Abstract:

Compositionality in object perception

Compositionality refers to the premise that the whole can be understood in terms of its parts. This is a fundamental question in our quest to simplify neural representations. In the case of vision, it is widely believed that our brain has evolved to highly specialized feature detectors whose response is "more than the sum of their parts", thereby violating compositionality. A classic example is the idea of a grandmother cell, which responds to any image containing your grandmother, whether small or big, rotated towards or away etc. Such feature processing, it is believed, is what makes our brain so good at vision compared to the best computers today. Identifying these highly specialized features then becomes extremely difficult because a given image might contain a large number of features, and finding the right combination of features involves searching through a combinatorial explosion of possible feature subsets.

In my lab, we are investigating these fundamental questions using a combination of experimental techniques. I will present a series of results from our lab that challenge these widely held beliefs about how higher-order visual processing works. Our key conceptual advance is that while identifying complex features is difficult, understanding how such features combine is in fact tractable. I will show that the response to the whole object is systematically related to its parts at both behavioral and neural levels, but the definition of parts require careful elaboration. Further, these systematic relationships can explain complex percepts like symmetry, visual word processing etc. Thus, it may be more insightful to understand how features combine than identifying the features themselves.

Brief Biography:

SP Arun received his B.Tech from IIT Bombay, and MS & PhD from Johns Hopkins University, all in Electrical Engineering. He completed his postdoctoral research at Carnegie Mellon University and joined the Centre for Neuroscience at IISc where he is currently an Associate Professor. His interests are in visual perception and object recognition. For more details please visit the homepage of the Vision Lab IISc https://sites.google.com/site/visionlabiisc/