NONLINEAR TRANSIENT FLUID/STRUCTURE INTERACTION USING REDUCED ORDER MODELS: FIRST APPLICATION TO FLAP TRACK FAIRING SUBJECTED TO ENGINE JET INDUCED VIBRATIONS

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KEYWORDS

FSI, Nonlinear, CFD, ROM, Transient, Aeroelasticity

ABSTRACT

The interaction between inertial, elastic and aerodynamic forces for structures subjected to a fluid flow may cause unstable coupled vibrations that can endanger the structure itself. Predicting these interactions is a time consuming but crucial task in an aircraft design process. A method for a fast nonlinear transient fluid structure interaction is presented in this paper. Surrogate reduced order models in both aerodynamic (Singular Value Decomposition) and structural (Component Mode synthesis) models are used to gain computation time. Structural complexities, such as non-linearities, are reintroduced after the reduction process. The nonlinear structural solver is MSC Nastran® and in particular the routine called is the SOL 400 enhancing the nonlinear capabilities of the Marc solver. It is coupled through MSC OpenFSI® to a database of pressures generated through Computational Fluid Dynamics simulations, ran using the software elsA®. OpenFSI is a precompiled customizable dynamic library

developed in C++ that allows Nastran to communicate with external software or, as in the case of study, with a database. This database is post-processed through a Python based reduction toolkit that can be launched directly from OpenFSI. Structural and aerodynamic models have non-coincident discrete interfaces. The MSC HSA Toolkit® is used to compose the aero-structure interpolation matrix that grants an optimal exchange of information on the six degrees of freedom, both translational and rotational. Splines of type 6 are. The methodology is applied on a specific aircraft component, the flap track fairing, and some preliminary results are presented. This stage aims at testing the methodology and not at making predictions on the real behaviour of the FTF. This paper shows that a combination of structural and aerodynamic reduced order models, interpolation techniques, and an efficient aero-structure data exchange could provide a fast method to estimate non-linear fluid structure interaction during transient response.