Engineers seek to improve industrial electric drives

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The same mechanical principles underlie whether a DVD player skips and whether the most advanced surgical robot will rotate its scalpel arm toward the wrong organ. Both depend on the stable performance of motors, where there's room for improvement.

A team of researchers from the Polytechnic University of Bari, in Italy, are working to do just that—improve how industrial electric drives operate. They propose a new control scheme that will improve not only how motors operates, but also how they interact with other systems. The scheme is detailed in a paper published in *IEEE/CAA Journal of Automatica Sinica* (*JAS*).

"The proposed solution improves the control dynamic performance and disturbance rejection," the researchers wrote in the paper. "It may help [reduce] the issues depending on control efforts, [and] energy consumption to compensate disturbances."

The scheme involves a two-fold update of the traditional methods. The conventional regulator is called a proportional-integral controller. It employs a feedback loop to keep the electrical drive system working by determining initial values for each operation. If any of the preset values change unfavorably, the controller is programmed to react and recalibrate to keep the system in optimal condition. The researchers propose using the same programming method to control the drive's counterparts. By using the same control on all of the system's parts, integration and acceptance could be quicker at less energy expense.

The researchers also propose an improved pre-filter to assist the system in maintaining attention on relevant and important data. The pre-filter fits to the updated feedback loop, encouraging the system to handle information chronologically or in order of significance.

"The feedback controller design is based on systematic closed-form expressions," the authors wrote. "The formulas allow easy and fast computation both of the controller parameters satisfying dynamic performance and robustness specifications and of the rational transfer function realization."

To assess their proposed improvements, the research team conducted a simulated analysis and tested them experimentally using permanent magnet DC-motors and permanent magnet synchronous motors. Both types of motor are used for a range of tasks from cooling computer towers to industrial settings. The team programmed the motors, and unleashed a litany of motor-specific plagues. Every time, the motors responded quickly and appropriately.

"Affordable realizations are required for low-cost implementation," wrote the researchers regarding how best to apply their proposed methods to control systems at large. They appear confident that their work is a step in this direction. "An extensive experimental (and simulation) analysis has shown the superior performance of the novel scheme and its potential impact."

More information: Paolo Lino et al, Synthesis of fractional-order PI controllers and fractional-order filters for industrial electrical drives, *IEEE/CAA Journal of Automatica Sinica* (2017). DOI: 10.1109/JAS.2017.7510325

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