Vertex morphing for CFD shape optimization in OpenFoam.

Aditya Ghantasala[1], Raza Najian-Asl[1], René-Daniel Cécora[2] and Kai-Uwe Bletzinger[1]

[1]Technische Universität München, Arccistraße 21 , 80333, München, +498928922152, (aditya.ghantasala@tum.de, reza.najian-asl@tum.de, kub@tum.de)

[2]Volkswagen Aktiengesellschaft; Brieffach 011/1697; 38436 Wolfsburg, CAE-methods developer, rene-daniel.cecora@volkswagen.de ; Automotive

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Numerical CFD shape optimization has been playing and will continue to play an important part in engineering design process. In this context, multiple parametrization techniques for the shape are in practice. In the light of well-established adjoint methods for sensitivity calculation, node-based shape optimization has gained traction in the recent days. One of the main reasons is that it offers a rich design space for the optimization. This presentation draws upon vertex morphing parametrization used for node-based shape optimization. Vertex morphing is useful for reducing the dependency of optimization on mesh irregularity and enhancing smoothness of the nodal sensitivities, thus aiding in producing smooth and regular optimization results. Initially presented examples both academic and industrial (from Volkswagen AG) using OpenFOAM establish the advantages and usability of the vertex morphing parametrization.

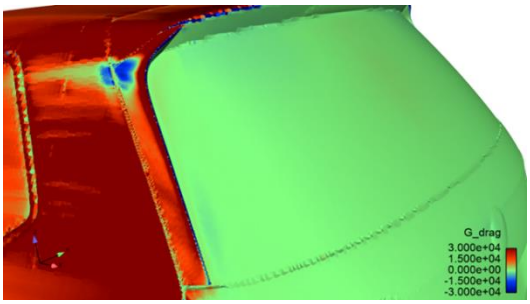

Figure 1: Noisy sensitivities sensitivities on flap of simplified Golf Sportsvan (using OpenFOAM)

Figure 2: Smooth optimized shape of the flap (red) which reduced the drag by 3%.

This method, which is developed at the Chair of structural analysis, Technical University of Munich, is available in an internal tool which is used for the above simulations Figure 1, Figure 2. Building up on this, this talk then will present VertexMorphingFoam, an OpenFOAM solver which uses readily available sensitivities calculated using a method and a tool of choice. Starting with an overview of the code structure we present the initial results from the implementation. With the importance of large-scale calculations in view a parallelization of the VertexMorphingFoam is in included in the work plan. A short overview of this and other planned activities in relation to this is also presented.