Mathematics, Statistics, and Computer Science **@ UIC**

Departmental Colloquium

Asymptotic Preserving Numerical Methods for Singularly Perturbed Problems

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Abstract: Solutions of many nonlinear PDE systems reveal a multiscale character; thus, their numerical resolution presents some major difficulties. Such problems are typically characterized by a small parameter representing, say, a low Mach or Fraude number. In the limiting regimes, the propagation speeds are very low, and therefore the use of explicit numerical methods would require very restrictive time and space discretization steps due to the CFL condition and restrictions on the smallness of numerical diffusion. This becomes rapidly too costly from a practical point of view, and consequently, numerical solutions for small parameter values may be out of reach. Moreover, standard implicit schemes, which will be uniformly stable, may be inconsistent with the limiting problem and may provide a wrong solution in the zero limits. Thus, designing robust numerical algorithms whose accuracy and efficiency are independent of the values of the small parameter is an important and challenging task. A widely used numerical approach applicable in all-speed regimes is based on asymptotic preserving (AP) numerical methods. AP methods guarantee that for a fixed mesh size and time step, the numerical scheme should automatically transform into a consistent and stable discretization of the limiting system.

In this talk, we will present several AP schemes for Navier–Stokes–Korteweg equation, rotational shallow water equations with Coriolis, and, if time permits, kinetic equations with singular limits.

Friday, April 7 at 3:00 PM in 636 SEO