Multipoint Global Optimal Shape Design by Morphing

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ABSTRACT

The aim of this study is to determine the aerodynamic, global optimized (GO) shape of a flying configuration (FC), which is flying at two supersonic cruising Mach numbers. Due to the fact that the GO shape of a FC with respect to minimum drag at cruise, changes its optimal planform very much, if the supersonic cruising Mach number is varied, this aim can be correct realized only by morphing. The morphing is obtained by using movable leading edges flaps. The surfaces of the wing, of the fuselage and of the flaps are supposed to be expressed or approximated in form of different superpositions of homogeneous polynoms in two variables with free coefficients. These coefficients, together with the similarity parameters of the planforms of these components of FC, are the free parameters of optimization. The determination of the GO shape of FC at two supersonic cruising Mach numbers leads to the solving of two consecutive extended variational problems with free boundaries. The first one consists in the determination of the GO shape of the unmovable integrated wing-fuselage part of FC with retracted flaps, which is of minimum drag at higher cruising Mach number. The second one consists in the determination of the shape of the stretched leading edges flaps, in such a manner that the entire FC with stretched flaps is of minimum drag, at the second lower cruising Mach number.

An own developed mathematical strategy called iterative optimum-optimorum (OO) theory is used for the solving of these both consecutive variational problems. In the first step of the iterative OO theory, the surrogate GO shape is determined by using the three-dimensional hyperbolic potential solutions of the author as start solutions, as in [1] and the OO-theory as strategy of optimization of the inviscid drag functional. It follows a computational checking of the inviscid GO shape of the surrogate model by using hybrid solutions for the Navier-Stokes layer (NSL), proposed by the author, as in [1] and [2]. The friction drag coefficient is computed and a weak interaction aerodynamics-structure is performed. Up the second step of iteration the new drag functional is the total drag and additional constraints due for the structure requests can occur.

REFERENCES

[1] A. Nastase, *Computation of Supersonic Flow Over Flying Configurations*, Elsevier Oxford, UK, 2008.

[2] A. Nastase, “Hybrid Navier-Stokes solutions for aerodynamic global optimal shape’s design”, *Proc. of Eng. Opt., Paper 750, Rio de Janeiro, Brazil*, (2008).

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