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AIMS AND SCOPE

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- analysis, modelling and control,
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- component and systems design,
- computer software and hardware interfacing and
- computer aided engineering for both static and dynamic analysis of fluid power systems.

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REVIEW PAPER

AN OVERVIEW ABOUT ACTIVE OSCILLATION DAMPING OF MOBILE MACHINE STRUCTURE

Robert Rahmfeld and Monika Ivantysynova

Technical University of Hamburg-Harburg, Aircraft Systems Engineering, Nesspriel 5, 21129 Hamburg, Germany
r.rahmfeld@tuhh.de, m.ivantysynova@tuhh.de

Abstract

One main current demand for mobile machinery development is the improvement of operator comfort and productivity in order to be competitive on the global market in the future. Actual trends towards cost effective actuator systems in offroad vehicles and thereby the use of electrohydraulic actuators reflects also the task of active oscillation damping of the machine structure. In the past several concepts, which differ in hydraulic system, control and sensor strategy, have been developed. However, the practical use is still minor as in most cases passive oscillation systems, which base upon high pressure hydro-pneumatic accumulators, are widely used although the component costs and frequent check intervals are problematic for this technology. This paper presents an overview of research work done in the area of active oscillation damping technologies for offroad vehicles.

Keywords: active oscillation damping, vibration suppression, vibration control, active oscillation control, mobile machines, working hydraulics

MOVEMENT OF THE CUPS ON THE BARREL PLATE OF A FLOATING CUP, AXIAL PISTON MACHINE

Peter A. J. Achten, Titus L. van den Brink and Jeroen W. Potma

Innas BV, Nikkelstr. 15, 4823AE Breda, Netherlands
pachten@innas.com

Abstract

In a floating cup axial piston machine, each piston has its own cuplike cylinder, floating on a barrel plate. On average the cups and the barrel rotate at the same rotational speed. A closer look at the kinematics of the floating cup principle however reveals that the cups make a small movement on the barrel plate. The size of this cup trajectory is strongly dependent on the tilt angle between the barrel and the rotor. Furthermore, the non-uniformity of the joint between the barrel and the rotor shaft can create an angular difference between the cup and the barrel position. This article will focus on the combined effect of the barrel tilt angle and the non-uniformity on the cup movement.

Keywords: axial piston machine, floating cup principle, construction, cup movement

ONE-DEGREE-OF-FREEDOM MODEL FOR TORQUE-MOTOR DYNAMICS

Eizo Urata

Department of Mechanical Engineering, Kanagawa University, Rokkakubashi 3-27-1, Kanagawa-ku, Yokohama, 221-8686, Japan
urata@mech.kanagawa-u.ac.jp

Abstract

This paper shows a simplified mathematical model for a torque-motor used in servovalves. The torque-motor treated in this paper is a commonly used prototype, in which an armature and flapper assembly is supported by a flexure tube. Combining mathematical expressions for mechanical and electromagnetic elements, transfer functions between variables are given. To represent the mechanical structure, a one-degree-of-freedom vibration system is assumed. This assumption simplifies the model, although restricts the frequency range in which the model can be applied. The analysis includes the influence of eddy currents in the yokes and armature. A first-order delay relating coil current to armature torque is used to represent the influence. Experiments verified that the presented mathematical model is valid up to the fundamental natural frequency of the vibration system.

Keywords: torque-motor, servovalve, one-degree-of-freedom model, magnetic circuit, eddy current, frequency characteristic

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PASSIVE BILATERAL TELEOPERATION OF A HYDRAULIC ACTUATOR USING AN ELECTROHYDRAULIC PASSIVE VALVE

Perry Y. Li and Kailash Krishnaswamy

Department of Mechanical Engineering, University of Minnesota, 111 Church St. SE, Minneapolis, MN 55455, USA
pli@me.umn.edu, kk@me.umn.edu

Abstract

A passive control scheme for the bilateral teleoperation of a one degree of freedom electrohydraulic actuator is proposed. The overall system enables a human operating a motorized joystick to feel as if he is manipulating a rigid mechanical tool with which the work environment is also in contact. By ensuring that the closed loop system behaves like a passive two port device, safety and stability when coupled to other systems are improved. The control scheme is developed by first using previously developed active feedback to passify a four way proportional directional control valve, and then by the design of a intrinsically passive teleoperation controller. The coordination error between the joystick and the hydraulic actuator converges to zero for sufficiently low manipulation bandwidth. Experimental results verify the characteristics of the control scheme.

Keywords: teleoperation, bilateral teleoperation, passive control, electrohydraulic actuator

EFFECT OF CONTROLLER IN REDUCING STEADY-STATE ERROR DUE TO FLOW AND FORCE DISTURBANCES IN THE ELECTROHYDRAULIC ACTUATOR SYSTEM

Eric Sampson, Saeid Habibi, Richard Burton and Yuvin Chinniah

Department of Mechanical Engineering, University of Saskatchewan, 57 Campus Drive, Saskatoon, Saskatchewan, Canada S7N 5A9
eric.s@usask.ca, saeid_habibi@engr.usask.ca, richard_burton@engr.usask.ca, yac494@mail.usask.ca

Abstract

This paper pertains to the nonlinear control of a high-precision hydrostatic actuation system known as the Electro-Hydraulic Actuator (EHA). It describes the action of the controller in reducing the steady state error resulting from flow and force disturbances. The EHA uses inner-loop pump velocity feedback to achieve an unprecedented level of accuracy for a hydrostatic system. A published mathematical model of the EHA is reviewed and expanded to produce an equation that predicts the response of the EHA to both desired inputs as well as flow and force disturbances. This equation suggests that the use of a proportional outer-loop controller should result in steady-state error as a result of these disturbances, but that a PI outer-loop controller should eliminate the steady-state error. Experimental results from a prototype of the EHA demonstrate that due to the nonlinear friction present in the actuator, the use of a conventional proportional or PI controller is not sufficient to effectively deal with these disturbances. However, a nonlinear proportional outer-loop controller does result in a substantial performance improvement in regards to disturbance rejection for positional accuracy. Experiments conducted on the prototype using the nonlinear controller reveal that it is capable of a positional accuracy of 1 μm for a load of 20 kg.

Keywords: actuator, electrohydraulic, hydrostatic, micro-precision, disturbance rejection