ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

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SEMINAR OF NUMERICAL ANALYSIS

- **WEDNESDAY 13 JUNE 2011 - ROOM MA A3 31 - 11h00**

Dr. Emmanuil Georgoulis, (Univeristy ofLeicester, UK) will present a seminar entitled:

"On numerical methods for multiscale elliptic problems"

Abstract:
I will present two recent research directions, which have common application on the development of efficient numerical methods for multiscale elliptic problems. The first part will be concerned with an adaptive discontinuous Galerkin multiscale method driven by an energy norm a posteriori error bound. Localized fine scale constituent problems are solved on patches of the domain and are used to obtain a modified coarse scale equation. The a posteriori error estimate is used within an adaptive algorithm to tune the critical parameters, i.e., the refinement level and the size of the different patches on which the fine scale constituent problems are solved. The fine scale computations are completely parallelizable, since no communication between different processors is required for solving the constituent fine scale problems. The convergence of the method, the performance of the adaptive strategy and the computational effort involved are investigated through a series of numerical experiments. Moreover, some a priori bounds for the proposed method will be presented. This part is based on joint work with D. Elfverson (Uppsala), A. Malqvist (Uppsala) and D. Peterseim (Berlin). In the second part, a multilevel kernel-based interpolation method, suitable for moderately high-dimensional function interpolation problems. The method, termed multilevel sparse kernel- based interpolation (MLSKI, for short), uses both level-wise and direction-wise multilevel decomposition of structured (or mildly unstructured) interpolation data sites in conjunction with the application of kernel-based interpolants with different scaling in each direction. On each level, anisotropic radial basis functions are used for solving a number of small interpolation problems, which are subsequently linearly combined to produce the interpolant. MLSKI can be viewed as an extension of d-boolean interpolation (which is closely related to ideas in sparse grid and hyperbolic crosses literature) to kernel-based functions, within the hierarchical multilevel framework to achieve accelerated convergence. Numerical experiments suggest that the new algorithm is numerically stable and efficient for the reconstruction of (d+1)-dimensional data in for d = 2, 3, 4, with tens or even hundreds of thousands data points. Some final comments on the potential application of the MLSKI method to solving high-dimensional elliptic problems will be given, if time allows. This part is based on joint work with J. Levesley (Leicester) and F. Subhan (Leicester/Peshawar).

Lausanne, 22 May 2011/FN/cr
