Novel technologies for next generation robotic artificial skin

Proposers
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Introduction

The next industrial revolution will see more and more robots employed in factories and SME, working in close cooperation with human workers; also, robot are being increasingly used in healthcare (e.g. robotic surgery, robot companions for the elderly) and service domains. Detecting and accurately measuring contacts with the environment (which includes both objects and people) is crucial for these robots to be both effective and safe. However, solutions for artificial skins that could cover the whole surfaces of robots and offer advanced sensing opportunities (e.g. force, temperature, vibration, proximity sensing on multiple contact points) are still not present on the market, and have been only tested in a few research laboratories. Big challenges are still present in terms of materials (the skin should be stretchable, to cover surfaces with different curvatures, and should be both soft and robust to facilitate long-term interactions with the external environment), electronics (with many sensing elements, optimizing the electronic design to reduce the number of wires and connections becomes crucial) and embedded computation (fast and low-power solutions to process high amount of data).

The Vislab group at ISR/IST has strong experience in human-robot interaction, robotic manipulation, force control and robot learning. The group can offer several robotic and measurement platforms, including the iCub, a 55-DOFs full humanoid robot equipped with visual and force/tactile sensing. Notably, some parts of the iCub body are covered with a state-of-the-art artificial skin, which is used by several robotic laboratories worldwide; however, several real-world experiments have revealed that further technological development is needed to realize an artificial skin that could enable successful robot tasks, and this further motivates the proposed PhD project.

Project outline/goal

The combination of highly sensitive magnetic sensors (e.g. GMR) and of soft elastomers with magnetic embedding will be investigated to create a soft stretchable artificial skin that can cover different parts of a humanoid robot body, targeting different control applications: the hands, to effectively manipulate objects, the arms and body, to safely interact with the external environment (including people), the bottom part of the feet, to perform dynamic locomotion measuring multiple contacts with the floor. Beyond these target applications, the developed sensor will be instrumental for any application where contacts with the external environment have to be precisely measured (e.g. minimally invasive surgery, industrial human-robot cooperation, physical human-robot social interaction).

Student profile: *preference, but not limited, to students with a background in Physics with an interest in Materials, Electronics and/or Robotics.*