High-order Virtual Element Method for 2D Solid Mechanics Problems

Edoardo Artioli* and Robert L. Taylor†

* Department of Civil Engineering and Computer Science
University of Rome 'Tor Vergata'
Via del Politecnico 1, I-00133 Rome, Italy
e-mail: artioli@ing.uniroma2.it, web page: http://dicii.uniroma2.it/?PG=21.1.87

† Department of Civil and Environmental Engineering
University of California, Berkeley
Berkeley, CA 94720-1710, USA
e-mail: rlt@ce.berkeley.edu - Web page: http://www.ce.berkeley.edu/ rlt/

ABSTRACT

The Virtual Element Method (VEM) is a new technology for the approximation of partial differential equation problems, see [1,2], as an evolution of modern mimetic schemes, which share the same variational background of the Finite Element Method (FEM). The initial motivation of VEM is the need to construct an accurate Galerkin scheme with the flexibility to deals with highly general polygonal/polyhedral meshes, including "hanging vertices" and non-convex shapes, retaining the conformity of the method, i.e. the property to build an approximated solution which shares the same regularity features as the analytical solution of the problem under consideration. In many interesting cases, this means that the discrete solution is continuous across adjacent elements.

The paper presents the theoretical aspects of VEM for 2D solid mechanics in mixed formulations in the small as well in the finite strain regime. The discussion aims at introducing the innovative method in the classical computational mechanics operative framework of finite element analysis and technology.

The work will present the theoretical background to express the VEM in a classical finite element form and presenting a selected number of benchmarks aiming at illustrate the specific features of the proposed method in relation to discretization and element topology, accuracy and interpolation features.

REFERENCES

[1] L. Beirão da Veiga, F. Brezzi, A. Cangiani, G. Manzini, L. D. Marini, and A. Russo, "Basic principles of virtual element methods", *Math. Models Methods Appl. Sci.* **23**, 199-214 (2013).

[2] L. Beirão da Veiga, C. Lovadina, and D. Mora, "A virtual element method for elastic and inelastic problems on polytope meshes", *Comp. Meth. Appl. Mech. Eng.* **295**, 327-346 (2015).