EngOpt2018 - 6th International Conference on Engineering Optimization
Instituto Superior Técnico, Lisbon Portugal • 17-19 September, 2018
Editors: H.C. Rodrigues, J. Herskovits, C.M. Mota Soares, et al.

Abstract ID 1017

SHAPE DERIVATIVES OF GEOMETRIC CONSTRAINTS WITHOUT INTEGRATION ALONG RAYS

Florian Feppon(1), Grégoire Allaire(1), Felipe Bordeu(2), Julien Cortial(2), Charles Dapogny(3)

(1)Ecole polytechnique, France
florian.feppon@polytechnique.edu, gregoire.allaire@polytechnique.fr

(2)SAFRAN TECH, France
felipe.bordeu@safrangroup.com, julien.cortial@safrangroup.com

(3)Université Joseph Fourier, Grenoble, France
charles.dapogny@univ-grenoble-alpes.fr

Keywords: Topology optimization, level set method, signed distance function, thickness constraints, advection operator

Abstract: A variational method is proposed to compute integral quantities along the characteristic curves of a velocity field without the need for computing these curves explicitly on the spatial discretization. Such needs occur for instance whencomputing shape derivatives of geometric constraints built upon the sign distance function, which involves integration along normal rays of the optimized shape. Here, we rely on a symmetric variational problem that can be solved conveniently with the finite element method. The well-posedness of the formulation is established through a detailed analysis of weighted graph spaces of the advection operator for C1 velocity fields. Our working assumptions are fulfilled in the context of shape optimization of C2 domains, for which the velocity field is a unit extension of the outward normal. The variational method is compared numerically to direct integration along rays on several analytical examples. Implementation issues such as curvature estimation or taking the skeleton of the ape into account are discussed. Finally, we illustrate the use of our method to enforce conveniently maximum and minimum thickness constraints in structural shape optimization.