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Textural-input-driven self-organization of tactile receptive fields

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Sensory neurons in the primary sensory cortices preferentially respond to specific patterns of input. Our hypothesis is that tactile receptive fields (TRFs) can be self-organized using the same cortical development mechanism found in the visual cortex, simply by exposing it to texture-like inputs. We used the LISSOM model of visual cortical development [1] to test our hypothesis. The results showed that texture-like inputs lead to the self-organization of TRFs while natural-scene-like inputs lead to visual receptive fields (VRFs). We analyzed the effectiveness of the TRFs and VRFs in representing texture, using kernel Fisher discriminant analysis (KFD) [2]. The responses to different classes of textural input were more clearly separable for the TRF than for the VRF. To quantify the merit of the different RF types in dealing with textural input, we measured classification performance. We ran the experiment for 30 times and for each experiment 50% of data set were randomly used as training set and the rest as testing set. As a classifier, *k*-nearest neighbor (kNN) was used. Average classification rates were 89.8% (for TRF-based) and 83.4% (for VRF-based) respectively. The main results suggest that tactile RFs can be self-organized by texture-like input using a general cortical development model (LISSOM) initially inspired by the visual cortex, and that the representations from tactile RFs are better than vision-based ones for texture tasks. We expect our results to help us better understand the nature of texture as a fundamentally tactile property.

References

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