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Dottorato di Ricerca in *Rischio e Sostenibilita' nei Sistemi dell'ingegneria Civile, Edile E Ambientale*

AVVISO DI SEMINARIO

06 Dicembre 2019, ore **11:30,** Sala Multimediale Laboratorio Strutture Strength L2

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Università UNINETTUNO

Title:

An application of variational methods in strain gradient damage and fracture mechanics

Abstract:

Localized deformations are often encountered in engineering applications. These lead to stress concentrations, damage and fracture mechanisms. Damage is therefore introduced via a scalar field, which has the role to degrade the elastic properties of the material, which is assumed geometrically nonlinear. Besides, in order to (i) control the size of localization regions, (ii) penalize deformations that are too localized and (iii) provide mesh independent numerical simulations, some characteristic lengths via the use of higher order displacement gradient terms in the internal deformation energy are adopted. In the literature, this is pretended to be achieved with the use of gradient damage terms and a discussion on advantages and disadvantages of the two approaches will be done.

On the one hand, damage and fracture phenomena are clearly of irreversible nature. Thus, a dissipation term in the deformation energy is considered. On the other hand, the use of higher order displacement gradient terms necessitates the use of a principle of least action guaranteeing the uniqueness of the solution, which is vital for engineering design.

Thus, we show a variational inequality formulation, which leads to (i) Partial Differential Equations (PDEs), (ii) Boundary Conditions (BCs) and (iii) Karush-Kuhn-Tucker (KKT) conditions. We remark that (i) PDEs are of fourth order, (ii) BCs include non-standard external actions such as, e.g., the possibilities of concentrated forces and distributed couples and (iii) KKT conditions are associated to an explicit and analytic damage evolution law.

The dependence of Lamé and second gradient elastic coefficients with respect to damage is a constitutive assumption and need to be experimentally identified. Generally, they are all assumed to decrease as damage increases and to be locally zero for the fracture condition.

A numerical technique based on commercial software will be presented and discussed for a couple of exemplary problems, where a discussion will be performed, with the inclusion of mesh-independence evidence and the result of a crack formation crossing the boundary of the body non orthogonally. The exemplary cases are related to an obliquely notched 2D rectangular specimen subject to monotonous tensile and shear loading tests and brittle fracture propagation is discussed.

Short Biography: I graduated in Physics at the University of Naples Federico II in 2001. Second degree in Engineering with Prof. R. Batra at the Virginia Polytechnic Institute and State University in 2002. I took the first PhD in 2004 at the Technical University of Darmstadt and the second PhD in 2006 at the University of Rome La Sapienza. From May 2011, I am assistant professor (ricercatore) at the International Telematic University Uninettuno. In 2014, I got the Italian habilitation and in 2016 the French habilitation (HDR). From 2019 I am associate professor at Uninettuno. Bibliometrics Scopus (AU-ID: 57199322424).