Ecole Doctorale Carnot-Pasteur

Proposition de sujet de thèse

Intitulé français du sujet de thèse proposé :

Calcul Haute Performancet pour les EDPs dispersives

Intitulé en anglais :

High performance computing for dispersive PDEs

Unité de recherche :

IMB

Nom, prénom et courriel du directeur (et co-directeur) de thèse :

STOILOV, Nikola, nikola.stoilov@u-bourgogne.fr

KLEIN, Christian, christian.klein @u-bourgogne.fr

Domaine scientifique principal de la thèse :

Mathématiques

Domaine scientifique secondaire de la thèse :

Physique

Description du projet scientifique

We offer a fully funded PhD position in high performance computing applied to non-linear dispersive partial differential equations, under the supervision of Prof. Christian Klein and Dr. Nikola Stoilov. Dispersive PDEs admit special classes of exact solutions such as solitons and breathers. Their role in the understanding of the long-time behavior of more general solutions to the equation is an open problem. Further, nonlinear dispersive PDEs could admit solutions

that exhibit a blow-up in finite time, i.e., a loss of regularity, posing significant challenges. In applications, a blow-up indicates where the approximations made in describing a situation via the studied model are no longer justified. The solutions of nonlinear dispersive PDEs can also have zones of rapid modulated oscillations called dispersive shock waves, which are difficult to describe both analytically and numerically. These three aspects of dispersive equations are understood to a different extent for equations in lower dimensions (1+1), however, in higher dimensions the results are few and far between. Numerical algorithms, relying on sophisticated implementations of (pseudo-) spectral methods, combined with innovative computing approaches have already achieved significant progress in this task, aiding and guiding analytical results for multi-dimensional problems. The position will concentrate on developing and implementing high performance numerical algorithms for simulating critical behavior in equations such as Benjamin-Ono, Zakharov-Kuznetsov and Davey-Stewartson, and implementing these algorithms on massive parallel, GPU- based computing systems. The position is funded under the ANR project ISAAC.

Connaissances et compétences requises :

Programming knowledge (Matlab, C++ or Fortran), possibly CUDA on GPUs.