Better control of robotic movements for human safety

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Researchers have improved the control of a key robotic component to better ensure the safety of humans. They have published their results in *IEEE/CAA Journal of Automatica Sinica (JAS)*, a joint publication of the *IEEE and Chinese Association of Automation*.

The team, based at Nankai University, China, focused on a series elastic actuators. The actuator is the "muscle" of robotic machinery. Just as humans adjust their muscle control for various tasks, robots must also be equipped to handle external factors.

"For example, leg dynamics dramatically change between the swing and the stance phase," wrote Prof. Lei Sun from Nankai University. "Also, damping and stiffness can be increased by muscle contraction, [such as] when we want to make a precise positioning or when we hold heavy loads."

A series elastic actuator not only allows for robotic movement, but it also allows for flexibility. It's not a perfect system, though. "The high-performance control design for [series elastic actuators] is still a challenging problem, particularly in the presence of unknown payload parameters and external disturbances, which are common in [human-robot interactions]," wrote Sun.

To help series elastic actuators better account for unknown variables, Sun's team developed an algorithm to understand the relationship between the motion of the payload and the full control system. The idea

is that the robot can adjust its response and handling of the payload based only on the initial motion of the payload, which is controlled by humans in this system. The payload may be the same size and weight, but the way a person initiates the human-robot interaction may vary. The actuator should be able to move the payload safely, regardless of whether it was slammed or gently nudged into place.

"The framework is suitable for both linear and nonlinear [series elastic actuators], which implies that it is more generic," Sun wrote, pointing to the wide applicability of the method. "Experimental results illustrate that the proposed controller can achieve better control performance than the existing methods in a variety of interaction situations."

The researchers are now building a robot with three series elastic actuators to continue testing their proposed control method.

More information: Meng Wang et al. Continuous robust control for series elastic actuator with unknown payload parameters and external disturbances, *IEEE/CAA Journal of Automatica Sinica* (2017). DOI: 10.1109/JAS.2017.7510610

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