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Step-Based Identification Methods for AeroElastic Dynamic Modeling

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Abstract

Poorly damped structural resonance modes induced by aero(servo)elastic interaction can be monitored and modeled via data-based estimation techniques. Such estimation techniques can use time-domain measurements of input/output behavior to formulate a dynamical model suitable for control system design. With the availability of a model, a model-based feedback control design technique can be used to dampen the resonance modes.

This talk gives an overview of the main ideas behind a new estimation that is able to deliver a consistent estimate of (poorly damped) structural resonance modes without user intervention. Essential for the consistent estimation of structural parameters, such as damping and location of resonance modes, is the availability of an excitation signal that exhibits a broad-band spectrum. However, instead of using broadband sinusoidal or sine sweep excitation signal, the new estimation method uses simple step excitation signals applied to any of the control surfaces of an aeroeleastic system to formulate a model of the aerodynamic induced structural vibration modes.

Simple step-based excitation signals address the issue of broadband excitation while allowing a reasonable (short-time) excitation signal on the control surfaces and our estimation method has been tailored to find consistent model estimates on the basis of such signals. The estimation method uses a modified version of the well-known Ho-Kalman algorithm [2, 1] to formulate a discrete-time model directly on the basis of step response data. Since the numerical implementation only requires a singular value decomposition and a standard Least Squares estimation, robust numerical algorithms can be put in place to formulate a dynamical model with little or no user intervention.

References

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