Intrinsic Sense of Touch for Intuitive Physical Human-Robot Interaction

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This article reports on a technological advancement in intuitive human-robot interaction, which enables an intrinsic robotic sense of touch without use of any artificial skins or tactile instrumentation. Based on high-resolution joint force-torque sensing in a redundant arrangement on our DLR SARA robot, we were able to let the robot sensitively feel the surrounding environment and accurately localize touch trajectories in space and time that have been applied on its surface by a human. Through an intertwined combination of manifold learning techniques and artificial neural networks, the robot can identify and interpret those touch trajectories as machine-readable letters, symbols or numbers. This opens up new opportunities in terms of intuitive and flexible interaction between human and robot. Furthermore, we show that our novel concept of the so-called virtual buttons can straightforwardly implement a tactile communication link, including switches and slider bars, which are complementary to speech, hardware buttons, and control panels. These interaction elements could be freely placed, moved, and configured in arbitrary locations on the robot structure. The intrinsic sense of touch we proposed in this work can serve as the basis for a novel category of physical human-robot interaction that has not been possible yet, enabling a shift from conventional modalities towards adaptability, flexibility, and intuitive handling.

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