First Order Tactile Neurons with Complex Receptive Fields: A Neural Instantiation of Compressed Sensing?

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Presentation Abstract Summary First-order tactile neurons in the glabrous skin of the human hand have distal axons that branch in the skin and form many transduction sites, yielding spatially complex receptive fields (RFs) with many highly sensitive zones. We have recently shown that this arrangement permits first-order tactile neurons to signal high-level features of touched objects such as the orientation of an edge, a capacity previously considered a hallmark of processing in the somatosensory cortex. Here we leverage machine learning tools to examine why complex receptive fields arise and what computational benefits they yield. We show that complex receptive fields are optimal under a wide range of training sets and biologically realistic network constraints, and that complex RFs benefit network performance, especially on complex discrimination tasks in the presence of noise. We propose that complex RFs reflect the role of first order neurons as input elements in a neural compressed sensing scheme.

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