XX Fluid Mechanics Conference KKMP2012,

Gliwice, 17-20 September 2012

DMD IN ASSESSMENT OF COMPUTATIONAL AEROELASTIC ANALYSIS OF FLUTTER AIRCRAFT DEMONSTRATOR

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Key Words: Dynamic Mode Decomposition, Aeroelasticity, Flutter, Aircraft

The multiphysics simulations become more and more popular in engineering applications. One of these problems is aeroelasticity, which is the branch of the mechanics dealing with the interaction of the fluid domain and the elastic solid body (Roszak et al, 2009). The applications of these simulations are very common especially in aeronautical industry, where the aeroelastic computations are standard procedure.

The aeroelastic (AE) system developed in Poznan University of Technology was used during realization of the project: Elaboration of the Method for Quick Estimation of Aeroelastic Characteristics during In-Flight Flutter Tests (Roszak et al, 2012). Main aim of the project was to determine the parameter indicating the flutter phenomenon - flutter velocity. The most reliable way to calculate this parameter is the analysis of damping coefficients depending on the velocity. It is necessary to obtain them for each particular mode shape of vibration. The velocity where damping coefficient decreases to critical value is flutter velocity.

One of the problems to determine the flutter phenomenon is the description of the results directly delivered from aeroelastic analysis. The time-dependant calculated variables do not allow defining the exact flutter velocity. Structure vibrations appearing during this phenomenon are assembly of several mode shapes. In order to calculate the damping coefficients necessary for defining flutter phenomenon, the decomposition of signal from simulation has to be conducted for every mode shape.

In this paper the application of DMD (Dynamic Mode Decomposition) algorithm for aeroelastic simulation will be presented (Schmid, 2009), (Frederich and Luchtenburg, 2011). This method helps to obtain dynamic modes from experimental data. Algorithm calculates mode shapes and coefficients, which represent modal damping (real part) and frequency (imaginary part). The necessary information for performing the DMD analysis is the displacement distribution in particular model nodes. The data obtained from aeroelastic numerical simulation is verified with one from wind tunnel tests. In the article, structure model and its DMD analysis will be presented for different mass configurations. These modifications influence on the value of flutter velocity. The structure model and the equations describing its behavior are not required, which is essential for this method.

This work has been funded by the Polish Ministry of Science under research grant no. UDA-POIG.01.03.01-00-160/08-00

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