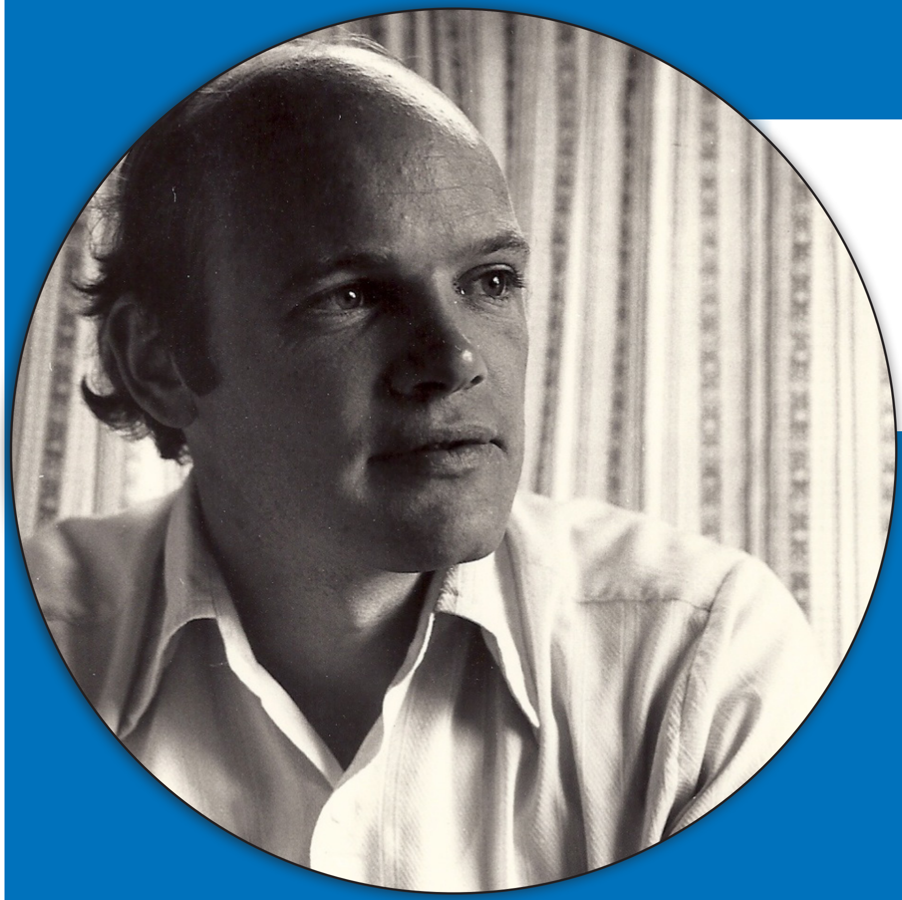

PIMS Marsden Memorial Lecture Series

April 7, 2014
Instituto Nacional de Matematica Pura e Aplicada (IMPA), Rio de Janeiro

Mathieu Desbrun (Caltech)

Geometric discretization for computational modeling

Abstract: Geometry is at the foundation of many physical theories, even if it is often obfuscated by their formulations in vectorial or tensorial notations. When computational simulation is needed, leveraging geometric formulations of physical models can potentially lead to numerical methods with exact preservation of momenta arising from symmetries, good long-term energy behavior, and robustness with respect to the spatial and temporal resolution — only if one can preserve some of the most defining continuous structures in the numerical realm. In this talk, we will review a number of structure-preserving discretizations of space and time, from discrete counterparts of differential forms and symmetric tensors on surfaces, to finite-dimensional approximation to the diffeomorphism group and its Lie algebra. A variety of applications (from masonry to magnetohydrodynamics) will be used throughout the talk to demonstrate the value of a geometric approach to computations.

MATHIEU DESBRUN is a Professor at the California Institute of Technology (Caltech) in the Computing + Mathematical Sciences department. He leads the Applied Geometry lab, which over the last ten years has focused (due to Jerrold E. Marsden's influence) on discrete differential modeling---the development of differential, yet readily discretizable foundations for computational modeling---and a wide spectrum of applications, ranging from discrete geometry processing to solid and fluid mechanics as well as field theory.

About this series: This lecture series is dedicated to the memory of Jerrold E Marsden (1942-2010), a world-renowned Canadian applied mathematician. Marsden was the Carl F Braun Professor of Control and Dynamical Systems at Caltech, and prior to that he was at the University of California (Berkeley) for many years. He did extensive research in the areas of geometric mechanics, dynamical systems and control theory. He was one of the original founders in the early 1970's of reduction theory for mechanical systems with symmetry, which remains an active and much studied area of research today.

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