ASPECTS REGARDING THE DESIGN OF A VIBRATIONS SUPPRESSION CONTROLLER FOR FLEXIBLE STRUCTURES

RUSU Marius Sebastian, GRAMA Lucian
"Petru Maior" University of Tîrgu Mureş
mrusu@engineering.upm.ro, lgrama@engineering.upm.ro

Keywords: vibrations suppression, controller design, flexible structures, system simulation

This paper presents some aspects regarding the design of a non-invasive command shaping multimode vibrations suppression controller for flexible structures. The original system is described by the parallel interconnection of independent second order modal transfer functions. A reference model is obtained by duplicating the configuration of the original system, but having unit damping ratios instead. The designed controller's transfer function is shown in Eq. (1).

$$H_c(s) = \frac{\sum_{i=1}^{n} K_i \cdot \left(\frac{\omega_{ni}}{s + \omega_{ni}} \right)^2}{\sum_{i=1}^{n} \frac{K_i \cdot \omega_{ni}^2}{s^2 + 2 \cdot \xi_i \cdot \omega_{ni} \cdot s + \omega_{ni}^2}} \tag{1}$$

where: K_i – gain; ω_{ni} – natural frequency (rad/s); ξ_i – damping ratio, i – mode index.

As seen in the simulation of a 5-DOF compensated and non-compensated system, the output overshoot has been improved by 100% and the settling time by 79.61%.

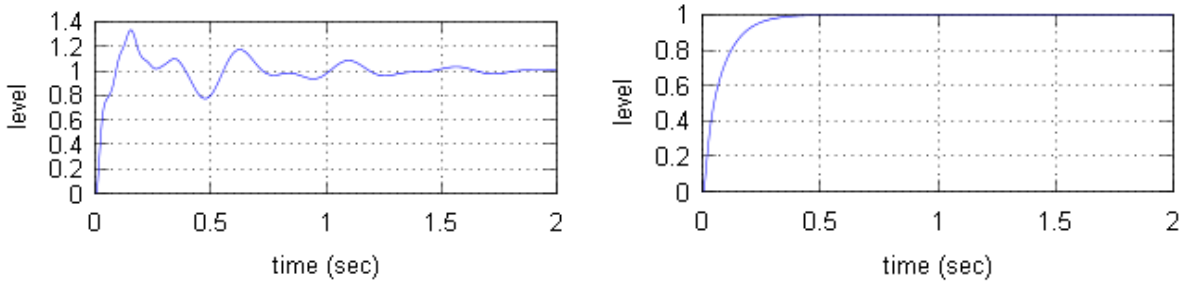

Fig. 1 – Unit step response of the original system (left) and of the compensated system (right)

A more detailed analysis of the overshoot and settling time sensitivity to frequency estimation errors reveals a satisfactory robustness of the solution.

BIBLIOGRAPHY

[1] Benaroya, H., "Mechanical Vibrations: Analysis, Uncertainties and Control", Second Edition, Marcel Dekker, 2004
[2] Eaton, J.W., et al, "GNU Octave, A high-level interactive language for numerical computations", Edition 3 for Octave version 3.0.3
[3] Meirovitch, L, "Principles and techniques of vibrations", Prentice-Hall International, New Jersey, 1997
[4] Moldovan, L., "Vibrații mecanice", Petru Maior University Press, 1996