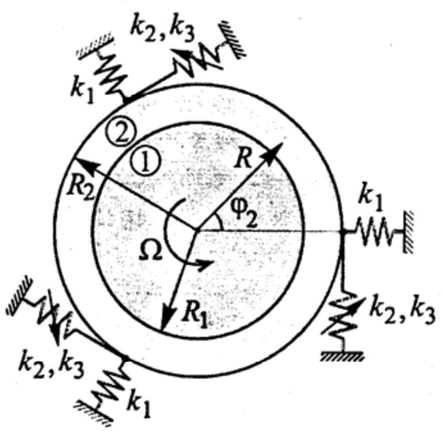
# THERMOELASTIC FRICTIONAL CONTACT OF A ROTATING CYLINDER WITH MOVING BUSH IN CONDITIONS OF STICK-SLIP CHAOS

Jan Awrejcewicz, Yurij Pyryev

*Department of Automatics and Biomechanics, Technical University of Łódź*




Consider thermoelastic contact of a solid isotropic circular cylinder of radius $R_1$ with a cylindrical tube-like rigid bush (solid linear) which is fitted to the cylinder at the initial instant of time according to the expression $U_0 h(t)$. Calculated per unit of the length inertia moment of the bush is equal to $B_2$. The bush is fixed to the steady-state base by the Duffing type springs with the reduced rigidity coefficients $k_1, k_2, k_3$. The shaft rotates with the angular velocity $\Omega(t) = \Omega_* (1 + \gamma \sin(\omega t))$. On the contact surface between the cylinder and the bush the friction force $F_t$ arises and (as the consequence) it is a heat is generated. The work of friction force is transformed into heat energy. The temperature of the cylinder at the initial instant of time is equal to $T_0$. Assume the Newton's heat exchange law between cylinder and the bush, and constant temperature of the bush $T_0$. Also assume that according to Coulomb's law the friction force is proportional to the normal part of reaction $F_t = f(V_w)N(t)$. In addition, the kinematical friction coefficient $f(V_w)$ depends on the relative velocity of the mōving bodies. The so called Stribeck's curve has a minimum. The problem is reduced to solution of the following dimensionless form of the nonlinear system of differential and integral equations:

$$\ddot{\varphi} - \varphi + b\varphi^3 = \varepsilon f(1 + \gamma \sin \omega\tau - \dot{\varphi}) p(\tau, \dot{\varphi}), \qquad f(v) = f_0 sign(v) - \alpha v + \beta v^3,$$

$$p(\tau, \dot{\varphi}) = h(\tau) + \gamma \tilde{\omega} \int_0^\tau G_u(\tau - \xi) f(1 + \gamma \sin(\omega\xi) - \dot{\varphi}) p(\xi, \dot{\varphi})(1 + \gamma \sin(\omega\xi) - \dot{\varphi}) d\xi,$$

$$G_u(\tau) = \sum_{m=1}^{\infty} \frac{2Bi}{Bi + \mu_m^2} e^{-\mu_m^2 \tilde{\omega} \tau}, \qquad Bi J_0(\mu_m) - \mu J_1(\mu_m) = 0.$$

Observe that if a small disturbance of the body takes place then using the Melnikov's method [1] we can find the conditions when the considered system moves in chaotic way (in absence of heat generation $\gamma = 0$). The aim of the considered work is focused on investigation of contact characteristics (contact temperature, contact pressure, velocity of bush movements) in conditions of frictional heat generation under small periodical disturbance of the cylinder's velocity. Stick-slip chaotic oscillations movements of the bush are investigated.

References

1. Awrejcewicz J., Holicke M. M., Melnikov's method and stick-slip chaotic oscillations in very weakly forced mechanical systems, International Journal of Bifurcation and Chaos, Vol.9, No 3, 505–518.