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OKINAWA INSTITUTE OF SCIENCE AND TECHNOLOGY
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VISITING PROGRAM

TSVP TALK

Seeing the World: Building Scenes From Pixels in the Mid-Level Visual Pathway

2025
TUE. **Dec. 9**

15:00–16:00

HYBRID **L5D23, ZOOM**



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Retinal images are just like digital images composed of many small pixels. Through its hierarchical visual cortices, our brain gradually groups these pixels, constructs contours and surfaces, and ultimately recognizes objects and scenes. Intermediate cortical areas, such as visual areas 2 and 4 (V2, V4), play crucial roles in this transformation. V2 neurons code the local side (direction) of the object with respect to borders defined by luminance, color, texture, and depth; that is, they find which side of the border belongs to the object. Pooling this information then contributes to the detection of contours, which form the periphery of an object. V4 neurons code a figure relative to the background and construct a surface, the spatial extent of objects enclosed by contours. Attributes such as shape, color, and texture are thought to attach to this surface and contribute to object recognition. If surface construction fails, even the perceived shape deviates from the true object, and recognition will also fail. Our recent study showed that individual V4 neurons were not capable of coding figures, but tens of neurons appeared to code figures at the population level. A pool of approximately forty to fifty neurons was capable of segregating figures in natural images, in good agreement with perceptual performance. Surface construction is thought to be driven by the prior probability structure of natural images, which is reflected in perceptual rules such as Gestalt factors. The resulting surface is considered a proto-object that provides bottom-up visual information for matching with top-down knowledge about objects. Further investigations of proto-objects may clarify how we understand and abstract visual scenes and conceptualize the world.



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