COMPMECH
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SEMINARIO

Touch science and engineering: from biomedical applications and tactile restoration with neuromorphic information encoding to sensory enrichment for the metaverse

The talk will discuss selected case studies of technologies developed for endowing robots and wearables with artificial tactile sensors distributed over large areas and to deliver tactile feedback from bionic limb prostheses up to the metaverse.
In the presented scientific approach, robotic systems are developed by capitalizing on a tactile interaction between robotics and neuroscience, so that the advancements of neurorobotic research can lead to the development of more effective technologies, which in turn contribute to the fundamental understanding of physiological processes.
A first case study proposed is with piezoresistive MEMS sensors, applied to bionic hand prostheses to restore rich tactile skills, such as texture discrimination in upper limb amputees. The developed biorobotic technologies and artificial intelligence methods, based on information encoding with neuromorphic spikes emulating physiological tactile representation, can be applied to a variety of sensory augmentation scenarios. Additional technologies were explored to cover large areas of robot or human bodies, including sensors based on cultured biological cells such as MDCK, piezoelectric ZnO nanowires grown with seedless hydrothermal method, and Fiber Bragg Gratings (FBGs).
Selected achievements are shown in the talk, discussing the application of tactile sensing technologies in a gripper able to manipulate fragile and deformable objects in collaboration with NASA-JPL, enabled by combining FEM and machine learning, or for equipping the full arms of an anthropomorphic robotic arm featured on the cover of Nature Machine Intelligence. Particularly, endowing robotic arms with large sensorized skins allows the implementation of smart collaborative policies, such as safe interaction and programming by demonstration, that can be deployed in the factories of the future.

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Aula M97 (DICAr)