DAMAGE MECHANICS

Research group: **Elena Ferretti**, Alessandro Marzani, Luisa Molari, **Francesco Ubertini**, Erasmo Viola

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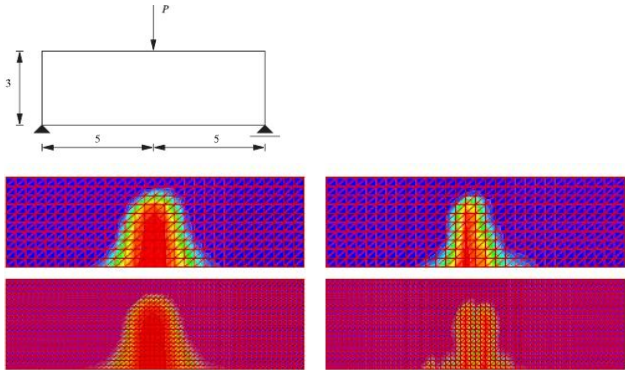

Fig.1 FEM analysis of damage in three-point bending

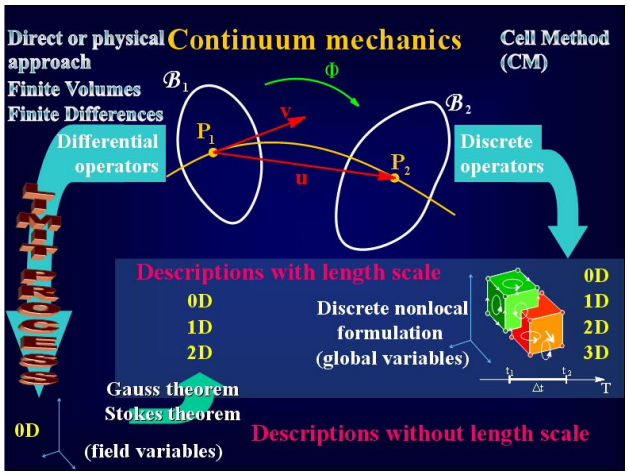

Fig.2 the CM compared to the differential formulation

The nucleation and growth of cracks can be described by continuum damage mechanics. An internal variable is included in the constitutive law to represent the evolution of microstructural damage.

Damage degradation can manifest itself in progressive material softening, for which reason numerical results based upon classical continuum mechanics are characterised by a pathological mesh dependence: to avoid this regularised continuum models have been introduced. Among these are the strain gradient models.

We address numerical issues associated with some strain gradient models. Numerical complication arises from the higher order character of the governing differential equations. A discontinuous Galerkin method has been developed.

An alternative approach shows that nonlocal constitutive laws between stresses and strains are not strictly needed to construct a material model. They are required only if we use a differential formulation, in which the length scale is absent since the metric notions have been lost in performing the limit process. Also the effective law, which is a local constitutive law, is suitable for modelling nonlocal effects if used with a formulation which is nonlocal in itself, such as the Cell Method (CM) is.

The research group has focused his attention both on static and dynamic analysis of damaged slender structures.

A new fatigue sensor called Smart Stress-Memory Patch, which can estimate the cyclic number, the stress amplitude and the maximum stress from the measurement of crack length and acoustic emission (AE), is proposed for Structural Health Monitoring (SHM), to evaluate the fatigue damage of such infrastructure as bridges and ships. The fatigue crack growth behaviour of thin electrodeposited (ED) Cu specimen for this sensor is investigated. The modified stress intensity factor is proposed to introduce the master curve of fatigue crack growth, because the fatigue growth behaviour of this patch is affected by the maximum stress and the stress ratio.

Links

elena.ferretti2@unibo.it
francesco.ubertini@unibo.it

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ALMA MATER STUDIORUM • UNIVERSITÀ DI BOLOGNA
VIALE DEL RISORGIMENTO, 2 - 40136 BOLOGNA - ITALIA - TEL. +39 051 2093237 - 2093502 - FAX +39 051 2093253
VIA TERRACINI, 28 - 40131 BOLOGNA - ITALIA - TEL. +39 051 2090312 - FAX +39 051 2090322
www.dicam.unibo.it