Asymptotic analysis and optimal decay ratio of damped slowly rotating Timoshenko beams

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A stability analysis was performed in the problem of a rotating Timoshenko beam whose movement is controlled by the angular acceleration of the driving motor into which the beam is rigidly clamped (cf. [1]). After introducing a damping effect with respect to a rotation angle of a cross section area of rotating Timoshenko beam model, we obtain [2] the following system of two dimensionless partial differential equations

$$\begin{cases} \ddot{w}(x,t) - w''(x,t) - \xi'(x,t) &= -u(t)(r+x), \\ \ddot{\xi}(x,t) - \gamma^2\xi''(x,t) + w'(x,t) + \xi(x,t) + \nu^2\dot{\xi}(x,t) &= u(t), \end{cases}$$

for $x \in (0,1)$ and $t > 0$, where ν is a damping constant, with boundary conditions

$$\begin{cases} w(0,t) = \xi(0,t) &= 0, \\ w'(1,t) + \xi(1,t) = \xi'(1,t) &= 0. \end{cases}$$

Next, we show some important spectral properties of operator connected with the system. Furthermore, we show the asymptotic stability of the system under certain assumptions on the physical parameter γ^2. We find the optimal damping coefficient, maximizing the stability margin of the system.

[1] W. Krabs, G. M. Sklyar, On Controllability Of Linear Vibrations, Nova Science Publishers Inc. 2002, Huntington, NY.

[2] J. Woźniak, M. Firkowski, Optimal damping coefficient of a slowly rotating Timoshenko beam, Proc. SIAM Conf. Cont. Appl. – 2015. – pp. 81 - 84.