Editorial

THE field of haptics is challenging both in terms of technological development for the generation of complex artificial stimuli and in terms of studies to advance the knowledge of the physiology of touch. This issue of IEEE TRANSACTIONS ON HAPTICS archives eleven articles that well describe the challenges that the field of haptics poses to our scientific community.

In this issue, we report results by Zhou et al. [A1] on electrotactile simulation to generate an artificial haptic sensation consisting of applying current or voltage to the body through a pair of surface electrodes. The paper investigates how to make electrotactile perception less sensitive to electrode-skin impedance. The paper focuses on a data driven approach to take into account the nonlinear behavior of the impedance.

Contact interaction is crucial also in electroadhesion displays since the change of contact condition causes variability in the produced friction for these displays. In the paper by Sun et al. [A2], the authors propose a novel method for closed-loop control using current regulation to improve the precision of the electroadhesion force regardless of contact conditions.

In the paper by De Pra et al. [A3], another aspect of contact interaction is studied. The authors conducted experiments to assess the sensitivity to normal or tangential vibration of a finger exerting constant pressing forces. Results show that perception thresholds for normal vibration depend on the applied pressing force. Conversely perception thresholds for tangential vibrations are independent of the applied force.

Two contributions published in this issue discuss the problem of controlling kinaesthetic devices in stiffness discrimination tasks. In the paper by Nomberg et al. [A4], a coupled stability theory is developed to stabilise the interaction with the environment in presence of delay. The main objective is to design less conservative controllers with better performances than existing solutions for haptics and teleoperation. In the paper by Zamani et al. [A5], the effects of physical hardness on the perception of rendered stiffness are studied in an encountered-type haptic display. The rendering approach proposed by the authors has been shown to be more realistic than previous methods for rendering hard objects.

Three papers on applications to robotics are archived in this issue. In the paper by Valdivia et al. [A6], wrapping haptic displays around robot arms are proposed to communicate learning with the aim of letting participants to kinaesthetically teach robotic arms more rapidly and effectively. In the paper by Azulay et al. [A7], the context is the autonomous robotic manipulation of objects with under actuated hands. The authors investigated the ability to track and manipulate objects relying only on haptic sensing without using any vision-based measure exploiting low cost tactile fingers and data-driven MPC approaches. The third paper by Li et al. [A8] is on teleoperation and proposes a haptic shared autonomy strategy to regulate the orientation at the remote side with the objective of assisting human operators to reduce the operator's burden while performing complex teleoperation tasks.

The last three papers of the issue deal with visually impaired people, with a skin stretch device and an instrumented object to recognize emotions by touch. The display for visually impaired people proposed by Chen et al. [A9] is based on innovative electromagnetic driving mechanisms of Braille dots that provides the display with improved stability of performances and long service life. The contribution by J. Kent [A10] is on novel and intuitive skin stretch devices used for sensory feedback based on studies of the biomechanics of the skin stretch of the lower limb. The last paper of this issue is by Niewiadomski et al. [A11] and presents an innovative approach to recognize the affective states of a person performing an action with an instrumented object able to sense both tactile and kinematic data of the action.

DOMENICO PRATTICHIZZO, *Editor-in-Chief*
IEEE TRANSACTIONS ON HAPTICS
dprattichizzo@unisi.it

APPENDIX: RELATED ARTICLES

[A1] Z. Zhou, X. Wang, Y. Yang, J. Zeng, and H. Liu, "Mathematical model of fingertip skin under constant-current electrotactile stimulation," *IEEE Trans. Haptics*, early access, Dec. 08, 2022, doi: 10.1109/TOH.2022.3227084.

[A2] Z. Sun, X. Guo, and X. Sun, "Closed-loop control of electroadhesion using current regulation," *IEEE Trans. Haptics*, early access, Dec. 23, 2022, doi: 10.1109/TOH.2022.3231685.

[A3] Y. De Pra, S. Papetti, H. Järveläinen, M. Bianchi, and F. Fontana, "Effects of vibration direction and pressing force on finger vibrotactile perception and force control," *IEEE Trans. Haptics*, early access, Nov. 30, 2022, doi: 10.1109/TOH.2022.3225714.

[A4] R. Nomberg and I. Nisky, "Human stabilization of delay-induced instability of haptic rendering in a stiffness discrimination task," *IEEE Trans. Haptics*, early access, Nov. 23, 2022, doi: 10.1109/TOH.2022.3221919.

[A5] N. Zamani and H. Culbertson, "Effects of physical hardness on the perception of rendered stiffness in an encountered-type haptic display," *IEEE Trans. Haptics*, early access, Dec. 5, 2022, doi: 10.1109/TOH.2022.3226182.

Digital Object Identifier 10.1109/TOH.2023.3256283

[A6] A. A. Valdivia et al., "Wrapping haptic displays around robot arms to communicate learning," *IEEE Trans. Haptics*, early access, doi: 10.48550/arXiv.2207.03315.

[A7] O. Azulay, I. Ben-David, and A. Sintov, "Learning haptic-based object pose estimation for in-hand manipulation control with underactuated robotic hands," *IEEE Trans. Haptics*, early access, Dec. 30, 2022, doi: 10.1109/TOH.2022.3232713.

[A8] G. Li, F. Caponetto, X. Wu, I. Sarakoglou, and N. G. Tsagarakis, "A haptic shared autonomy with partial orientation regulation for DoF deficiency in remote side," *IEEE Trans. Haptics*, early access, Jan. 24, 2023, doi: 10.1109/TOH.2023.3239602.

[A9] H. Chen et al., "A novel refreshable braille display based on the layered electromagnetic driving mechanism of braille dots," *IEEE Trans. Haptics*, early access, Feb. 8, 2023, doi: 10.1109/TOH.2023.3241952.

[A10] J. A. Kent, "Biomechanically-consistent skin stretch as an intuitive mechanism for sensory feedback: A preliminary investigation in the lower limb," *IEEE Trans. Haptics*, early access, Jan. 20, 2023, doi: 10.1109/TOH.2023.3238525.

[A11] R. Niewiadomski, C. Beyan, and A. Sciutti, "Affect recognition in hand-object interaction using object-sensed tactile and kinematic data," *IEEE Trans. Haptics*, early access, Dec. 19, 2022, doi: 10.1109/TOH.2022.3230643.