11th World Congress on Structural and Multidisciplinary Optimisation
07th -12th, June 2015, Sydney Australia

Topology Optimization of a Transient Thermo-Mechanical Problem using Material Penalization

Emiel van de Ven[1, 2], Evert Hooijkamp[2], Matthijs Langelaar[2], Fred van Keulen[2]

[1] National Aerospace Laboratory, Amsterdam, the Netherlands, emiel.van.de.ven@nlr.nl;
[2] Delft University of Technology, Delft, the Netherlands, m.langelaar@tudelft.nl, a.vankeulen@tudelft.nl;

Abstract

Designing transient thermal mechanical systems is a challenging task. Material can have many different functions: it can provide heat capacity, heat conduction, mechanical stiffness or even function as an actuator. Topology optimization can provide the engineer with valuable insight on such a problem. One of the most popular topology optimization approaches is the density method. This method is applied to a transient thermal mechanical problem. In order to ensure manufacturability, penalization is applied to suppress intermediate densities in the final design. However, for transient thermal mechanical optimization problems, conventional penalization does not work for most objective functions. A new penalization method, material penalization, is presented that does suppress intermediate densities in the transient thermal mechanical domain. Each element is given its own unique set of penalization parameters which are optimized to maximize the objective function for a minimization problem. By reusing sensitivity information from the density variables, the additional computational cost is limited.

Keywords: topology optimization; penalization; manufacturability; transient thermo-mechanical.