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AN RBF CAD-COMPATIBLE PARAMETERIZATION FOR ADJOINT BASED SHAPE OPTIMIZATION

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Gradient–based optimization methods, coupled with adjoint methods for the computation of the objective function gradient are widely used in aerodynamic shape optimization problems. In most works found in the literature, the design variables are either CAD parameters or control points used to morph the shape to be optimized. The first approach has the drawback of allowing the CAD parameters to change during the optimization process in arbitrary ways, often resulting in noisy shapes (with kinks, cusps e.t.c.), especially for complex parts with large number of parameters. On the other hand, morphing approaches provide a tool for smoothly sculpting the shape to be optimized, but result in geometries which are described as a set of discrete points, thus destroying the link with the underlying CAD model. This paper focuses on coupling an RBF model with CAD representations, namely NURBS patches, so as to exploit the advantages of each approach. An RBF model is created, which instead of directly morphing the aerodynamic shape, is used to modify the CAD parameters, namely the NURBS patches control points. By doing so, the geometry movement remains smooth during the optimization, due to the inherent smoothness of the radial basis functions. The updated aerodynamic shape is created based on the updated CAD and an RBF–based mesh deformation algorithm [1] is, then, employed to deform the computational mesh. The RBF/CAD coupled model is differentiated in order to compute the so–called geometric sensitivities which, combined with the sensitivities with respect to the displacement of the surface nodes, as computed by the adjoint method, provide the objective function gradient. The flow solver and its continuous–adjoint counterpart, run on a cluster of GPUs, reducing the optimization turnaround time [2]. The developed tool will be showcased on the shape optimization of the wing of a fuselage-wing aircraft configuration.

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