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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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Currently, three issues are planned for 2004, but the journal is moving towards quarterly publication.

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EFFICIENT COLLABORATIVE MODELLING AND SIMULATION WITH APPLICATION TO WHEEL LOADER DESIGN

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Abstract

Technical systems are becoming increasingly integrated, partly because of the intensive use of software due to demands for energy efficiency, performance and customizability. This leads to complicated interactions among the sub-systems during operation. The dynamic behaviour of such a system is hard to predict since every sub-system needs to be taken into account. Also, the sub-systems often differ in characteristics between engineering domains, and engineers therefore need to collaborate to make the prediction. A validated model is needed to predict how a change to a system will affect its behaviour. The paper investigates how the modelling, simulation and validation processes can be organized in the described case where several engineers from different disciplines are involved. The application studied is a wheel loader that is complex and represents a large family of machines. In the resulting approach, teams of engineers from the different disciplines create one general-purpose model, each team using the most appropriate modelling environment. The system simulation is realized through coupled simulation, where accurate results are achieved by connecting the simulation environments by so-called bilateral delay lines.

Keywords: collaborative, multi-domain, hydraulics, multi-body dynamics, coupled simulation, bilateral delay lines

A SYSTEMATIC METHODOLOGY FOR OPTIMAL COMPONENT SELECTION OF ELECTROHYDRAULIC SERVOSYSTEMS

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Abstract

This paper focuses on optimal hydraulic component selection for electrohydraulic systems used in high performance servo tasks. Dynamic models of low complexity are proposed that describe the salient dynamics of basic electrohydraulic equipment. Rigid body equations of motion, the hydraulic dynamics and typical trajectory inputs are used in conjunction with optimization techniques, to yield an optimal hydraulic servosystem design with respect to a number of criteria such as cost, weight or power. The optimization procedure employs component databases with real industrial data, resulting in realizable designs. An example illustrates the developed methodology.

Keywords: electrohydraulic servosystem, optimization, optimal design

NEW RESULTS IN CONTROL SYNTHESIS FOR ELECTROHYDRAULIC SERVOS

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Abstract

This survey presents some recent results of the authors in the field of the control synthesis for electrohydraulic servos. Three are the methodologies of control theory herein considered. Firstly, an integrated methodology of robust control synthesis with antiwindup feedback compensation for linear model of electrohydraulic servo is developed. Secondly, in a strongly nonlinear framework, an integrated fuzzy supervised neurocontrol is proposed. This represents a control strategy which is in fact independent of mathematical model of the systems, thus achieving certain robustness and reducing complexity. At last, the backstepping is used for obtaining of control laws for asymptotic tracking of position or force references in the case of a certain model of an electrohydraulic servo. Conclusive numerical simulations are provided to verify the behaviour of the controlled systems by the proposed control laws.

Keywords: electrohydraulic servo, robust linear control, control saturation, antiwindup compensation, fuzzy supervised neurocontrol, backstepping control, numerical simulation

DESIGN AND EXPERIMENTAL EVALUATION OF POSITION CONTROLLERS FOR HYDRAULIC ACTUATORS: BACKSTEPPING AND LQR-2DOF CONTROLLERS

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Abstract

In this paper the problem of experimental control of hydraulic actuators is considered. To deal with mechanical and hydraulic uncertainties two different controllers are synthesized: a backstepping controller and a LQR-2DOF controller. Experimental results of both implementations are analyzed in the context of practical difficulties, mainly the measurement of acceleration. These results illustrate the main features of these controllers when applied on a hydraulic actuator.

Keywords: hydraulic actuators, nonlinear control, Lyapunov based design, backstepping, linear control, 2DOF control design, robustness, disturbance rejection

FLUID POWER CONTROL UNIT USING ELECTRORHEOLOGICAL FLUIDS

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Abstract

Electrorheological (ER) fluids can change their rheological properties when subjected to an electrical field. By using ER fluids as the working medium in fluid power systems, direct interface can be realized between electric signals and fluid power without the need for mechanical moving parts in fluid control unit. The pressure drop and flow rate can be directly controlled through the change of applied electric fields. This paper investigates the design and controllability of ER fluid power control system for large flows. The design criterion for an ER valve is proposed and four ER valves are manufactured based on this criterion. A fluid control unit consisting of an ER valves bridge circuit is constructed, the characteristics of which are theoretically and experimentally investigated. The results show that the ER fluid control units have better controllability for fluid power control.

Key words: electrorheological (ER) fluids, ER valve, fluid control unit, design criterion