

Self-excited oscillations in some mechanical systems

Analysis, Control and Application

Hiroshi Yabuno

Faculty of Engineering, Information and Systems, University of Tsukuba

Abstract

Self-excited oscillations have been known to occur in a variety of engineering systems and have a long history of study. In the 1980's, the dynamics received much attention with the advancement of the nonlinear approach to dynamical systems. Much of that work focused on the analyses of their occurrence and response.

In this presentation, we propose the stabilization control methods for some self-excited mechanical systems theoretically and experimentally. The self-excited oscillation in a fluid-conveying pipe, which is produced due to the nonself-adjointness depending on the boundary, is stabilized through a boundary bifurcation control. We deal with also the self-excited oscillation in a railway vehicle wheelset. To enhance the running performance on both straight and curved rails, we propose the use of a gyroscopic damper; the gyroscopic damper can suppress not only static destabilization but also dynamics destabilization. Furthermore, we introduce high-performance sensors as the positive applications of self-excited oscillation. Then, the self-excited oscillation for a resonator realizes the high-accurate measurement of biological samples in liquid environment because the self-excitation of resonator compensates the viscous damping effect. We demonstrate an ultrasensitive mass detection using self-excited coupled microcantilevers.