Biomimetic Sensory Solutions for Dexterous Robotic Hands

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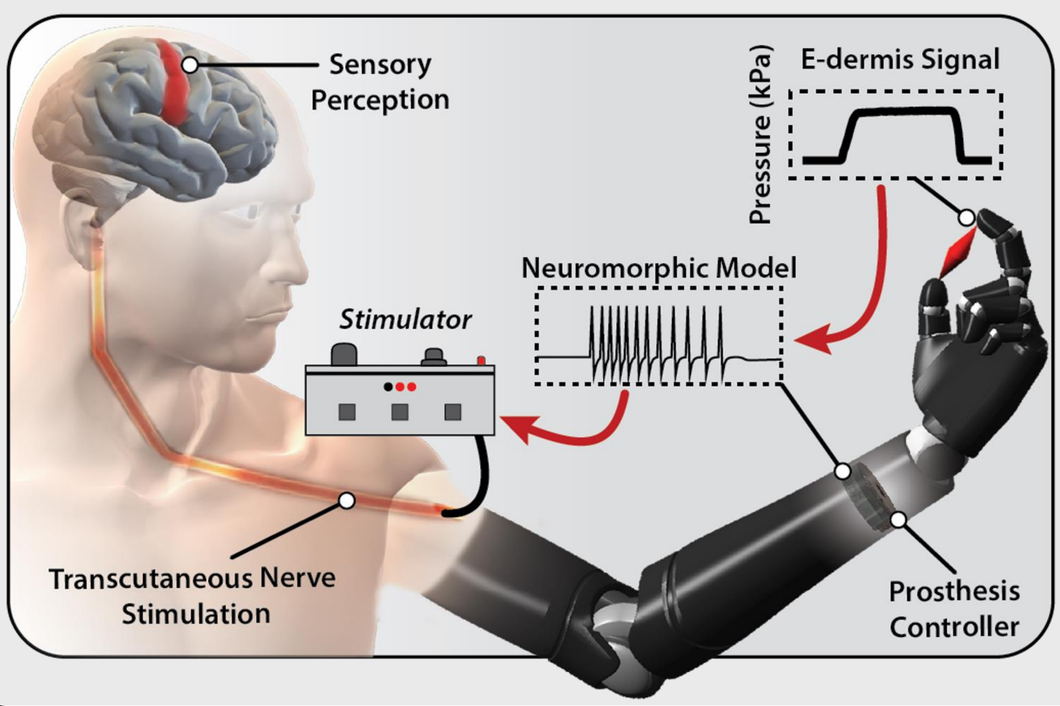
Summary

Our central focus is to provide enhanced tactile sensory perception through sensor-enabled dexterous robotic hands. We incorporate tactile sensors to achieve two goals: 1*) model mechanoreceptors and develop algorithms for neural encoding* with digital output mimicking sensorized skin and 2) *flexible neuromorphic sensing and decoding* to provide perception and understanding of textures and shapes.

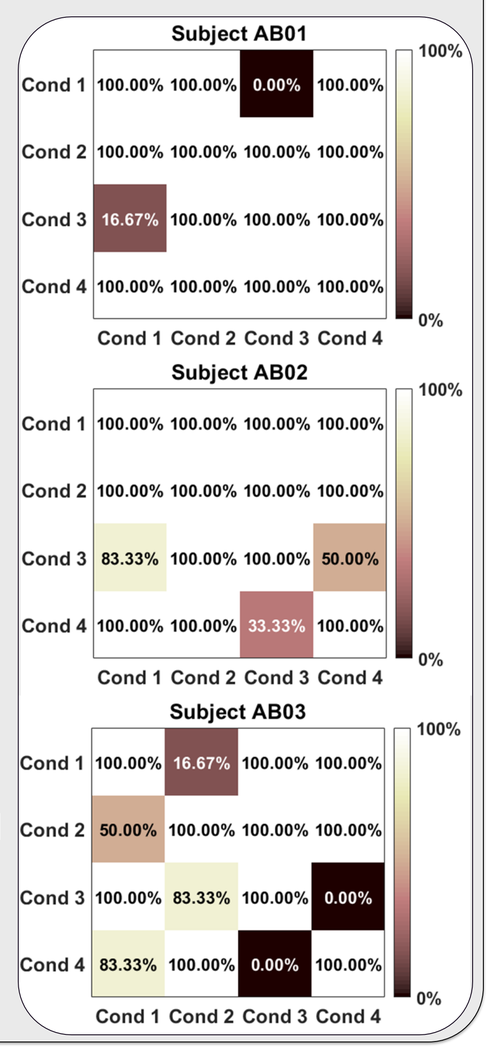


Results

- Stimulation through transcutaneous electrical nerve stimulation (TENS)
- Discrimination experiment of four stimulation conditions on three able-bodied subjects

