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Multi-Scaling Approach in the Mechanics of Disordered Materials

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Several theories have been proposed in the last decades, in order to describe the scaling of mechanical properties in solid mechanics, particularly the brittle-ductile transition as the structure size increases. Among them, the only approach that encompasses coherently the size-scale effects not only on strength, but also on fracture energy and on the critical displacement, is the fractal one. It is based on the assumption of a fractal-like damage localization at the mesostructural level. This fractality evidences the size scale effects and permits, by using a renormalization procedure, to define new fractal quantities, which are the true material properties governing the failure mechanism independently of the structural size. These quantities permit to introduce a scale-independent (fractal) cohesive crack model, which overcomes the original cohesive crack model drawbacks. Moreover, the fractal quantities allow, by means of fractional calculus, to write the Principle of Virtual Work for fractal media. Eventually, the fractal model is applied to some experimental data.

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