MEETING ON ANALYSIS AND MODELING OF MULTI-SCALE PROBLEMS

June, 1 2017 at 9:30 AM in Aula Buzano, DISMA Politecnico

Speakers:
Micol Amar, University of Rome La Sapienza
Andrea Braides, University of Rome Tor Vergata
Paolo Cermelli, University of Torino
Grigory Panasenko, University of Saint Etienne (France)

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PROGRAMME

9.30 **M. Amar**
Homogenization of a heat conduction problem involving tangential operators

10.15 **A. Braides**
A simple discrete model for damage exhibiting infinitely-many phases and a continuum counterpart

11-11.30 coffee break

11.30 **P. Cermelli**
The limit of the cut functional on dense graph sequences

12.15 **G. Panasenko**
Asymptotic reduction and hybrid dimension models for the flows in domains containing thin tube structures

13 lunch

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ABSTRACTS

Micol Amar (University of Roma "La Sapienza")
Homogenization of a heat conduction problem involving tangential operators

We present a model for the heat conduction in a composite having a microscopic structure arranged in a periodic array made by two phases separated by a thermally active membrane.
The thermal behavior of the membrane is described by a parabolic equation involving the Laplace-Beltrami operator. Such interface equation furnishes the contact temperature of the two diffusive phases in terms of the jump of the heat fluxes at the interface.
We obtain the macroscopic behavior of the material via an homogenization procedure based on the unfolding technique, providing the equation satisfied by the effective temperature.
We are also able to prove an error estimate on the rate of convergence of the sequence of approximating solutions to the homogenized solution.
These results are part of a joint research with R. Gianni.

Andrea Braides (University of Roma "Tor Vergata")
A simple discrete model for damage exhibiting infinitely-many phases and a continuum counterpart

We give a variational interpretation of a model by Novak and Truskinovsky of a discrete systems where microscopic fracture produces macroscopic damage. Depending on the arrangement at a discrete level the overall response corresponds to different damaged materials. We give a formal continuum counterpart depending on a small parameter mimicking the discrete dimension. The homogenized description as this parameter tends to zero departs from the previous one in certain regimes. Work in collaboration with A.Causin, M.Solci and L.Truskinovsky.

Paolo Cermelli (Univerrsity of Torino)
The limit of the cut functional on dense graph sequences

The cut functional on a finite graph is a measure of the total number of edges connecting different communities, and can be used to find optimal splittings of the graph into highly connected components. It also arises as a spin functional with simple pairwise interactions between the nodes. Given that large graphs have increasing importance in applications, it is important to understand the structure of the cut functional when the order of the graph goes to infinity, as well as its relation with its finite counterpart. In this work we exploit the spin-functional analogy, the theory of limits of graph sequences and Gamma-convergence to explore the limit functional on dense graph sequences, in order to elucidate the structure of the interfaces in the large graph limit.

Grigory Panasenko (Univ Lyon, UJM-Saint-Etienne, CNRS, Institute Camille Jordan UMR 5208, SFR MODMAD FED 4169, F-42023, Saint-Etienne, FRANCE)

Asymptotic reduction and hybrid dimension models for the flows in domains containing thin tube structures

Thin structures are some finite unions of thin rectangles (in 2D settings) or cylinders (in 3D settings) depending on small parameter $\varepsilon << 1$ that is, the ratio of the thickness of the rectangle (cylinder) to its length. We consider thin structures and multistructures which consist of several "massive" domains independent of ε connected by thin structures. Viscous flows in such structures are modeled by steady or non-steady Stokes or Navier-Stokes equations stated in thin structures or multistructures with the no-slip boundary condition at the lateral boundary of the cylinders and with the inflow and outflow conditions with the given velocity on some part of the boundary.

For thin structures an asymptotic expansion of the solution is constructed and justified. It has a form of a Poiseuille (or Womersley) flow within thin cylinders at some distance from the bases while the boundary layers near the ends of the cylinders decay exponentially. The algorithm of construction of the expansion deals with a special Reynolds type problem on the graph for the pressure. This structure of the expansion allows to reduce the dimension within the cylinders at the distance of order $\varepsilon |\ln \varepsilon|$ from the bases of the cylinders and derive the junction conditions between models of different dimensions. This approach is extended for multistructures (Stokes equations).

Finally, we discuss the possibility of asymptotic derivation of boundary conditions describing the elasticity of the wall and of non-Newtonian equations for the fluid motion.

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