THE FOURTH SCANDINAVIAN INTERNATIONAL CONFERENCE ON FLUID POWER

PROCEEDINGS OF THE CONFERENCE
TAMPERE, FINLAND
SEPTEMBER 26 – 29, 1995

Editors Ulla Ahlfors, Lea Lahti and Raili Siekkinen

Tampere University of Technology
1995

UDK 62–82 621.6 62–522 681.527
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.00-09.10</td>
<td>Opening addresses</td>
</tr>
<tr>
<td></td>
<td>President of Tampere University of Technology</td>
</tr>
<tr>
<td></td>
<td>Rector T Lepistö, Finland</td>
</tr>
<tr>
<td>09.10-09.40</td>
<td>Trends in mobile hydraulics</td>
</tr>
<tr>
<td></td>
<td>Professor W. Backé, Germany</td>
</tr>
<tr>
<td>09.40-10.10</td>
<td>Design methods for hydraulic circuits</td>
</tr>
<tr>
<td></td>
<td>Professor C.R. Burrows, UK</td>
</tr>
<tr>
<td>10.10-10.40</td>
<td>The current situation of fluid power in China</td>
</tr>
<tr>
<td></td>
<td>Professor, Dr.-Ing. Y. Lu, China</td>
</tr>
<tr>
<td>11.10-11.40</td>
<td>Machine automation in mining</td>
</tr>
<tr>
<td></td>
<td>Director of R&amp;D R. Ström, Finland</td>
</tr>
<tr>
<td>11.40-12.10</td>
<td>Application of hydraulics in high-tech diesel engines</td>
</tr>
<tr>
<td></td>
<td>Director of R&amp;D D. Paro, Finland</td>
</tr>
<tr>
<td>12.10-12.40</td>
<td>Open forum talk about high-tech business on fluid power in Finland</td>
</tr>
<tr>
<td></td>
<td>Professor J. Routti, Finland</td>
</tr>
<tr>
<td>12.40-13.10</td>
<td>Fluid power education - what went wrong?</td>
</tr>
<tr>
<td></td>
<td>President R.E. Koski, USA</td>
</tr>
<tr>
<td>13.10-13.20</td>
<td>Welcome address to Hydraulics and Pneumatics Trade Fair</td>
</tr>
<tr>
<td></td>
<td>Business Development Manager T. Väänänen, Finland</td>
</tr>
</tbody>
</table>
THURSDAY, SEPTEMBER 28

A - SESSIONS

SESSION A1
NEURAL AND FUZZY CONTROL
Chairman J.S. Stecki
09.00-10.20

Neural network modelling and control of fluid power systems
D.J. Hatch, M. Samai and J.S. Stecki, Australia
94

Hydraulic servo cylinder position control using a hybrid
neuro-fuzzy controller
M-C. Shih and K-C. Lee, Taiwan R.O.C.
105

Usage of fuzzy-logic in hydraulic servo
E. Niemelä and T. Virvalo, Finland
119

Synchronizing of the movement of four cylinders
T. Virvalo, Finland
133

SESSION A2
DESIGN OF CONTROL SYSTEM
Chairman M. Kivikoski
10.50-12.10

A Study of the different pole placement strategies for
position control of hydraulic actuators
J-C. Mare and J-M. Laffitte, France
147

The behavior of a position controlled actuator with
switching valves
U. Becker, Germany
160

The control system and synchronization of distributed
real time application for industry
P. Tuominen and T. Virvalo, Finland
168

Influence of pipeline on performance of hydraulic servo drives
A. Ellman, J. Mylykylä, T. Virvalo and M. Vilenius, Finland
181

SESSION A3
CONTROL APPLICATIONS
Chairman A. Halme
13.30-14.50

Control of the hydraulic system of a walking machine MECANT
I. Leppänen, A. Halme and H. Lehtinen, Finland
190

