



THE UNIVERSITY OF CHICAGO

COMPUTATIONAL AND APPLIED MATHEMATICS COLLOQUIUM

PANOS STINIS

Pacific Northwest National Laboratory

Mesh Refinement and Coarse-Graining for Complex Systems

THURSDAY, April 5, 2018, at 5:00 PM

Jones 226, 5747 South Ellis Avenue

ABSTRACT

Most real-world problems involve many more scales than we are able to resolve (huge complexity). Mesh refinement and coarse-graining (model reduction) are two ways to deal with complexity. The former attempts to increase the resolution in computationally demanding areas while the latter attempts to account for details that we wish not to resolve. While appearing to derive from opposite considerations, in both tasks the objective is to keep the important features (scales, structures, patterns etc.) and account for the rest in a simplified manner. Moreover, both tasks depend on monitoring accurately the transfer of activity (e.g. mass, energy) to the unresolved scales. The observation of this common underlying principle has allowed us to construct a unified framework for mesh refinement and coarse-graining. This framework has been applied successfully to a variety of challenging problems including the location of bifurcations, the estimation of small failure probabilities, the location and tracking of singularities of partial differential equations and the design of better machine learning algorithms for prediction.

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