How to improve physical interactions between robots and humans

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Popular entertainment often portrays robots as the perfect best friend, from Bender in the cartoon *Futurama* to the mighty Transformers. These close friendships don't exist off-screen yet, but humans and robots are getting to know each other better in real life.

Dr. Ali Safavi and Prof. Mehrdad Zadeh at Kettering University have proposed a model to improve human-robot interactions using haptic guidance. They have published their results in *IEEE/CAA Journal of Automatica Sinica (JAS)*, a joint publication of the IEEE and the Chinese Association of Automation.

"This approach leads to less intervention from the robot where the user (human) is demonstrating a good set of skills, resulting in smoother motion," the authors wrote.

Safavi and Zadeh incorporated a model predictive control framework in their approach. By using an adaptable interaction model rather than a general one, they were able to personalize human-robot interactions. Personalizing this experience allows the robot to learn from the user and adjust for optimal interference (force, speed and direction), which results in more precise shared movements, the data suggests.

"We believe that such a personalizing [of] the experience could result in a more intuitive framework where the robot interference in the shared control is completely adaptable to the users' behavior pattern and performance," wrote the authors.

To develop a more intuitive framework, Safavi and Zadeh included learning from demonstration techniques. In this case: a simple surgical related task using the hand. After ever few interactions between robot and user, performance is calculated based on skill and improvement. Lower performance of the user, results in higher intervention from the robot. While acceptable performance of the task results in less intervention, as guidance forces are adjusted.

"In other words," wrote the authors, "the user performance is collected and may be updated after every few runs. This allows the system to adjust with the latest performance of the user rather than the initial performance."

For training in skill-based tasks such as surgical procedures, personalizing the human-robot interaction results in more accurate teaching, it appears. This is noteworthy, as lower costs and recent advances have enabled what the authors call a new era in skill-based training. A better rapport between human and robot also has applications in the field of assistive robots for the elderly and mobility impaired.

"This could be a good step for developing more advanced and intuitive movement control frameworks," the authors concluded.

More information: Ali Safavi et al, Teaching the user by learning from the user: personalizing movement control in physical human-robot interaction, *IEEE/CAA Journal of Automatica Sinica* (2017). DOI: 10.1109/JAS.2017.7510634

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