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SHAPE SENSITIVITY ANALYSIS IN THE CARTESIAN GRID FINITE ELEMENT METHOD (cgFEM)

Onofre Marco[1,2], Juan José Ródenas[1]*, F. Javier Fuenmayor[1], Enrique Nadal[1] and Manuel Tur[1]

[1] Research Centre in Mechanical Engineering (CIIM). Universitat Politècnica de València
Camino de Vera, s/n, Edificio 5E, 46022 Valencia, Spain
[2] Laboratori de Càlcul Numèric (LaCàN). Universitat Politècnica de Catalunya
Jordi Girona 1-3 E-08034 Barcelona, Spain

e-mail: onofre.marco@upc.edu, jjrodena@mcm.upv.es, ffuenmay@mcm.upv.es, ennaso@upvnet.upv.es, manuel.tur@mcm.upv.es

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Immersed boundary methods like, in this case, the Cartesian grid Finite Element Method (cgFEM), described for the 2D case in [1], can be used to improve the behaviour of shape optimization algorithms by reducing the computational cost associated to each of the individual FE analyses to be performed during the optimization process. In this work, we show how the shape sensitivity analysis (SSA) techniques required to obtain the gradients for gradient-based optimization algorithms have been adapted, in the 3D case, to the cgFEM framework [2]. This adaptation includes a custom-made evaluation of the design velocity field required by the SSA and to take into account that Dirichlet boundary conditions must be applied on non-fitted meshes. The numerical results show that the behaviour of the SSA within the cgFEM context is adequate in terms of both, convergence rate and accuracy.

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