IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

Author: Mr. Kellen Devries
University of Prince Edward Island, Canada, kdevries@upei.ca

Mr. Lucas Vanderaa
University of Prince Edward Island, Canada, lvanderaa@upei.ca
Mr. Edward Shim
Canada, edward@studio1labs.com
Dr. Olivia Y.-H. Lin
Studio 1 Labs Inc., Canada, olivia@studio1labs.com
Dr. Nadja Bressan
University of Prince Edward Island, Canada, nbressan@upei.ca

DEVELOPMENT OF ARTIFICIAL EXTERIOR SKIN FOR REMOTE ROBOTICS

Abstract

INTRODUCTION:

The application of robotic systems to space exploration is challenging considering the environment's extreme conditions. These include significant temperature variations, vibrational noise, presence of space debris, and radiational interference, among others. Current feedback systems typically use strain-gauges, piezoelectrics, or micro-electromechanical systems (MEMS) to provide force responses to the robot; however, these sensor types are not well suited to space applications due to their nonlinear response characteristics, temperature sensitivities, and weak electrical profiles. Conversely, fabric sensors present significant advantages over the outlined traditional alternatives due to their material and structural resistances to temperature variations, vibrational interferences, and radiation events. They are capable of determining variations in pressure and vibration throughout a sensor network, which can be used to identify and characterize inputs across a 2-dimensional surface. This research explores the potential applications of fabric sensors for use in feedback systems for space robotics.

METHODOLOGY:

In the first phase of the project, the fabric sensor's perception will be characterized using a sensory glove integrated with the Fanuc six-axis robot LR Mate 200iD/4S. This will be used to validate texture, pressure, temperature, and friction responses provided by the sensor. Following the development of this system, a waterproof artificial skin to encapsulate the fabric sensors will be created and validated in a wave tank. This environment will be used to more closely represent space conditions during testing, to allow for greater accuracy in the validation process.

PRELIMINARY TESTING:

Initial testing will consist of the generation of characteristic response curves for four materials: metal, foam, silicone, and polylactic acid (PLA). Uniformly sized samples will be prepared for each material and subjected to an applied load within the testing system described previously; the feedback received from the fabric sensor will then be used to describe the material's response. This information can subsequently be used to identify material composition based on the sensor's feedback.

DISCUSSION:

The main limitation to deploying smart textiles is their integration with other systems to produce valuable information which can be translated to applied knowledge. By providing sensory feedback to robots in remote applications, fabric sensors with haptic functionalities can enable fewer human personnel to be exposed to dangerous environments and reduce the impact of physical limitations such as personnel shortages. This will greatly enhance the potential for technological advancement in space research.