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PARAMETRIC CONTROL OF BLADE VIBRATIONS IN ROTATING MACHINERY

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ABSTRACT

In many cases the blades of rotating machines can be considered as slender beams. The concept of active damping of beam vibrations by the feedback control of one system parameter has been studied several times, see [1] and [2], for example.

In [3] the active vibration control of a cantilever shaped hollow beam was investigated. A feedback controlled axial force *F(t)* was applied to the beam using a string inside the beam, connected to the tip of the beam at one end, and to an actuator system on the other end. Therefore, the force applied to the beam is always directed to the clamping point. The applied control law (control law I) is based on measurements of the axial velocity of the tip of the beam multiplied by a chosen amplification factor.

In this contribution the control law as presented in [3] is modified to achieve a significant improvement of the introduced artificial damping to the lateral vibrations of the beam. The new control law (control law II) consists of axial velocity feedback combined with a state dependent amplification to get a reference input for the underlying controller of the force in the string. Whereas the use of control law I results in a decreasing force *F(t)* in the string with decreasing amplitude of the beam vibration, the new nonlinear control law keeps the amplitude of *F(t)* almost constant. The stability of the steady state of the closed loop system is investigated by using Lyapunov's direct method. Numerical results show the efficiency of the new control law.

Keywords: Parametric Control, Active Damping, Blade Dynamics

[1] Springer, H., Kovyrshin, S. (2004): Active parametric vibration control of a smart beam. In *Proc. of Eight Int. Conf. on Vibrations in Rotating Machinery*, Univ. of Wales, Swansea, Sept. 7-9. IMECHE, C623/017, pp.703-712.

[2] Rahn, C.D., Mote, C.D. (1994): Parametric Control of Flexible Systems. *Journal of Vibration and Acoustics*, 116, pp. 379-385.

[3] Pumhössel, T., Springer, H. (2006): Active Vibration Control of Nonlinear Cantilever Shaped Blades in Turbomachinery, In *Proc. of 7th IFToMM-Conference on Rotor Dynamics*, Vienna, Austria, 25-28 September 2006