Adaptive finite elements for structure design

Simona Perotto, Nicola Ferro and Stefano Micheletti

MOX – Department of Mathematics, Politecnico di Milano
Piazza Leonardo da Vinci, 32, I-20133, Milano, Italy
e-mail: simona.perotto@polimi.it, web page: http://www1.mate.polimi.it/~simona/

ABSTRACT

The spread of Additive Manufacturing (AM) has raised interest in a deeper knowledge of production processes. There is a strong concern in identifying the actual benefits brought by AM with respect to traditional subtractive techniques. In particular, it is widely agreed that structures have to be conceived via new paradigms to take advantage of the peculiar features of AM processes. In this respect, topology optimization (TO) provides a relevant mathematical tool for the design of geometries characterized by completely new shapes and features.

SIMP (Solid Isotropic Material with Penalization) method represents one of the approaches to TO most frequently investigated in the literature [1]. SIMP identifies the optimal material/void distribution inside an assigned design domain, under desired constraints on the final configuration. Variants of SIMP have been proposed to overcome some issues arising from the basic procedure and to increase the quality of the resulting structures.

In this presentation we present a methodology for the design of structures which are almost ready for the industrial production, containing as much as possible any post-processing (e.g., smoothing) phase. For this purpose, we propose the algorithm SIMPATY (SIMP+AdaptiviTY), which enriches the standard SIMP method with the employment of computational meshes strictly customized to the optimization procedure, towards the design of ready-to-print structures [2, 3]. In particular, after introducing the background mathematical setting, we provide the implemented algorithm assessed on benchmarks as well as on more challenging structure configurations.

REFERENCES

