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Spontaneous pattern formation in large scale brain activity: What visual migraines and hallucinations tell us about the brain

In 1952 Turing's paper on the chemical basis of morphogenesis initiated an important approach to the mathematical analysis of spontaneous pattern formation. In 1973 Wilson and Cowan introduced a similar formulation in nets of interacting neurons and in 1979 Ermentrout and Cowan developed the mathematical analysis of such nets using local bifurcation theory and symmetry groups. Bressloff, Cowan, Golubitsky, Thomas and Wiener (2001) further developed this approach to characterize and analyze some of the circuitry of the primate visual cortex. The symmetry group used was the Euclidean group in the plane, $E(2)$, under a novel rotation action. Such an action is related to the fact that the visual cortex is a network of oriented edge detectors. However it is clear that much more than the orientation of a local edge is detected in the visual cortex: movement, texture and surface information, color and depth, for example. In this talk I will describe a new approach that allows the incorporation of these features into a comprehensive account of the origins of visual hallucinations and migraines.

Jack Cowan
University of Chicago