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A DISCRETE EMBEDDED STRONG DISCONTINUITY APPROACH FOR THE SIMULATION OF THREE-DIMENSIONAL FRACTURE PROBLEMS

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In recent years, several approaches have been proposed to deal with the simulation of the fracture behaviour of quasi-brittle materials. Currently, different examples can be given, concerning either nodal or element enrichment strategies, which can adequately handle bi-dimensional or even three-dimensional settings [1, 2, 3, 4]. In the latter case, however, the process of progressive nodal enrichment can become quite complex and computationally demanding.

Aiming at contributing to the development of a robust approach for three-dimensional fracture, an element enrichment technique is herein proposed within the scope of the discrete crack approach [5, 6]. For this purpose, the DSDA [5] is extended to deal with three-dimensional problems, being herein designated by 3D-DSDA. With this approach, regular finite elements are enriched with additional degrees of freedom for capturing the spatial jumps of an embedded discontinuity. The corresponding jumps are then transmitted as a rigid body motion to the surrounding neighbourhood.

The following main characteristics are highlighted: (i) variational consistency; (ii) no limitations on the choice of parent element; (iii) comprehensive kinematics of the discontinuity; (iv) additional global degrees of freedom are located at the discontinuity; (v) continuity of both jumps and tractions across element boundaries; and (vi) stress locking free. Comparing with other nodal enrichment techniques, e.g. XFEM or GFEM, significantly less degrees of freedom are required to model the discontinuity using the

3D-DSDA [7, 8]. Furthermore, additional integration on subdomains is not needed, which makes the proposed formulation much easier to implement and less prone to numerical integration problems.

Finally, the 3D-DSDA is herein validated using both numerical and experimental results from benchmark tests. Finally, the most important results are discussed and the main conclusions are drawn.

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