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A.L. Araújo, C.A. Mota Soares, et al. (Editors)

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ACTIVE BUCKLING CONTROL OF AN AXIALLY LOADED BEAM-COLUMN WITH CIRCULAR CROSS-SECTION BY ACTIVE SUPPORTS WITH INTEGRATED PIEZOELECTRIC ACTUATORS

[1]Maximilian Schaeffner, [2]Roland Platz, [1]Tobias Melz

[1]System Reliability and Machine Acoustics SzM, Technische Universität Darmstadt, Germany
schaeffner@szm.tu-darmstadt.de, melz@szm.tu-darmstadt.de

[2]Fraunhofer Institute for Structural Durability and System Reliability LBF, Germany
roland.platz@lbf.fraunhofer.de

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Summary: Buckling of slender beam-columns subject to axial compressive loads represents a critical design constraint for light-weight structures. Passive solutions to increase the critical buckling load are limited by increasing or modifying the cross-sectional area, changing the material or reducing the beam-column length and may lead to oversizing or unwanted change in geometry. Active buckling control provides a possible alternative to stabilize slender beam-columns by active lateral forces or bending moments with fewer modifications in geometry, shape and material. In this paper, the potential of active buckling control of an axially loaded beam-column with circular solid cross-section by active supports with integrated piezoelectric actuators at both ends is investigated numerically. The beam-column itself stays free from any geometrical or material modifications along its length. A mathematical model of the axially loaded beam-column is derived and a linear quadratic regulator (LQR) with state observer is designed to stabilize the system. The effectiveness of the stabilization concept is investigated by numerical simulation of the supercritically loaded beam-column. With the proposed active buckling control it is possible to increase the maximum bearable axial compressive load significantly above the first critical buckling load of the passive beam-column.