MULTIDISCIPLINARY OPTIMISATION OF FORWARD SWEPT LAMINAR WING

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Abstract. The paper presents methodology of multi-disciplinary optimization of transonic wing for large passenger aircraft. The optimization procedure is based on multi objective, multi constraint genetic Algorithm using real encoding and real genetic operators. The developed parametric model of the wing enables to generate a wide family of wing geometries defined by relatively small number of design parameters. The objectives and constraints express typical requirements for preliminary design, such as:

- minimization of fuel consumption,
- minimization of drag,
- minimization of wing weight,
- maximization of natural-laminar-flow area.

Apart from these quantitative objectives, some qualitative objectives are applied as well in order to increase efficiency of the optimization process. All objectives and constraints are evaluated using simplified and fast CFD and CSM codes, which significantly decrease the computing time and enable to obtain satisfactory results within an acceptable time. This methodology was used for preliminary design of the forward swept wing suitable for a large passenger aircraft. The goal of optimization was to design transonic, forward swept wing with a maximum natural laminar flow which is expected to reduce drag and to obtain considerable reduction of fuel consumption. As the fuel consumption is a function of both the drag and the wing weight, the aerodynamic and structural aspects of wing design have been taken into consideration. To perform the preliminary design, the parametric model of the wing was selected describing basic geometric features of wing planform and wing sections (13 parameters). The multi objective-optimization approach was applied. Four quantitative and qualitative objectives expressed required properties of the optimized wing. Additionally few other geometrical and aerodynamic constraints were imposed. As a result of multi-objective optimization, the set of Pareto optimal solutions was obtained. For a wing selected from the Pareto set, the analysis of aerodynamic and structural properties was performed confirming that significant gains were obtained during the optimisation process.