Design of material anisotropy constitutive matrices for structural stiffness and strength optimization - DTU Orbit (16/12/2018)

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Improved possibility to produce specific materials, say by fiber lay-up, makes research with Free Material Optimization (FMO) directly applicable. Multiple load cases (restricted to be design independent) are involved with the objective to optimize the structural stiffness and/or strength. The design optimization is possible by a conceptual separation of the material distribution throughout the structure and subsequent use of local amount of material to obtain optimized constitutive matrices, that are normalized to non-dimensional unit size (trace and Frobenius norm). Alternatively formulated: Where to put the material and how to use it locally? The presentation at first concentrates on the stiffness objective for single as well as multiple load cases. The objective of strength is simultaneously obtained for the single load case, but not for multiple load cases, because stiffness and strength then may require different optimized designs. Next the strength objective is investigated with recursive redesign to obtain uniform maximum elastic energy density, based on given total available material. The following material redesign, in each iteration, of the local constitutive matrices are determined analytically directly from the actual strain fields. An example of a 2D plane stress problem with 8 load cases and 8192 design parameters is optimized.

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