How to better track the movement of robots

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Pop culture predicts a wide array of robots to aid humans, from the Jetsons' housekeeper, Rosie to the adorable (and helpful) R2-D2 and BB-8 in the *Star Wars* universe. They may not yet be capable of washing dishes or smuggling holograms, but the robots of our time are getting better at moving.

Prof. Mou Chen at the Nanjing University of Aeronautics and Astronautics has proposed a method to better control the tracking of self-balancing mobile robots. He published his proposal in *IEEE/CAA Journal of Automatica Sinica (JAS)*, a joint publication of the IEEE and the Chinese Association of Automation.

According the Chen, the sliding mode control technique is the most commonly used way to regulate the behavior of a robot. This technique pulls information from the nonlinear system, which can behave differently depending on varying factors including time. The algorithm organizes the information into a representation of the robot's normal behavior.

"Although different [sliding mode control] schemes have been extensively studied in the practical systems, it needs to be further developed for the self-balancing robot," Chen wrote.

Chen also noted that the dynamic information of a variable called the unknown disturbance should be fully utilized. In order to better understand the unknown disturbance—which could be any number of things, such as skidding or slipping—scientists introduced a disturbance

observer into the sliding mode control technique. This mathematically determines the value of an unknown disturbance, allowing the sliding mode control method to adjust and keep the robot behaving normally.

The disturbance observer tracking control scheme requires improvement, though, according to Chen. His proposed method is a refined version of the previously developed disturbance observer controller.

"By using the output of the nonlinear disturbance observer, the tracking control scheme has been designed using the sliding mode technique to guarantee that all the closed-loop signals are ultimately uniformly bounded," Chen wrote. The robot, no matter the disturbance, should still end up moving in the desired trajectory.

Chen tested his algorithm with the parameters of a self-balancing mobile robot produced by Googol Technology Consulting, Inc., a China-based company specializing in research and development of controller-based systems.

"The simulation results have shown that a good tracking performance has been achieved," wrote Chen. "In future work, the experimental study will be done for the self-balancing mobile robot."

More information: Mou Chen, Robust tracking control for self-balancing mobile robots using disturbance observer, *IEEE/CAA Journal of Automatica Sinica* (2017). DOI: 10.1109/JAS.2017.7510544

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