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Bio-Inspired Tactile Sensing: Distinction of the overall object contour and macroscopic surface features

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Abstract: Vibrissae of rats are part of the somatosensory system. A tactile stimulus along the hair shaft is transmitted to the Follicle-Sinus complex and transduced into an action potential by mechanoreceptors. The signal contains information about the texture of the contacted object including the overall contour, the waviness (macroscopic feature) and the roughness (microscopic feature). Here, the overall contour and the waviness of an object are analyzed using an artificial vibrissa-like sensor that is dynamically swept along the object. The natural vibrissa is replaced by a cylindrical steel wire and the Follicle-Sinus complex by a force / torque sensor, respectively. The overall object contour is designed as a sine wave (long wavelength) and is super-imposed by a second sine wave with a shorter wavelength in order to represent the waviness. A procedure to distinguish both components is developed and successfully applied. The combination of the sensor shape and the scanning conditions -- for example, the large, nonlinear deformation of the sensor shaft -- operate like a morphological filter and consequently influences the detected profile features.

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