13th World Congress on Computational Mechanics

2nd Pan American Congress on Computational Mechanics

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ABSTRACTS

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Extended Virtual Element Method for Problems with Singularities

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ABSTRACT

Extended Virtual Element Method for Problems with Singularities E. Benvenuti1*, A. Chiozzi1, N. Sukumar2, G. Manzini3 1 University of Ferrara, Ferrara, Italy 2 University of California, Davis, USA 3 Los Alamos National Laboratory, New Mexico, USA E-mail: andrea.chiozzi@unife.it, elena.benvenuti@unife.it, n.sukumar@ucdavis.edu, gmanzini@lanl.gov Keywords: virtual element method; extended finite element method; singularities. The eXtended Finite Element Method (XFEM) was first proposed by Belytschko 's group [1] as an innovative computational technology for dealing with discontinuities and singularities without tailored meshes. This goal is achieved by enriching the approximation space by means of additional shape functions that reproduce the non-smooth features of the expected solution. Owing to its great flexibility, XFEM has become one of the most exploited methodology for crack simulation in mechanical and structural engineering. More recently [2], an eXtended Finite Element Method exploiting polygonal basis functions has been proposed for polytopal meshes, that can be especially useful when meshing complex domains, such as those occurring in bodies with cracks and inclusions. The Virtual Element Method (VEM) is a generalization of the Finite Element Method capable of dealing with very general polytopal meshes without using polygonal basis functions[3]. The key feature of VEM relies on the introduction of a suitable projector operator to approximate the bilinear form arising in the weak formulation of the continuous problem, so that the explicit construction of the elemental basis functions can be avoided. Based on illustrative numerical examples, the presentation to be delivered at the conference aims to discuss how to extend the XFEM to polytopal meshes by exploitation of the VEM methodology in problems with singular unknown fields. References [1] Moës, N., Dolbow, J. and Belytschko, T., “A finite element method for crack growth without remeshing”, International Journal for Numerical Methods in Engineering, 46, 131-150, 1999. [2] Tabarraei, A. and Sukumar, N., “Extended finite element method on polygonal and quadtree meshes”, Computer Methods in Applied Mechanics and Engineering, 197, 425-438, 2008. [3] Beirao da Veiga, L., Brezzi, F., Cangiani, A., Manzini, G., Marini, L.D. and Russo, A., “Basic Principles of Virtual Element Methods”, Mathematical Models and Methods in Applied Sciences, 23, 119-214, 2013.