A hybrid VEM/BEM numerical technique for simulating damage in composite materials

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Abstract:

Composite materials are nowadays widely used in the aerospace sector both for primary and secondary structures for their high mechanical properties and the ability to model them according to project needs. Therefore, accurately predicting material behaviour when subjected to operating loads is extremely important in making the design process more efficient. For this purpose, computational approaches based on continuum damage mechanics have been largely used to study the progressive loss of material integrity due to the propagation and coalescence of microscopic defects.

In this contribution, a recently developed hybrid computational technique, which combines the *Virtual Element Method* (VEM) with the well-known *Boundary Element Method* (BEM), is employed to study unidirectional fibre-reinforced composite material's transverse behaviour in the presence of inclusions with complex geometries. BEM is used to model the stiffer inclusion phase, which is considered a linear elastic material and maintains its pristine state. VEM is adopted to study the softer matrix phase, using VEM's peculiar feature, which can simulate general nonlinear phenomena with a straightforward implementation like that of the standard FEM one.

In this work, an application of the hybrid formulation mentioned above is presented to simulate damage onset and propagation in the matrix phase of the transverse section of a composite unite cell.

Numerical results are discussed and compared with known results available in the relevant literature.