Topology optimization for maximizing the fracture resistance of materials and structures

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Abstract

Topology optimization has been massively applied in the recent years to structures and heterogeneous materials to improve their elastic properties (stiffness, compressibility, thermal conductivity, etc.). If these techniques are well established in the linear regime, applications in the nonlinear framework remains relatively unexplored and adds many difficulties.

In the present work, we present a topology optimization framework to maximize the resistance of materials and structures to crack propagation. In contrast to stress-based approaches restricted to the linear regime, we here take into account the full initiation and propagation of cracks within the structures or the materials. Then, different criteria based on minimal fracture energy or minimal total crack length have been developed. Several problems are investigated: (i) the design of two-phase composites; (ii) 3D printed materials with strong anisotropy and (iii) structures subjected to dynamic loads.

References

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