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Slosh analysis on a full car model with SDRE control and hydraulic damper

Wagner Barth Lenz, Mauricio A. Ribeiro, Angelo M. Tusset, Elżbieta Jarzębowska, Jose Manoel Balthazar

Abstract: Slosh has been one of the main concerns for transportation vehicles, specifically with partially filled tanks. The liquid movement due to changes of vehicle velocity magnitude and direction as well as external excitations can be the source of damage and stability problems in trucks and passenger vehicles. Due to size and the intrinsic movement, the natural frequency of sloshing is similar to the human input frequency. Thus, managing and controlling the vehicle-tank system dynamics is required to maintain the desired safety standards. In this paper a numerical study of a full vehicle-tank model is conducted by investigating motion of a linear pendulum model without baffles. A numerical analyses of the full vehicle-tank dynamics model, biffurcation diagram and 0-1 test, is performed and a controller based upon the State-Dependent Riccati Equation method to control the pressure on the chamber of the damper is considered the dissipation on the restriction valve dynamics . The preliminary results demonstrate s that the pendulum model adequately maps the fluid behavior in the tank. Nevertheless, due to low dissipation of slosh motion, around the natural frequency the displacement increases significantly and the vehicle motion can cause damage and loss of control. In this case, the passive control is unable to significantly reduce the slosh. Nevertheless, it significantly reduce the pendulum motion and avoids the overturn and improving the driviblility and safety

[1] Wagner Barth Lenz, M.Sc.: Federal University of Technology – Paraná, 84016-210, Brazil (BR), wagner.barth5@gmail.com .

[2] Mauricio A. Ribeiro, Ph.D.: Federal University of Technology – Paraná, 84016-210, Brazil (BR), mau.ap.ribeiro@gmail.com .

[3] Angelo M. Tusset, Ph.D.: Federal University of Technology – Paraná, 84016-210, Brazil (BR), a.m.tusset@gmail.com .

[4] Elżbieta Jarzębowska, Associate Professor: Warsaw University of Technology, Poland, 00-661, Poland (PL), elajarz@meil.pw.edu.pl .

[5] Jose Manoel Balthazar, Professor: Federal University of Technology – Paraná, 84016-210, Brazil (BR), jmbaltha@gmail.com , the author presented this contribution at the conference in the special session: "Nonlinear behavior, performance, and control designs for complex structures in Civil, Aeronautical, Aerospace and Ocean Engineering" organized by J.M. Balthazar, E. Jarzębowska and A.M. Tusset.