

RESUMO N° 86

## HIGH-ORDER CFD COMPUTATIONS WITH STABILIZED POWELL-SABIN ELEMENTS

**Giorgio Giorgiani**, giorgianig@yahoo.it

*Centre national de la recherche scientifique, France*

**Hervé Guillard**, herve.guillard@inria.fr

*INRIA, France*

**Boniface Nkonga**, boniface.nkonga@inria.fr

*INRIA, France*

**Keywords:** Powell-Sabin, CFD, Stabilization, Spline

In the last recent years, thanks to the increasing power of the computational machines, the interest in

more and more accurate numerical schemes is growing. Methods based on high-order approximations are nowadays the common trend in the computational research community, in particular for CFD applications.

This work is focused on Powell-Sabin (PS) finite elements. PS splines are piecewise quadratic polynomials with a global C1 continuity, defined on conforming triangulations. Despite its attractive characteristics, so far this scheme hasn't had the attention it deserves. PS splines are adapted to unstructured meshes and, contrary to classical tensor product B-splines, they are particularly suited for local refinement, a crucial aspect in the analysis of highly convective and anisotropic equations. The additional global smoothness of the C1 space has a beneficial stabilization effect in the treatment of advection-dominated equations and leads to a better capturing of thin layers. Finally, unlike most of other typology of high-order finite elements, the numerical unknowns in PS elements are located in the vertices of the triangulation, leading to an easy treatment of the parallel aspects.

Some geometrical issues related to PS elements are discussed here, in particular, the generation of the control triangles and the imposition of the boundary conditions. A variational multiscale stabilized formulation is considered for the solution of compressible flow problems. Some examples for CFD applications will demonstrate the attractiveness of the PS discretization.