An Equivalent Polynomial Library for Accurate Quadrature of the Regularized Heaviside Enrichment Function

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ABSTRACT

When dealing with transition from continuous to discontinuous displacement in XFEM a regularized form of the Heaviside step function is quite often employed. The regularized Heaviside step function is ruled by a parameter such that the exact step function is recovered in the limit, Fig. 1.

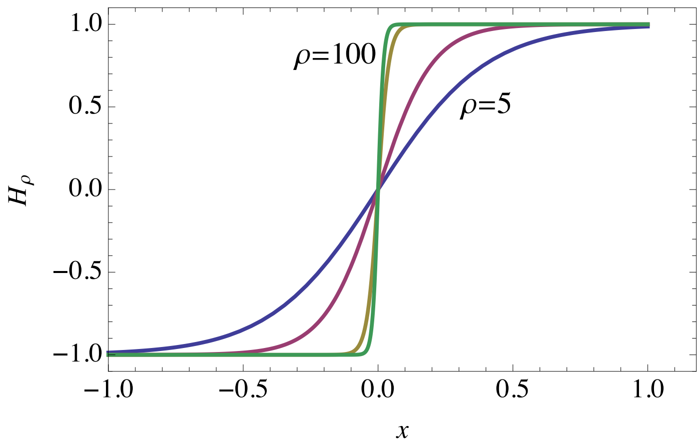

Figure 1: Graph of a regularized Heaviside step function ruled by a control parameter ρ.

When introducing this kind of enrichment function a noticeable problem is given by an accurate evaluation of the element stiffness. In fact, Fig. 1, as the control parameter ρ diverges mimicking a sharp displacement transition, the gradient of the regularized Heaviside function diverges as well and the quadrature of terms involving the enrichment function becomes more and more difficult and computationally expensive.

To solve this issue the regularized Heaviside function has been successfully mapped onto an equivalent polynomial [1,2] having the property of giving the same integral of the enrichment function in the finite element domain, but computable with traditional Gaussian quadrature. The general methodology for the construction of the equivalent polynomial will be shown and the use of the computational library made available on http://equivalent-polynomials.net will be introduced. Emphasis will be given to the performance of the method in terms of accuracy of the evaluated integrals and examples of applications will be shown.

REFERENCES

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