

FREQUENCY MODULATION EFFECT OF FINGERPRINTS MEDIATES THE SENSITIVE PERCEPTION

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ABSTRACT

When the fingers run over the surface of an object, its information about geometry, mechanical and material properties can be easily and sensitively perceived. Mechanoreceptors especially Pacinian afferents are widely believed to convey the generated vibrations enhanced by fingerprints. However, as the afferents have very narrow range of frequency sensitivity, how do they convey features of natural surfaces that is randomly distributed and generate a broad spectrum of frequencies? Here, we illustrate the way of frequency modulation when fingerprint touches textures with different scales. Fingerprint plays a critical role in modulating frequencies to effectively stimulate cutaneous sensitive perception. We show the unification of sensitive perceptive mechanisms of mechanoreceptors on both coarse and fine textures, mediated by the frequency modulation effect of fingerprints. Our results are of great importance for restoring the sensory capabilities to people, and for the development of advanced prosthetic skin, human-machine interaction and robotic sensation and intelligence.

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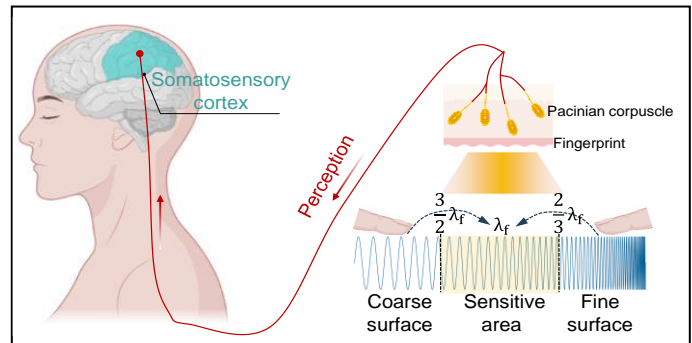


Fig.1 The frequency modulation of fingerprints on surfaces with a wide range of frequencies for sensitive perception. The tactile mechanoreceptors of human fingertip have sensitive range of frequencies (or periods, $\lambda_f * 2/3 - \lambda_f * 3/2$). For surfaces with features outside this sensitive area, fingerprints can modulate it to generate an additional frequency falling in the sensitive range so as to achieve sensitive and precise surface recognition.

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