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Optimization of the actuator/sensor placement for active vibration control of a funnel shaped piezoelectric structure

Tamara Nestorović, Kevin Hassw, Atta Oveisi

Abstract: Placement of piezoelectric actuators and sensors implemented in the form of thin piezoelectric films plays an important role in active vibration control of structures, since after applying they remain permanently integrated with a structure. In this work we analyze a funnel shaped structure – inlet of the magnetic resonance imaging (MRI) tomopraph and perform a balanced optimization of the actuator/sensor placement based on H2 and Hinf norms. The applied procedure is a global one, seeking for optima across the entire domain of the structure. A thorough study of the mesh refinement influence with respect to the eigenfrequency analysis was performed in order to obtain a reliable numeric finite element (FE) model for the optimization purposes. The material parameter optimization was performed as well. Based on placement indices optimal placement study was performed under consideration of several eigenmodes of interest. The optimization was performed for individual modes as well as for simultaneous consideration of multiple modes. A software in the loop approach with recurrent communication in each iteration of the optimization between the numerical simulation FE software and optimization tool designed in Python was implemented through out evaluation of the placement indices for candidate locations over the entire curved surface of the structure. Depending on support conditions the optimal locations of piezoelectric are proposed.

[1] Tamara Nestorović, Professor: Ruhr-Universität Bochum, Universitätsstr. 150, 44803 Bochum, Germany (DE), tamara.nestorovic@rub.de.

[2] Kevin Hassw, M.Sc.: Ruhr-Universität Bochum, Universitätsstr. 150, 44803 Bochum, Germany (DE), Kevin.Hassw@rub.de.

[3] Atta Oveisi, M.Sc.: Ruhr-Universität Bochum, Universitätsstr. 150, 44803 Bochum, Germany (DE), atta.oveisi@rub.de.