A finite element method for elliptic equations on moving surfaces

Maxim A. Olshanskii

Department of Mechanics and Mathematics
Moscow State M.V. Lomonosov University, Moscow 119899
email: Maxim.Olshanskii(at)mtu-net.ru

In this talk a new finite element approach for the discretization of elliptic partial differential equations on surfaces is treated. The main idea is to use finite element spaces that are induced by triangulations of an "outer" domain $\Omega \subset \mathbb{R}^3$ to discretize the partial differential equation on the hypersurface $\Gamma \Subset \Omega$. The method is particularly suitable for problems in which there is a coupling of a problem in the outer domain with the equation on Γ and Γ may vary in time. This happens, for example, in multi-phase fluids models if one takes so-called surface active agents (surfactants) into account. These surfactants induce tangential surface tension forces and thus cause Marangoni phenomena. We show that the method has optimal order of convergence. We also discuss numerical properties of the corresponding linear algebraic systems. Some other issues of numerical analysis for multi-phase flows will be sketched in the talk. This presentation is based on the joint research with Arnold Reusken from RWTH Aachen.