Abstract Gillot:

Within the framework of mechanical product design, several approaches can be used in order to define an optimal product shape with regard to given specifications. Among those approaches, recent works are mainly focused on topographical optimization in order to converge to a theoretical optimal shape. Unfortunately, such approaches hardly provide local gradient when used during non-linear optimization problems. Moreover, obtained optimal shapes are usually impossible to manufacture without deep modifications. Because of these changes, the rebuilt design will no longer be optimal and the objective functions values will be altered. On the other hand, parametric approaches are commonly used to generate optimal shapes. Even if this allows fast computing, it also restricts the design subspace to a limited set of solutions depending on the way the part is initially parameterized. Moreover, parametric approaches allow only a few topology changes.

We present in this paper a shapes blending optimization framework under implicit parameters constraints. Our approach is able to provide optimal shape designs within a short time scale. The optimization loop relies on surrogate models of objective functions. Indeed these surrogate models are built by considering mode shape blending of a subset of eigenmodes shape. Thus, design parameters are the coefficient of each eigenmodes. The problem's size is similar to geometric approach although the design subspace is close to topography optimization one. Thereafter, manufacturing steps are taken into considerations by sequentially filtering the blended eigenmodes with experts rules. These rules correspond to a given manufacturing process. Hence, it can easily be changed without modifying the initial shape parameterization.

Unfortunately, due to these filters, surrogate models only based on eigenmodes shapes are misrepresenting the physical phenomenon. Hence, we take into account the effect of each filter directly when building the surrogate models. These effects are what we call implicit parameters. We calculate each implicit parameter by a weighted function comparing the non-filtered shape to the filtered one. Since we want to enhance surrogate model quality, we determine what type of function should be use by confronting surrogate models built without implicit parameters and surrogate models built with implicit parameters calculated in different ways.

My presentation will describe a new approach to find an optimal design for non-linear optimization problems, which is able to take into account several manufacturing processes. Moreover, the explored subspace is close to topography optimization space and the problem size is similar to parametric problems. We give an example of an automotive mechanical part design obtained by simple shapes blending optimization. We compare those results with results provided by our proposed framework, proving the efficiency of our parameterization.