# A remedy for traction oscillations in interface elements

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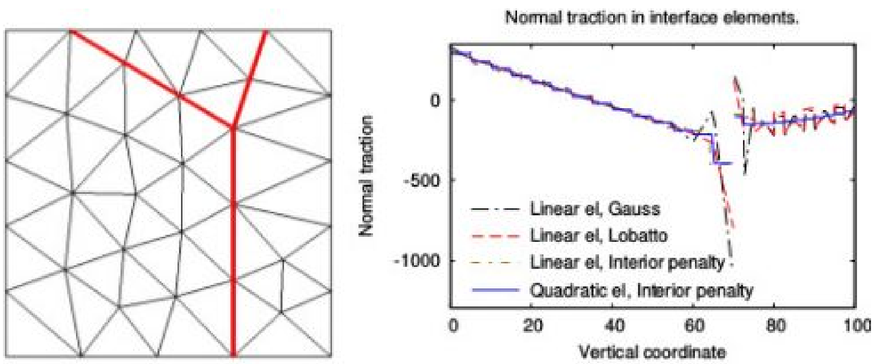
**ABSTRACT**

It is well known that the use of so-called intrinsic interface elements employing a cohesive zone model with a high initial stiffness may result in traction oscillations along the cohesive zone. Common strategies to circumvent these problems are to lower the elastic stiffness or to resort to reduced integration (Newton-Cotes/Lobatto) of the traction along the cohesive surface, cf. e.g. [1] for the latter. In the present work, we show that these oscillations are related to violation of the inf-sup (LBB) condition for the corresponding mixed formulation. In particular, we show that oscillation free results can be obtained by choosing a stable traction approximation and applying it to the interface elements as an interior penalty formulation. As an example, we note that a locally quadratic displacement approximation in combination with a traction approximation that is piecewise constant on each element is stable (see e.g. [2]). This way, a stable approach is obtained without having to resort to a mixed formulation with additional (traction) degrees of freedom. To illustrate the effect of the interior penalty formulation, we consider a structure with a branching crack modeled by interface elements as shown to the left in the figure below. The normal traction along the left crack branch is shown to the right in the figure below. As can be seen, the interior penalty formulation gives a smooth traction profile, whereas both standard Gauss quadrature and Lobatto integration result in spurious traction oscillations.




## References

[1] J. C J Schellekens and R. de Borst. On the numerical integration of interface elements. Int. J. Numer. Meth. Eng., 36(1), 43-66, 1993

[2] E. Lorentz. A mixed interface finite element for cohesive zone models. Comput. Method. Appl. M., 198(2), 302-317, 2008