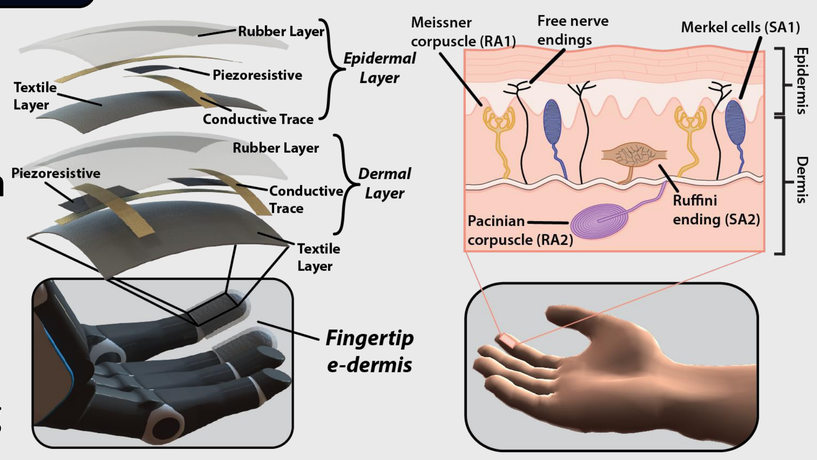
Condition	Subject AB01 PW (ms)	AB01 Freq (Hz)	AB02 PW (ms)	AB02 Freq (Hz)	AB03 PW (ms)	AB03 Freq (Hz)
1	1	10	2.5	10	5	5
2	10	10	10	10	10	5
3	1	50	2.5	50	5	50
4	10	50	10	50	10	50

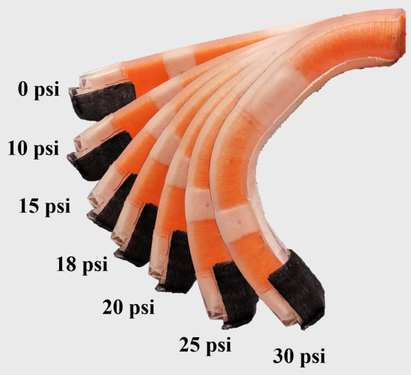
- Confusion matrix shows the subject's ability to identify if the conditions presented were the same or different
- Subjects successfully distinguished different stimulation conditions through sensory feedback



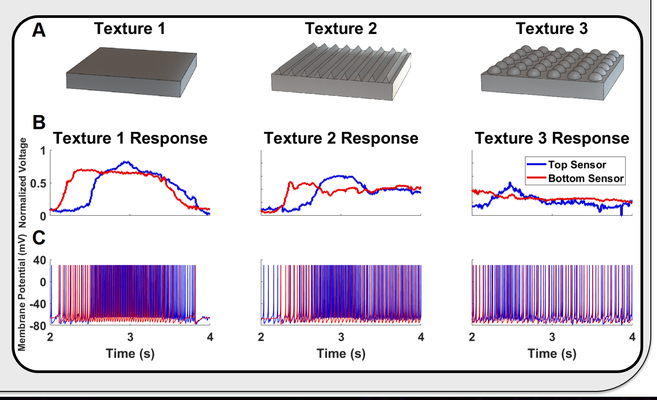
Solution

- Flexible, multilayered electronic skin
- Biomimetic artificial receptors for tactile sensing



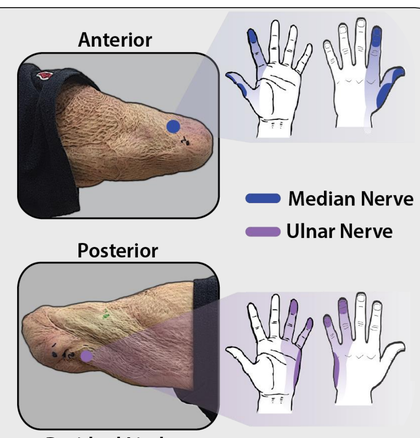


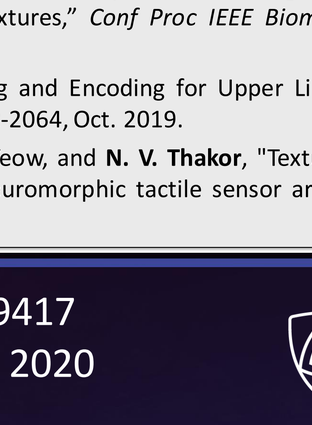
- Pneumatically actuated soft biomimetic finger with integrated tactile sensor
- Compliant palpation of the tactile environment
- Neuromorphic encoding and stimulation for object detection
- Receptor specific modeling for enhanced performance



Impact

- Natural tactile sensory feedback for upper limb amputees for more natural touch, texture, shape, and object recognition
- Foundation for multisensory skin and sensory perception in autonomous sensorized robots and human interactions
- Educational impact through Neural Prostheses course for undergrads and student training for local high school students and REUs





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