

# International Journal of Fluid Power

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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.

In addition, the journal commissions and publishes state-of-the-art reviews on both existing and emerging technologies, and with a philosophy of maintaining scientific rigour and the practical realities of fluid power. The International Editorial Board is composed of leading members of the fluid power community having expertise covering the broad spectrum of fluid power, and all papers are peer reviewed by at least two experts. Technical quality and integrity are considered crucial to the review process. The Associate Editors and the Editorial Board also undertake an active role in ensuring that this is achieved.

Currently, three issues are planned for 2002, but the journal is moving towards quarterly publication.

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# COMPUTER AIDED OPTIMIZATION OF BEARING AND SEALING GAPS IN HYDROSTATIC MACHINES - THE SIMULATION TOOL CASPAR

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## Abstract

The simulation tool CASPAR (**C**alculation of **s**wash **p**late type **a**xial piston pump and motor) is presented in this paper. Based on the simulation of the flow through the lubrication gaps in swash plate type axial piston machines the pressure, velocity and temperature fields in the considered gaps can be determined. This allows the calculation of the main losses generated in the machine due to viscous friction and gap flow. The individual gaps are connected in a complex way to each other. The calculation of the gap flow requires the determination of the instantaneous gap heights for all considered gaps. This is realized by solving the motion equation for all moveable parts of the rotating group. For determination of pressure dependent external forces the instantaneous pressure in the displacement chamber is calculated simultaneously. The program further calculates the instantaneous inlet and outlet flow of the swash plate machine for pumping and motoring mode as well as internal volumetric losses.

**Keywords:** axial piston machine, non-isothermal gap flow, prediction of losses, computer aided design of swash plate machines

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# A CONTRIBUTION TO THE DESIGN OF HYDRAULIC LUBE PUMPS

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## **Abstract**

With special reference to gerotor lube pumps the paper details how a simulation environment can be instrumental in design development. The relevance of testing is stressed as an essential counterpart to simulation. Original modelling techniques are also proposed that provide a unified approach to volumetric pumps studies.

**Keywords:** gerotor pumps, design, simulation and testing in fluid power

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# PRESSURE COMPONENTS STABILITY ANALYSIS: A REVISITED APPROACH

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## Abstract

In this paper the stability of pressure relief valves and pressure reducers is analysed. MacCloy and Merritt have previously proven that the stability analysis of these two components can be viewed with the same calculation. The purpose of this paper is to extend their results to other pressure control components and to add some other views of stability analysis using a simplification of the dynamics linked to the generally small volume of the counter reaction chamber. This simplification leads to a third order transfer function, which is easier to analyse. The static behaviour of both the pressure relief valve and the pressure-reducing valve is explained using this transfer function. A proof is given that the eigenvalues are heavily coupled using the roots calculation of a third order polynomial function. The analysis shows that the inner mechanical control loop of these two components can be viewed as a PD force controller. Root loci are used to understand the stability influences of certain design parameters. Other basic rules are also established.

**Keywords:** pressure relief valve, pressure reducing valve, stability problems, force control, pressure components

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# PERFORMANCE LIMITATIONS OF A CLASS OF TWO-STAGE ELECTRO-HYDRAULIC FLOW VALVES

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## Abstract

By examining the dynamics of a popular type of two-stage electronic proportional valve, this paper addresses its performance limitations, with both cautions in control implementation and suggestions in valve design. While several benefits do exist, there are limitations to the closed loop performance of the valve when it is included in a valve-controlled electrohydraulic system. These limitations come from the structural feature that the pilot flow not only controls but also contributes to the total flow. Although for steady state performance this design gives a higher flow efficiency, for dynamic performance it results in zeros in the open loop transfer function, which will limit the closed loop bandwidth of a flow control system. A nonlinear analytical model of this particular type of valve is derived first. It is then simplified as a reduced order linear model with the inherit system zeros illustrated. Validation of the analysis is obtained by experimental results on a testbed.

**Keywords:** electro-hydraulic, valve, valvistor, zero, model

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# ON THE DEVELOPMENT OF A REAL-TIME SIMULATOR ENGINE FOR A HYDRAULIC FORESTRY MACHINE

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## Abstract

This work focuses on the development of a real-time training simulator engine for a forestry machine. The rigid body dynamics of the machine's manipulator is integrated with electrohydraulic actuator dynamics and joint controllers. System numerical stiffness introduced by the closing valves, high order hydraulic dynamics, and simulator implementation using an interpreted language were identified as the prime reasons for slowing down the integration. Successive models of lower complexity and switching between models for the open and closed phases of the valves are proposed aiming to achieve a satisfactory simulator engine that can run in real-time. Simulation results demonstrate very good prediction of an actual machine behaviour with execution speeds improved by a factor of 35.

**Keywords:** machine training simulator, hydraulic dynamics, numerical stiffness, real-time, control system

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