Surrogate Models for the Iterative Optimum-Optimorum Theory and their Applications

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[†] ABSTRACT

The author use the principle of minimal singularities of M. van Dyke, the compability conditions of P. Germain and the hydrodynamic analogy of E. Carafoli. for the development of non-classical three-dimensional analytic hyperbolic solutions (HAS) for the boundary valuue problems of hyperbolic PDEs of the axial disturbance velocities, over several flying configurations (FCs), in supersonic flow. These solutions are written in integrated forms and use mnimal singularities, which are located only along the singular lines (like subsonic leading edges, junction lines wing-fuselage, junction lines wing-leading edge flaps etc.) and fulfill the local jumps. These non-classical HAS are used in the first step of her iterative optimum-optimorum (IOO) strategy, as start solutions for the inviscid global optimization (GO) of the shapes of FCs. New performant FCs models with GO shapes are designed and tested in the trisonic wind tunnel of DLR Cologne. A new optimized variant of Saenger project for the turistic flight in space is proposed.

The inviscid GO shapes of FCs are also used as surrogate models of IOO, in its first step of iteration. Up the second step of IOO, the use of hybrid analytic-numeric solutions for the PDEs of the three-dimensional Navier-Stokes layer (NSL) are proposed. These hybrid NSL's solutions use the HAS two time namely, as boundary values at the NSL's edge and to reinforce the NSL's solutions. These hybrid NSL's numeric solutions which are products between the HAS and polynoms with free coefficients have important analytic properties like: correct last behaviors, correct jumps over the singular lines. the singularities are balanced, the condition on the characteristic surfaces, which occurs in supersonic flow and the non-slip condition ares automatically fulfilled. A logarithmic density function is introduced instead of the density, in order to split the NSL's PDEs as in [1.[and]2]. The total drag of a FC, including friction, is computed.

REFERENCES

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