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GEOMETRIC CONSTRAINT IMPOSITION ON TRIMMED NURBS PATCHES FOR ADJOINT OPTIMIZATION

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NURBS [1] has been the leading mathematical standard that describes geometries contained in standard CAD files. NURBS surfaces have been connected to adjoint optimization methods quite successfully, as they provide a robust and well defined deformation tool for the shapes to be designed. Quite often, optimal NURBS shapes are wrinkly with high-curvature areas that make the final model non-manufacturable. Furthermore, because NURBS surfaces are manipulated through control points, there is no direct control over the deformed shape's volume which cannot be constrained. Therefore, the optimal shape can have a volume larger than the one required to fit in an assembly. In this work, we are addressing ways to handle these two constraints that arise in different shape optimization scenarios. In these scenarios the continuous adjoint technique is used to generate a sensitivity map. The map, is then projected onto the trimmed NURBS patches that are contained in standard CAD files. The intersections between the trimmed NURBS are handled using a Null-space projection method [2]. The two constraints are defined as follows: (a) keeping the maximum curvature on a NURBS-defined solid under a threshold and (b) keeping the volume of the solid under a threshold. The constraints are programmed using Sequential Quadratic Programming and the Augmented Lagrangian Method [3]. Constraint (a) requires a technique to identify areas with curvature higher than a threshold and constraint (b) is implemented using slack variables. Their differentiation is verified using Finite-Differences and the constrained optimization algorithm is tested in various optimization examples, such as 3D wings and ducts.

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