Subject N°1 : Schwarz Waveform relaxation and AMR.

Location: LAGA, University Paris 13

Duration : 3 months

Director: Laurence Halpern (LAGA) and Juliette Ryan (ONERA)

Summary : Evolution problems have a particular direction, namely the time direction, which usually plays quite a different role from the spatial directions. This needs to be taken into account when one tries to solve such problems in parallel. Over the last decades, several different approaches for the parallelization of evolution problems have been proposed and analyzed, and particularly the class of optimized Schwarz waveform relaxation methods. These methods are based on a decomposition of the problem in space, like classical Schwarz methods, but they solve subdomain problems in both space and time. This approach allows us to use non-matching grids both in space and time, or even different space-time models in different subdomains. Rapid convergence is obtained using optimized transmission conditions between subdomains, like in optimized Schwarz methods. Such methods are also easy to use, if one has already a solver for the associated evolution problem.
The purpose of the thesis is to become familiar with such methods by application to the N-dimensional heat equation, and thereafter to use it for the adaptive mesh refinement, by improving the exchange of data between two grids.

Prerequisits : partial differential equations, domain decomposition, Matlab.

Salary : 3500 €

Subject N°1 : Domain decomposition for micromagnetic models.

Location: LAGA, University Paris 13

Duration : 3 months

Salary : 3500 €

Subject N°2 : Domain decomposition for ferromagnetic materials.

Directors: Laurence Halpern and Stéphane Labbé (Université Grenoble, France)

Summary : Ferromagnetic materials are becoming more and more important in conceiving high technologies objects (mobile phones, hard disk , storage, etc ..). It is necessary, in order to get the best out their properties to optimize their shape and composition. This procedure, in laboratories can be long and fastidious. This is where numerical simulation can be at its best as a predictive tool .
But simulating ferromagnetic materials behaviour can be particularly expensive in terms of storage and computing time. The management of complex systems with several magnetic parts can prove to be out of reach for current computing performances. The main stumbling block for these simulations is the determination of the demagnetizing field, a Maxwell asymptotic for the low frequencies.
During this master thesis , the student will have to study a Schwartz type domain decomposition algorithm for the demagnetizing field and compare results with those obtained with a method based on the use of multilevel Toeplitz matrices.

Prerequisits : partial differential equations, domain decomposition, Matlab.

Salary : 3500 €