Processing of Sensory Information from a Bio-Inspired Flexible Artificial Skin Using a Kohonen Artificial Neural Network

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Artificial skin is a synthetic membrane structure that mimics the flexibility and sensory functions of biological skin. Similar to receptors in biological skin sending signals to neurons in the brain, an artificial skin needs sensors capable of converting information into electrical signals and transmitting them. Artificial skins are of increasing interest for prosthetics, soft robotics, virtual reality, wearable devices, and emerging medical applications. They can also potentially help reduce the number of amputations due to foot ulcers found in 25% of diabetic individuals. The goal of this research project is to demonstrate a method based on Kohonen artificial neural networks to map a temperature-sensitive artificial skin and pinpoint the location of a hot spot placed randomly on its surface, while using only a limited number of electrodes placed at the periphery of the large area film. Doing so would demonstrate the ability of this method to mimic how a brain functions when interpreting information from multiple-sensors. The artificial skins used were optimized previously from low-methoxyl pectin, a natural substance found in many fruits and vegetables. They resulted into flexible films whose electrical conductivity increased with temperature. A Kohonen artificial neural network is now trained with the electrical measurement data collected from the periphery of the artificial skin as a hot object is placed randomly on the sample surface to heat it locally. A representative two-dimensional map of the artificial skin sample is obtained in the topology of the resulting trained neural network, with the location of the hot object identified.

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