SEMINAR - סמינר

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ב' 04.01.2021
(כ' בטבת תשפ"א), בשעה 14:30 באמצעות הזום: https://technion.zoom.us/j/96246742416

מרצה:

Damiano Padovani, PhD, Associate Professor
Faculty of Engineering and Science, University of Agder, Norway
damiano.padovani@uia.no

על הנושא:

Increasing Energy Efficiency of Hydraulic Control Systems

The seminar will be given in English

להלן תקציר ההרצאה:

This lecture addresses the energy consumption of hydraulic actuators mainly used in industrial environments, earth-moving, construction and agriculture (*e.g.* in manipulators, excavators or wheel-loaders). The goal of this investigation is finding an energy-efficient approach to design and control system architectures applicable to most hydraulic machines. This concern is motivated by the fact that current design solutions have very low energy efficiency, defined as the ratio of the actuators' output energy over the pump's input energy. Its value can drop below 15% during standard operations of most hydraulic actuators.

Due to increasing attention paid on the environmental impact, such as CO_2 emissions, reduction of power dissipation while preserving the existing performance is one of the most important current demands. Different hydraulic system architectures have been developed to comply with the above requirement. Some efforts were devoted to mechanical–hydraulic solutions (*e.g.* load-sensing systems), but a clear tendency toward the use of electro-hydraulic components (*e.g.* electronic flow matching) prevails. These valve-controlled concepts based on nonhybrid layouts, including mechanical–hydraulic architectures, are still popular choices despite their poor efficiency.

This limitation is eliminated in throttleless actuation (*e.g.* displacement control or electro-hydraulic systems) since it removes those functional power dissipations generated by valves to control the hydraulic power. Efficiency improvements up to 50% and engine downsizing by 50% were demonstrated for displacement-controlled excavators in limited operations. Nevertheless, fundamental research is still needed to address several important issues of displacement control, such as low pump efficiency at partial displacement and inconvenient machine electrification. Towards this goal electro-hydraulic systems have been recently adopted in simple layouts. However, an inclusive approach covering design of complete architectures, as well as their control is still missing.

Several attempts will be presented to attack the problem of developing energy-efficient architectures by focusing on their design and control. The main steps cover:

* Modular design for electro-hydraulic systems suitable for several applications where the control element becomes a variable-speed electric motor
* Control algorithms for position tracking capable of adding artificial damping.

Some important results to be presented refer to (i) electro-hydraulic drives characterized by high energy efficiency (about 60% during actuation) and (ii) model-based approaches for adding artificial damping (the damping ratio of the system is increased to higher values that lead to a good dynamic behavior). Crucial directions for future research will be briefly mentioned, such as machine hybridization to enable downsizing of the prime mover and thermal management to maintain optimal operating temperatures.

מארח: פרופ' מיכאל שפירא

בברכה,

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