ROMA TRE
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Avviso Seminari

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The XFEM/GFEM – basics and recent advances

Abstract

The eXtended Finite Element Method (XFEM) / Generalised Finite Element Method (GFEM) is a well established technique for the simulation of arbitrary strong and weak discontinuities such as cracks and their propagation and heterogeneities. One of the advantages is that changes in the discontinuity can be simulated without a change of the mesh leading to a great efficiency. The XFEM/GFEM incorporates so-called enrichment functions to account for the respective discontinuity within finite elements. In most cases the XFEM/GFEM is used in combination with level set techniques to reflect the geometry of the discontinuity almost independent of the finite element mesh.

In this presentation the basics of the XFEM/GFEM, important computational aspects for a robust implementation as well as current difficulties and possible solutions are presented. Applications are 2D and 3D crack propagation examples in linear elastic fracture mechanics, crack face contact, crack propagation in combination with highly nonlinear material behaviour as well as the simulation of heterogeneities under small and finite elastic and inelastic deformations.

Dipartimento di Ingegneria, Aula Seminari, via Vito Volterra 62
Lunedì 30 Settembre 2019, ore 11:30

Multiscale Methods for Fracture

Abstract

Classical numerical multiscale techniques like computational homogenisation or FE^2 methods are based on the concept of a representative volume element (RVE). To achieve accurate results the size of the RVE should be chosen appropriately such that the statistical representativeness is given and at the same time the computational effort is reasonable. In case of localisation phenomena such as dominantly growing cracks the classical RVE concept fails. The effective response of the RVE strongly depends on the chosen size of the RVE unless special care is taken about the localisation effect. In this presentation an alternative strategy is presented that can generally be used for localisation phenomena such as crack propagation and local instabilities, i.e. fibre kinking etc. The concurrent multiscale technique is based on the projection of the stresses and stiffness from the fine scale to the coarse scale mesh. Fine scale features such as microcracks or heterogeneities are considered explicitly only within the fine scale domain. Their effect however is implicitly included in the coarse scale simulation. The boundary conditions for each fine scale simulation are pure displacement boundary conditions coming from the coarse scale solution. They are projected onto the boundary of the fine scale domain. Each fine scale domain can be simulated independently and in parallel leading to an efficient technique also for multiple fine scale domains. It is shown that this multiscale projection method leads to converged results independent of the choice of an RVE size.

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