AN OVERVIEW OF QUADRATURE TECHNIQUES IN XFEM AND NEW RESULTS WITH EQUIVALENT POLYNOMIALS

Giulio Ventura
Department of Structural, Geotechnical and Building Engineering, Politecnico di Torino
Corso Duca degli Abruzzi 24, 10129 Torino, ITALY
giulio.ventura@polito.it

Elena Benvenuti
Engineering Department, University of Ferrara
Via Saragat 1, 44122 Ferrara, ITALY
elena.benvenuti@unife.it

Key Words: *extended finite element method, quadrature, equivalent polynomials.*

ABSTRACT

Current literature [1,2,3] shows an increasing interest on the quadrature of enriched finite element stiffness. This interest is justified by both improving numerical efficiency and simplifying the computer implementation of the eXtended Finite Element Method. In fact, the introduction of highly non-linear or discontinuous enrichment functions has the consequence of generating element stiffness expressions that are very difficult to be integrated efficiently. The problem is nowadays still open although some significant contributions in the literature have been presented.
Some of the literature approaches to the problem will be commented to illustrate the general flux of ideas circulating on this topic and the still open points. In particular, one of the first approaches for dealing with the problem is based on equivalent polynomials [4]. The enrichment function, nonlinear and/or discontinuous, is replaced by a polynomial whose integral at the element level is equal to the one of the original function, allowing the straightforward use of standard Gauss quadrature.
The method is briefly illustrated and new results of its application will be shown, with some considerations related to its approximation properties compared to exact quadrature.

REFERENCES

[1]. S. Natarajan, D.R. Mahapatra, S.P.A. Bordas, Integrating strong and weak discontinuities without integration subcells and example applications in an XFEM/GFEM framework, Int. J. Numer. Meth. Engng., Vol. **83**, 269–294, 2010.
[2]. S.E. Mousavi, N. Sukumar, Generalized Gaussian quadrature rules for discontinuities and crack singularities in the extended finite element method, Comp. Meth. Appl. Mech. Engng., Vol. **199**, 3237–3249, 2010.
[3]. D.J. Holdych, D.R. Noble, R.B. Secor, Quadrature rules for triangular and tetrahedral elements with generalized functions, Int. J. Numer. Meth. Engng., Vol. **73**, 1310–1327, 2008.
[4]. G. Ventura, On the elimination of quadrature subcells for discontinuous functions in the eXtended Finite-Element Method, Int. J. Numer. Meth. Engng., Vol. **66**, 761–795, 2006