

Accepted Manuscript

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PII: S1270-9638(17)31274-9
DOI: <https://doi.org/10.1016/j.ast.2017.11.011>
Reference: AESCTE 4286

To appear in: *Aerospace Science and Technology*

Received date: 13 July 2017
Revised date: 26 October 2017
Accepted date: 6 November 2017

Please cite this article in press as: R. Puente et al., Comparison between aerodynamic designs obtained by human driven and automatic procedures, *Aerosp. Sci. Technol.* (2017), <https://doi.org/10.1016/j.ast.2017.11.011>

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Comparison Between Aerodynamic Designs Obtained by Human Driven and Automatic Procedures

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Abstract

In this paper a fast automatic design environment is developed, making use of a well established and validated turbomachinery design software system for geometry generation and flow analysis. The design is updated via a gradient based algorithm, where gradients are obtained using an adjoint method. The computational advantages of Graphics Processing Units are used to accelerate the mesh generation and flow analysis. The capabilities of the system are illustrated by automatically generating two Low Pressure Turbine vanes, and comparing them to the ones arrived at by a human designer, respecting the same explicit design criteria. The quality of the automatically designed airfoils is assessed against the human generated ones, and insight on the influence of implicit criteria is extracted. It is concluded that acceptable quality geometries can be designed automatically in a short time. For instance, the automatic procedure takes of the order of two days for an equivalent human driven case, where the designer took of the order of two weeks.

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