

Accepted Manuscript

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PII: S0045-7825(18)30276-7
DOI: <https://doi.org/10.1016/j.cma.2018.05.032>
Reference: CMA 11933

To appear in: *Comput. Methods Appl. Mech. Engrg.*

Received date : 17 November 2017
Revised date : 25 May 2018
Accepted date : 27 May 2018

Please cite this article as: G. Giorgiani, H. Guillard, B. Nkonga, E. Serre, A stabilized Powell–Sabin finite-element method for the 2D Euler equations in supersonic regime, *Comput. Methods Appl. Mech. Engrg.* (2018), <https://doi.org/10.1016/j.cma.2018.05.032>

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A stabilized Powell-Sabin finite-element method for the 2D Euler equations in supersonic regime

Giorgio Giorgiani^{a,*}, Hervé Guillard^b, Boniface Nkonga^b, Eric Serre^a

^a*Aix-Marseille Univ., CNRS, Centrale Marseille, M2P2 Marseille, France*

^b*INRIA Sophia Antipolis, 2004 Route des Lucioles, 06902 Valbonne*

Abstract

In this paper a Powell-Sabin finite-element (PS-FEM) scheme is presented for the solution of the 2D Euler equations in supersonic regime. The spatial discretization is based on PS splines, that are piecewise quadratic polynomials with a global C^1 continuity, defined on conforming triangulations.

Some geometrical issues related the practical construction of the PS elements are discussed, in particular, the generation of the control triangles and the imposition of the boundary conditions. A stabilized formulation is considered, and a novel shock-capturing technique in the context of continuous finite-elements is proposed to reduce oscillations around the discontinuity, and compared with the classical technique proposed by Tedzuyar [1]. The code is verified using manufactured solutions and validated using two challenging numerical examples, which allows to evaluate the performance of the PS discretization in capturing the shocks.

Keywords: Shock capturing, high-order, C^1 approximations, splines, CFD, compressible flow.

*Corresponding author

Email addresses: giorgio.giorgiani@univ-amu.fr (Giorgio Giorgiani),
herve.guillard@inria.fr (Hervé Guillard), boniface.nkonga@inria.fr (Boniface Nkonga),
eric.serre@univ-amu.fr (Eric Serre)

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