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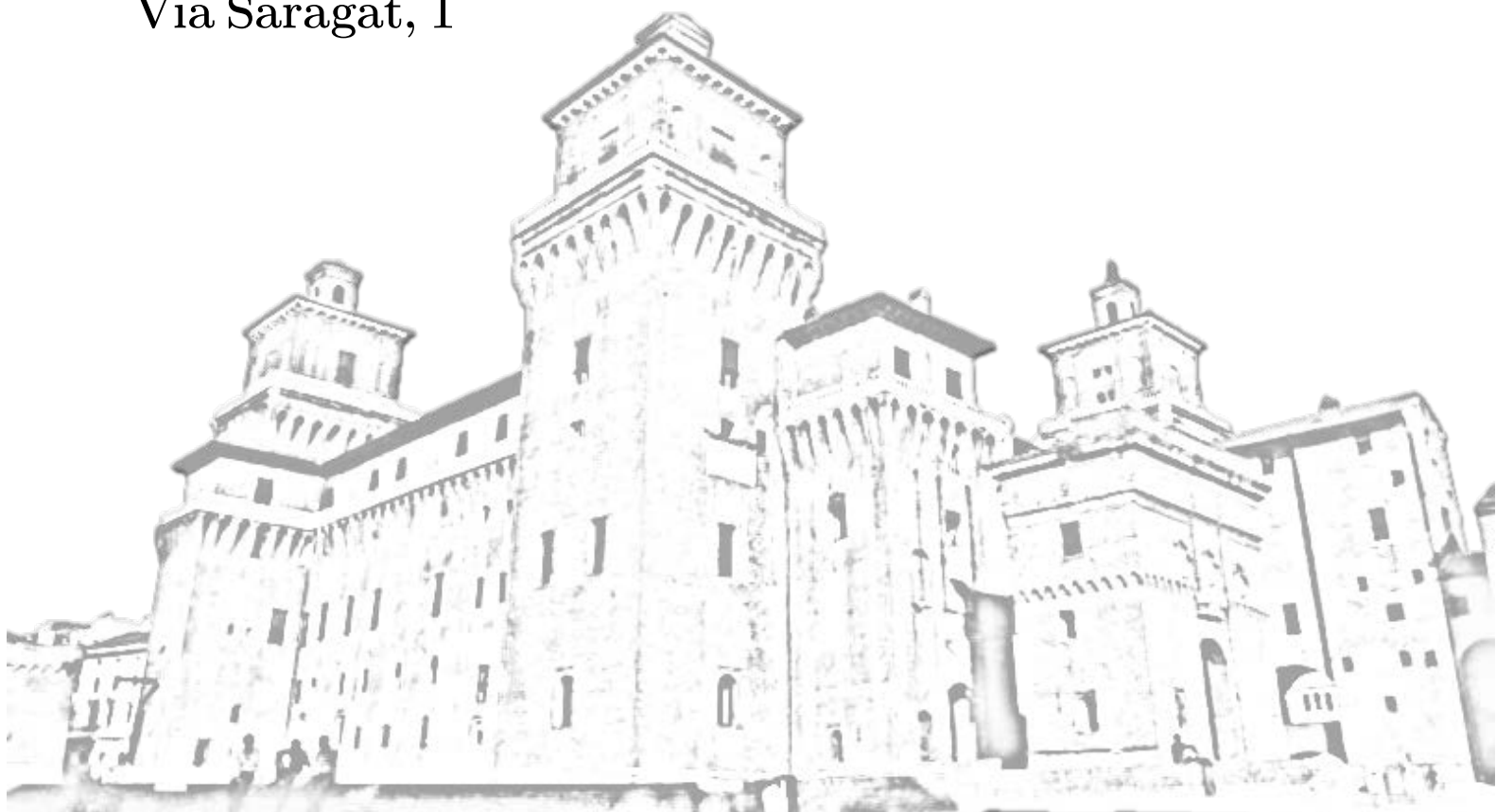


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Stress evaluation within nonlocal Finite Element Method

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The paper deals with the stress evaluation in 2D nonlocal elastic structures discretized by displacement-based, isoparametric, 8-nodes, Serendipity, nonlocal finite elements (NL-FEs) implemented by the authors in [1]. It is pointed out how, in the numerical analysis carried on by NL-FEs models, the computed nonlocal stresses are affected by some *spurious oscillations* arising in the zones of macroscopic inhomogeneity and propagating in the surrounding areas. This highly undesirable phenomenon, which yields an unreliable solution in terms of stresses, recalls a sort of locking in FEM widely studied in the early seventies in the context of classical (local) finite element method (see e.g. [2], [3] and references therein) and, for many formal aspects, it also recalls the *stress locking* exhibited by FEs with embedded discontinuities, [4].

To overcome the above drawback, here named *nonlocal-stress-locking*, a Gauss rule with *reduced integration* is proposed in the context of nonlocal finite elements. Some general considerations and remarks on the reasons of such oscillations, strictly related to the evaluation of the nonlocal operators involved in the numerical computations, as well as on the benefit of using a reduced integration in NL-FEM will be argued in the paper. Few numerical examples and benchmark problems, for which alternative analytical solutions are available, are presented and critically discussed to highlight the remarkable improvements obtained in terms of nonlocal stress field evaluation for the considered cases. Possible future steps of the ongoing research on this theme are also drawn.

References

- [1] Fuschi, P., Pisano A.A., De Domenico D., "Plane stress problems in nonlocal elasticity: finite element solutions with a strain integral formulation", *Journal of Applied Mathematical Analysis and Applications*, Vol. 431, pp. 714-736, (2015).
- [2] Zienkiewicz, O.C., Taylor, "The Finite Element Method", McGraw-Hill book company, (1989).
- [3] Bathe, K.J., "Finite Element Procedures", New-Jersey: Prentice-Hall, (1996).
- [4] Jirasek, M., Zimmermann T. "Embedded crack model. Part I and Part II", *International Journal for numerical Methods in Engineering*, Vol.50, pp. 1269-1305 (2001).