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AIMS AND SCOPE

The *International Journal of Fluid Power* is dedicated to the latest advances in the science and technologies associated with hydraulics and pneumatics. The aim of the journal is to provide the engineering community with high quality information concerning developments in research, design and application of fluid power technology. Special emphasis is placed on papers concerned with components and system integration by embracing key aspects of:

- analysis, modelling and control,
- monitoring and fault diagnosis,
- artificial intelligence applications,
- 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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Submissions

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MODEL AND EXPERIMENTAL VALIDATION OF A LOAD SENSING SYSTEM WITH A CRITICALLY LAPPED REGULATOR SPOOL

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Abstract

A load sensing (LS) system is one in which the pump flow is regulated to keep the pressure drop across an orifice constant and independent of any variation in the load pressure. This ensures that the pressure loss across the orifice is kept to a minimum, thereby increasing efficiency. An LS regulator spool is used to sense the pressure drop across the orifice to control pump delivery. The spool can be under lapped, critically lapped or overlapped. As a trade-off between efficiency and dynamic response, the LS spool is usually critically lapped. This results in a nonlinear model that is sensitive to operating regions.

In this paper, a review of published literature on LS systems is briefly summarized. An LS system model is developed and linearized. Procedures to solve these very complex equations are introduced. Because load sensing systems require pressure feedback, stability can often be an issue. Analysis of these systems to determine the steady state and dynamic performance is very difficult to do because of the dependency of the models on the operating point. Linearized models which reflect a methodology to account for changing operating conditions have been developed and have established three distinct regions of operation (labeled “Conditions I, II, and III”). This paper presents the experimental nature of these conditions and provides experimental evidence that the models so derived are valid over certain frequency ranges. The objective of this paper, then, was to establish confidence in the models by examining frequency response performance under these three distinct conditions. The results show that good agreement does exist between the models and their physical counterparts and establishes limitations thereof.

This research can assist in the design or optimization of an LS system and help in the development of advanced control strategies for obtaining further efficiency within certain dynamic performance constraints.

Keywords: load sensing, stability, linearization, operating point, energy efficiency

PRESSURE MEASUREMENTS FOR TRANSLATING HYDROSTATIC THRUST BEARINGS

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Abstract

The objective of this study is to take insitu measurement of the pressure profile that exists between a sliding thrust bearing and a stationary thrust surface. Using a two-dimensional model of the bearing and the classical one-dimensional Reynolds equation, the experimental results are explained and the minimum fluid film thickness and the tilt angle of the bearing are numerically determined. In this work, it is shown that the bearings tilt into the leading edge of the bearing and that the minimum fluid-film thickness at the leading edge of the bearing is on the order of the surface roughness.

This work provides fundamental insight into the problem of metal-to-metal contact for thrust bearings.

Keywords: hydrostatic thrust bearing, pressure profile, bearing tilt, Reynolds's Lubrication equation

THE RESPONSE PERFORMANCE OF ELECTORRHEOLOGICAL FLUIDS IN A CONTROL FLOW FIELD

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Abstract

The accurate description of the flow behaviour is a key link for the practical application of electrorheological (ER) fluids in fluid control technology. This paper is concerned with an experimental determination of the response performance of ER fluids. A power source control system for ER fluids has been designed to obtain the flow information of the ER fluids in the practical application. The dynamic response of ER fluids in control flow field was experimentally measured. The experimental results show that the response characteristics of ER fluids in control flow field differ from that in rotary shearing flow field. Besides the ER effect, there is a concomitant-effect of ER response called "capture effect".

Keywords: electrorheological (ER) fluids, suspensions, control flow field, ER response, capture effect

MODELLING OF A NOZZLE-FLAPPER TYPE PNEUMATIC SERVO VALVE INCLUDING THE INFLUENCE OF FLOW FORCE

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Abstract

This paper proposed a nonlinear mathematical model for a 4-port pneumatic nozzle-flapper type servo valve with dual fixed orifices and dual nozzles. In this model, the influence of the flow force was also included. The determination of the flow force on the flapper was proposed using an experimental approach. The effectiveness of the proposed model was verified by comparing experimental and simulated results. This comparison confirmed the influence of flow force on the static and dynamic behavior of the servo valve. A linear model, which was derived from the nonlinear model, showed an applicable range of about $\pm 30\%$ of rated input current. A practical, order-reduced linear model, which neglects the dynamics of the torque motor and the armature-flapper, was also proposed. The order-reduced model was suitable for systems with large load volumes.

Keywords: nozzle-flapper type pneumatic servo valve, nonlinear model, flow force, linear model

OPTIMIZATION AND EXPERIMENTAL VERIFICATION OF A VARIABLE RATIO FLOW DIVIDER VALVE

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Abstract

A common problem in fluid power control systems is the synchronization of two loads. A frequent solution to this problem is to use a flow divider valve. Typical flow divider valves can deliver flow to two circuits such that the ratio of flows is independent of the load pressures, but it is not possible to easily change the ratio after manufacturing. In this paper, the design process used to develop a new variable ratio flow divider valve is introduced. As the first step, a preliminary model was used to optimize the physical parameters for a prototype. In the second step, a valve was subsequently constructed and the performance experimentally determined. The prototype constructed exhibits low dynamic and steady state error with low pressure losses in experimental tests. This novel valve shows sufficient feasibility to warrant future study and development for commercialization.

Keywords: flow divider, hydraulic valve, variable ratio, multiobjective optimization, experimental
