

Speaker Karlsruhe Days of Optics & Photonics 2021



Abstract: Looking, Seeing, and the Central-Peripheral Dichotomy --- a new framework to understand how vision works in our brain

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Visual attention selects only a tiny fraction of visual input information for further processing. Selection starts in the primary visual cortex (V1), which creates a bottom-up saliency map (V1 Saliency Hypothesis, V1SH) to guide the fovea to selected visual locations via gaze shifts.

This motivates a new framework that views vision as consisting of encoding, selection, and decoding stages, placing selection on center stage. It suggests a massive loss of non-selected information from V1 downstream along the visual pathway. Hence, feedback from downstream visual cortical areas to V1 for better decoding (recognition), through analysis-by-synthesis, should query for additional information and be mainly directed at the foveal region (Central-Peripheral Dichotomy, CPD).

Accordingly, non-foveal vision is not only poorer in spatial resolution, but also more susceptible to many illusions. Some background/details are in http://www.lizhaoping.org/zhaoping/NewPathPaperEtc_2019.html

I will also show the latest findings, including a peripheral illusion predicted by this framework and a stereo vision paradigm as an example to investigate the analysis-by-synthesis process in the top-down feedback for visual inference in central vision.

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Biography:

I obtained my B.S. in Physics in 1984 from Fudan University, Shanghai, and Ph.D. in Physics in 1989 from California Institute of Technology. I was a postdoctoral researcher in Fermi National Laboratory in Batavia, Illinois USA, Institute for Advanced Study in Princeton New Jersey, USA, and Rockefeller University in New York USA. I have been a faculty member in Computer Science in Hong Kong University of Science and Technology, and was a visiting scientist at various academic institutions. In 1998, my colleagues and I co-founded the Gatsby Computational Neuroscience Unit in University College London. From Oct. 2018, I am a professor in University of Tuebingen and the head of the Department of Sensory and Sensorimotor Systems at the Max Planck Institute for Biological Cybernetics in Tuebingen, Germany. My research experience throughout the years ranges from areas in high energy physics to neurophysiology and marine biology, with most experience in understanding the brain functions in [vision](#), [olfaction](#), and in [nonlinear neural dynamics](#). In late 90s and early 2000s, I proposed a theory (which is being extensively tested) [that the primary visual cortex in the primate brain creates a saliency map](#) to automatically attract visual attention to salient visual locations. This theory, and the supporting experimental evidence, have led me to propose [a new framework for understanding vision](#). I am the author of [Understanding Vision: theory, models, and data](#) , Oxford University Press, 2014.