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ON THE SUBSCALE ENRICHMENT OF CRACK TIP ELEMENT IN XFEM AND THE PHANTOM NODE METHOD

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For accurate modelling of fracture in thin-walled large-scale structures, a sufficient fineness of the spatial discretization is needed. However, for efficiency reasons, large-scale structures cannot be modelled with an extremely fine mesh.

To couple accuracy to efficiency, it is intended in the current contribution to represent the propagation of a crack not only segment-wise through the entire shell elements (edge to edge) [1] but also inside the elements with the possibility to include kinks. The basic concept relies on the fact that the crack tip element is treated on a subscale, where, in addition to the macroscopic displacement fields, a fluctuation field is introduced to allow for proper representation of the discontinuous kinematics, cf. Figure 1.

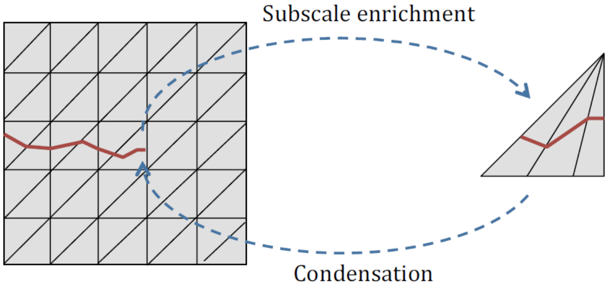

Figure 1: Subscale enrichment of the cracked element.

In order to obtain a method that does not influence the spatial discretization of the domain of interest on the macroscopic scale, a subscale enrichment of the displacement field is proposed in conjunction with a local model reduction technique such that introduction of new nodes in the macroscopic mesh is avoided. For each cracked element, the subscale problem in terms of its additional enrichments can be solved locally by applying the boundary variables associated with the boundary nodes obtained from the macroscopic scale. After this the effect is condensed and applied to the global problem. Alternatives of the approach to be utilized for both XFEM and phantom node method will be addressed and evaluated.

REFERENCES

[1] Mostofizadeh, S., Fagerström, M., Larsson, R., Dynamic crack propagation in elastoplastic thin-walled structures: Modelling and validation. *International Journal for Numerical Methods in Engineering*, 96 (2) pp. 63-86.