Programmable servo control - a new approach
I.M. Whiting and N.P. Cottell, UK
204
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The implementation of global clock using CAN in distributed control system</td>
<td>218</td>
</tr>
<tr>
<td>P. Tuominen and T. Virvalo, Finland</td>
<td></td>
</tr>
<tr>
<td>On-Off - Electrohydraulic synchronous system</td>
<td>233</td>
</tr>
<tr>
<td>C. Li, J. Wang and J.Hu, China</td>
<td></td>
</tr>
<tr>
<td>The robust trajectory control using disturbance observer of a hydraulic manipulator for live-line maintenance</td>
<td>241</td>
</tr>
<tr>
<td>T. Yamamoto, S. Yokota and Y. Tamura, Japan</td>
<td></td>
</tr>
<tr>
<td><strong>SESSION A4</strong></td>
<td></td>
</tr>
<tr>
<td><strong>COMPUTER AIDED DESIGN</strong></td>
<td>15.20-16.40</td>
</tr>
<tr>
<td><em>Chairman H. Handroos</em></td>
<td></td>
</tr>
<tr>
<td>HYDROPS Computer aided design of hydraulic systems</td>
<td>250</td>
</tr>
<tr>
<td>D. Spath and R. Gapp, Germany</td>
<td></td>
</tr>
<tr>
<td>An ICAD system for plastic injection molding machine</td>
<td>262</td>
</tr>
<tr>
<td>C. Zhao and Y. Lu, China</td>
<td></td>
</tr>
<tr>
<td>Early prototyping in fluid power technology</td>
<td>272</td>
</tr>
<tr>
<td>J-O. Palmberg, P. Krus and A. Jansson, Sweden</td>
<td></td>
</tr>
<tr>
<td>Interaction of application engineering and product design thru a common CAE - tool</td>
<td>287</td>
</tr>
<tr>
<td>S. Bartelmei, D.G. Feldmann and K.P. Nissen, Germany</td>
<td></td>
</tr>
<tr>
<td><strong>B-SESSIONS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SESSION B1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SIMULATING TOOLS AND LANGUAGES</strong></td>
<td>09.00-10.20</td>
</tr>
<tr>
<td><em>Chairman D.G. Feldmann</em></td>
<td></td>
</tr>
<tr>
<td>A simulator tool for the evaluation of control concepts for vehicle drive systems</td>
<td>299</td>
</tr>
<tr>
<td>J. Lennevi, J-O. Palmberg and A. Jansson, Sweden</td>
<td></td>
</tr>
<tr>
<td>The simulation and design of a low cost active suspension system</td>
<td>317</td>
</tr>
<tr>
<td>L. R. Hickson and J. Darling, UK</td>
<td></td>
</tr>
<tr>
<td>DSHplus - an easy operationable simulation programme for electrohydraulic systems</td>
<td>325</td>
</tr>
<tr>
<td>R. Kett, Germany</td>
<td></td>
</tr>
<tr>
<td>Computer modelling of hydraulic systems using the Nut language and programming environment</td>
<td>336</td>
</tr>
<tr>
<td>G. Grossschmidt, J. Pahapill, Estonia and A. Züger, Switzerland</td>
<td></td>
</tr>
</tbody>
</table>
SESSION B2
MODELLING AND SIMULATION  
Chairman J-O. Palmberg  
10.50-12.10

Utilization of a genetic algorithm in determining unknown parameters of a simulation model
J.S. Halme and H.M. Handroos, Finland  
346

Modelling and simulation of contamination in fluid power control systems
J. S. Stecki and L. Chao, Australia  
356

Simulation software for offshore applications - Two case studies
D. Fargeton and C.W. Richards, France  
369

SESSION B3
FLUID FLOW PHENOMENA IN HYDRAULIC COMPONENTS  
Chairman P. Krus  
13.30-14.50

Viscosity criteria for selection of long transmission model
J.S. Stecki, Australia and A. Garbacik, Poland  
384

Flow force compensation in 2-way cartridge valves - Flow visualization and computational fluid dynamics
C. Latour, Germany  
399

Determining the dynamic flow-pressure relation for a mobile valve
C. Isacsson and J-O. Palmberg, Sweden  
412

SESSION B4
FLUID FLOW PHENOMENA IN HYDRAULICS  
Chairman A. Ellman  
15.20-16.20

Investigations of differential-producing flowmeters performances under conditions of pulsed flows
V.V. Viktorov, Russia  
426

Unsteady flow investigation by infrared and thermoanemometer techniques
M. Lähdeniemi and A. Ekholm, Finland, T. Koppel and U. Liiv, Estonia  
432

Study and construction of a high-gain laminar fluidic amplifier
G. Belforte, T. Raparelli, V. Viktorov, G. Eula and A. Ivanov, Italy  
442
C - SESSIONS

SESSION C1
PNEUMATIC COMPONENTS 09.00-10.20

Chairman S. Scavarda

Pressure versus flow characteristics of a pneumatic pressure control proportional valve with diaphragms
N. Chen and K. Araki, Japan

Study of digital pneumatic valves geometry
G. Belforte, M. Carello and N. D’Alfio, Italy

Model and dynamic of energy saving pneumatic actuator
G. Quaglia and L. Gastaldi, Italy

Development of a new actively compensated pneumatic journal bearing
G. Belforte and T. Raparelli, Italy

SESSION C2
PNEUMATIC POSITION SERVOS 10.50-12.10

Chairman E. Mäkinen

Verification of electropneumatic servovalve size using non-linear control theory applied to cylinder position tracking
S. Sesmat, S. Scavarda and X. Lin-Shi, France

Multivariable control for damping oscillations of flexible pneumatic servodrive
J. Mattila and T. Virvalo, Finland

Improving the use of the stroke of a pneumatic servo cylinder
T. Virvalo, Finland

An investigation into the profile following capability of servocontrolled air motors
J.Pu, C.B.Wong and P.R.Moore, UK

SESSION C3
CONTROL APPLICATION IN PNEUMATICS 13.30-14.50

Chairman J. Pu

Intelligence in pneumatic servo positioning axis
H. Zhou, Germany

Air jet massage device
V. Reedik, Ü. Kristjuhan and T. Tähemaa, Estonia
Control behaviour of a pneumatic actuated process control valve
J. Riihilahti, Finland

SESSION C4
HYDRAULIC PUMPS
Chairman P. Wüsthof

Ceramics in axial piston pumps and motors
M. Schöpke and D.G. Feldmann, Germany

Production of high pressure by using high speed kinetic pumps
J. Larjola, Finland

Multiple hybrid control of pump displacement
R. Paoluzzi, L.G. Zarotti and G. Ferretti, Italy

New high-pressure axial pump with direct capacity control
A. Osiecki and L. Osiecki, Poland

Hydrostatic transmissions in shipbuilding applications
with axial piston units
G. Elbers, Germany