YVES BOURGAULT, Universite d'Ottawa, Ottawa, Ontario

A mortar element for coupling hyperbolic and parabolic problems

The mortar element method is now very popular to decompose elliptic problems on multiple sub-domains. The main feature of this method is its ability to deal with nonmatching grids on sub-domain interfaces without loosing any accuracy of the global solution, while allowing the parallel computing of the solution. As far as we know, the mortar method has been introduced for elliptic or parabolic PDEs only. Its extension to hyperbolic problems (such as the Euler equations for inviscid flows) or mixed-type equations (such as the Navier-Stokes equations for compressible flows) would be a definite asset.

The present work is an initial step into the development of an "all-at-once" mortar methods that works for all type of equations, first concentrating on its development for the linear advection equation. The proposed mortar method works for hyperbolic equations, through a combination of streamline-diffusion up-winding, discontinuous and mortar finite element terms in the Galerkin formulation. A weak flux continuity condition at the sub-domain interface is enforced by means of Lagrange multipliers which yields a solution with optimal accuracy even with non-matching grids at sub-domain interfaces. The method can be consistently applied to the advection-diffusion equation. The method has been implemented using MPI and numerical results will be shown for the pure advection as well as the advection-diffusion equations.