Variable Impedance Actuators Moving the Robots of Tomorrow

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Abstract

In emerging robotic applications, in which robots need to cooperate closely with humans, traditional rigid structures and stiff actuation systems should be properly modeled and controlled in order to achieve adaptability, compliancy and safety. An alternative design approach is to build actuators with physically adjustable compliance and damping, able to store and release mechanical energy, to react softly when touching the environment, and intrinsically safe, just like human muscles do. Robots and biomechatronic systems can be given similar capabilities as humans by implementing variable impedance actuators, characterized by the property that their apparent output stiffness, and thus the stiffness of the actuated joint, can be changed independently from the actuator output position. Variable impedance actuators realize robust, energy-efficient and highly dynamic systems, which permit the embodiment of natural characteristics, found in biological systems, and implementable into a new generation of robots. This full-day workshop covers the challenges related to the technological realization and the functionalities of such actuation systems, in terms of both mechanical design and control, by mostly focusing on complex robotic and biomechatronic applications, such as robotic manipulation, bipedal and multi-legged locomotion, prosthetics (hands, arms and legs), rehabilitation devices and social robots (humanoids).