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A psychophysical investigation on vibrotactile sensing for transradial prosthesis users (Article) (Open Access)

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Abstract

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The absence of tactile sensory feedback in transradial prosthetic hands is one of the major contributing factors for these devices to be rejected by users. This paper reports human psychophysical response to vibrotactile sensations in discriminating surface textures, as a possible non-invasive method to supplement sensory feedback for prosthetic hand users. The vibrotactile sensations were supplied by a specially fabricated actuator that vibrates according to signals obtained by a prosthetic finger when sliding across textured surfaces. Participants were provided with four different types of vibration patterns, randomly repeated for five times and were required to state which surface textures that the vibration patterns represent. A Chi-square test statistical procedure was designed to evaluate the relationships between these two categorical variables. The investigation which comprises of 300 samples has shown a statistically significant relationship between the vibration patterns and the surface textures ($p < 0.001$). The participants were able to discriminate surface textures and associate them to the vibration patterns provided by the vibrotactile actuator accordingly. The outcome of this work has provided optimistic possibility for implementation of painless, non-invasive sensory feedback that will undoubtedly boost the users' sense of embodiment and encourage them to fully utilize a well-designed prosthetic device. © 2018, © 2018 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

Author keywords

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Noor Hazrin Hany Mohamad Hanif is an Assistant Professor in the Mechatronics Engineering Department of International Islamic University Malaysia. Her research interests include rehabilitation instrumentation, wearable devices and energy harvesting. P. H. Chappell is an Associate Professor in Electronics and Computer Science at University of Southampton. His research interests are in medical engineering, particularly prosthetics and functional electrical stimulation. N. M. White holds a Personal Chair of Intelligent Sensor Systems in the Electronics and Computer Science, University of Southampton. His research interests include thick-film sensors, intelligent instrumentation, MEMS, self-powered microsensors and sensor networks. A. W. Cranny was a Senior Research Fellow within the Electronics and Computer Science, University of Southampton.

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