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A CAD-free adjoint shape optimization framework applied in industrial problems

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This paper deals with the development of a CAD-free adjoint shape optimization framework, with a high degree of automation and efficiency, for application in an industrial context.

Specifically, it deals with the treatment of various problems that are present in adjoint-based shape optimization applications, in which a parameterization of the surface is absent. The absence of a parameterization helps maximize the efficiency and minimize the user input, thus making the method considerably generic.

The continuous adjoint method is used for the calculation of the surface gradients in the most effective way and combined with all the different components that are necessary to construct a shape optimization framework. These include: a general implicit smoothing algorithm to ensure the geometry remains manufacturable during the optimization process; a robust mesh deformation tool, based on mesh optimization technique that includes both volume and surface regularization methods, and allows the generation of complex shapes and extreme deformations; the implementation and application of constraints in the form of constraint/limit surfaces and static surface components with smooth transition to deformable regions.

The method's efficiency is demonstrated for both external and internal flow cases and a summary of computational effort and optimization efficiency is provided.

REFERENCES

[1] Jameson A (1988) Aerodynamic design via control theory. Journal of Scientific Computing (3), pp. 233-260
[2] Stuck A and Rung T (2011) Filtered Gradients for Adjoint-based Shape Optimisation, 20th AIAA Computational Fluid Dynamics Conference 27 - 30 June 2011, Honolulu, Hawaii.
[3] Georgios K. Karpouzas, Evangelos M. Papoutsis-Kiachagias, Thomas Schumacher, Eugene de Villiers, Kyriakos C. Giannakoglou, Carsten Othmer (2016) Adjoint Optimization for Vehicle External Aerodynamics, International Journal of Automotive Engineering, Vol.7, No.1,pp.1-7