Ultra high resolution topology optimization: Brute force or smart discretizations?

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The optimal topology of large structural systems has until now been concerned with the design of individual parts and not that of complete assemblies. Following recent advances in numerical algorithms tailored for large scale structural optimization, this limitation has now be circumvented, mainly by utilizing powerful HPC system [1]. The design approach has been demonstrated on both aircraft, bridge and ship design problems, resulting in noticeable performance enhancement. However, the increase in design resolution comes at a great cost in terms of the needed computational power. Therefore, it is interesting, if not paramount, to pursue alternative design representation schemes that allows for ultra high resolution optimal designs without the need for large computing resources. This talk will present both the brute force topology optimization approach, in which the governing PDEs are solved by classical methods, i.e. Krylov methods and multigrid preconditioning [2], as well as novel homogenization based projection schemes [3]. The latter allows for the solution of the design problem at low resolution, and by parameter extraction, one can represent the design using orders of magnitude finer design representations.

