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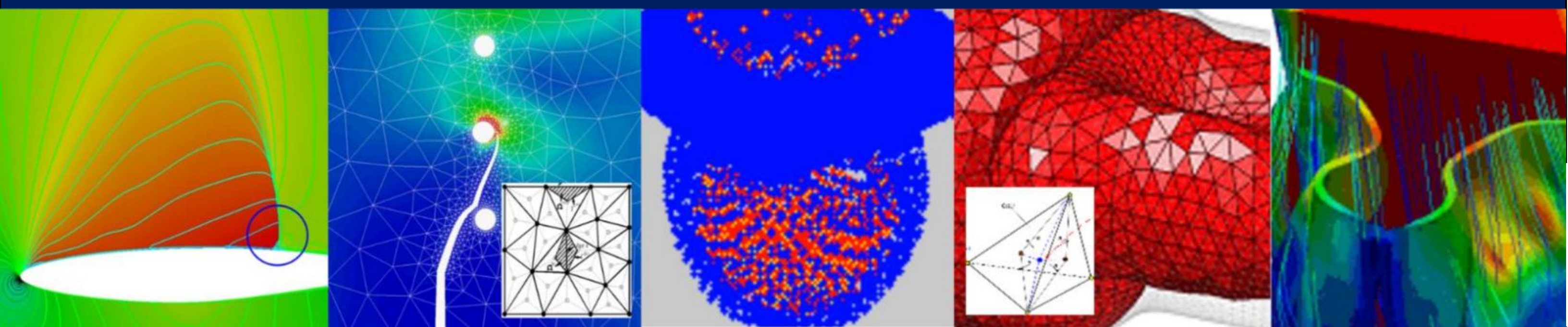

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Stress evaluation in nonhomogeneous nonlocal elastic 2D structures

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Abstract

Some important research themes of engineering applications involving nonlocal continuum approaches require a reliable evaluation of the nonlocal stress fields. This is the case, for example, of elastic fracture mechanics problems where a nonlocal approach, which overcome singularity drawbacks arising from a local elastic treatment, could be fruitful applied together with nonlocal stress based criteria, or, referring to more recent challenges, problems of nonlocal limit analysis of nano-structures tackled by a static approach.

The nonlocal stress field can indeed be (approximately) obtained as solution of a displacement-based nonlocal finite element method (NL-FEM). To this concern a NL-FEM was implemented by the authors with reference to plane stress cases and for 8-node, serendipity, isoparametric quadrilateral finite elements [1]. It has been observed that the NL-FEM produces reliable results in terms of (nonlocal) strain distributions while, when applied to nonhomogeneous structures, the solution in terms of (nonlocal) stresses shows some spurious oscillations in the zones characterized by stress concentrations or macroscopic inhomogeneity.

The present study investigates on the reasons of such spurious oscillations, which render the nonlocal stress solution unreliable, envisaging a sort of *nonlocal stress locking* resembling, in many formal aspects, analogies with a similar phenomenon exhibited by local finite elements with embedded discontinuities, [2]. With the aid of some numerical examples and benchmark solutions, it will be shown that such anomalies in the stress solution can be totally removed by using a well know numerical technique, i.e. the Gauss rule with *reduced integration* [3], [4]. The numerical results, at least for the analyzed cases, show how the reduced integration, which is only one of the possible remedies for locking in FEM, yields to very good results in terms of nonlocal stress evaluation opening the way to several fields of modern applications.

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