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Reorganization of neuronal circuits in growing visual cortex WOLFGANG KEIL, MPIDS Goettingen, SIEGRID LOEWEL, University Jena, FRED WOLF, MPIDS Goettingen, MATTHIAS KASCHUBE, Princeton University — The dynamics of reorganization of large cortical circuits is rooted in plasticity of individual synapses, but rules governing the collective behavior of large networks of neurons are only poorly understood. The postnatal brain growth partly evoked by extensive formation of new synaptic connections may expose cortical areas to a 'natural perturbation' sufficiently strong to observe signatures of large scale reorganization. Quantifying large sets of imaging data from juvenile cat visual cortex, we observe a novel mode of reorganization of domains that prefer inputs from one eye or the other. Our theoretical analysis shows that this mode can be explained quantitatively by the so called Zigzag instability, a dynamical reorganization, well-known in the field of pattern formation in physics, by which 2D isotropic Turing patterns respond to an increase in their typical spatial scale with a zigzag-like bending of domains. We point out that this instability has in fact been predicted, albeit implicitly, by most models of visual cortical development that have been proposed so far. We conclude that cortical networks can undergo large scale reorganizations during normal postnatal development.

Matthias Kaschube
Princeton University

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