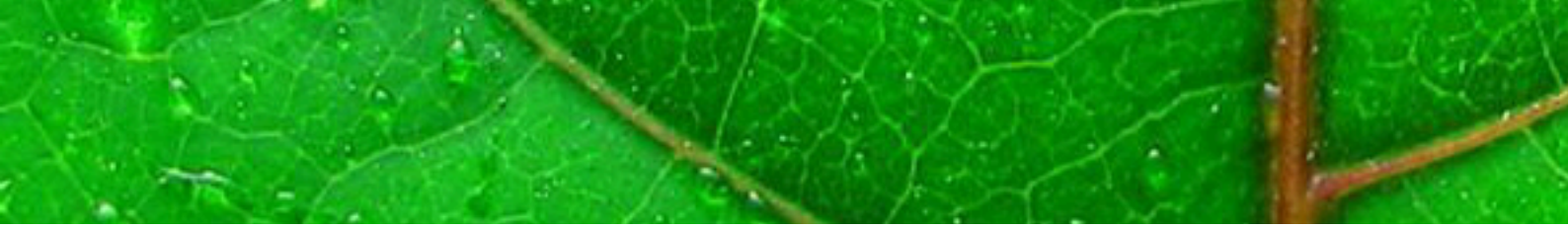

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Title : Shape Optimization for Additive Manufacturing problems.

Abstract: Additive Manufacturing (AM) is the set of processes for building objects using a layer by layer deposition system. This is an active field thanks to the provided advantages: the complexity of the structures is almost unlimited from a geometrical point of view in comparison with classical methods such as moulding or casting. Applications of AM can be seen in diverse industries such as aeronautics, automotive or biomedical.
In this talk we will discuss some problems of interest in AM and how shape optimization tools can help us to address them. In first place we consider the problem of optimal placement of support structures, used to reinforce overhanging (near-to-horizontal) regions of the desired structure and/or to facilitate the mitigation of residual thermal stresses, when an imperfect interface between them and the supported structure is considered, which modelizes the fact that supports are, on purpose, weakly connected to the built structure for easing their removal. In second place, we consider the so-called accessibility constraint: in the context of AM, the support structures need to be removed, most of the time with a drill, without touching the supported part. Therefore it is necessary to define properly when a surface is accessible (for a removal tool) and how to quantify this, for a given geometry. have an access to the surface of the part to perform a finishing operation, a specific zone of the part could be inaccessible by a tool if another part of the manufactured part obstruct the way to the tool.
In both cases, we present the modelization of each problem in terms of defining an appropriate cost functional and therefore obtaining an optimization problem where the unknown is a domain/shape. Then, we use the Hadamard approach together with the adjoint method to compute a shape derivative, which allows to define a gradient-descent-like numerical scheme in which we use the level-set method in order to track in an efficient way the modifying domain in consideration.
This is joint work with Grégoire Allaire (CMAP), Beniamin Bogosel (CMAP) and Martin Bihr (SAFRAN, CMAP).