

Coarse Analysis of Neuronal Network Models

C. Ellsaesser¹

Abstract: We present an extensive and in-depth numerical approach to study spatiotemporal pattern formation in neuronal network models. The aim is to investigate a spatially coarse-grained behavior in networks that are defined at a single-neuron level through well-known models such as Integrate-and-Fire, Spike-Response, or Hodgkin-Huxley. In contrast to traditional approaches (which are not applicable here) where the coarse equations are derived from a detailed model and subsequently analyzed, we use an approach that allows us to directly analyze the coarse-grained behavior by evaluating detailed models only. The coarse analysis concept has already been applied successfully to different kinds of model, e.g., in chemistry. We extend it to network dynamics and use it to examine coarse-grained quantities such as global activity and several examples of spatial activity distributions. Besides the mathematical interest, our motivation is to gain a deeper understanding of the biological relevance of spatiotemporal patterns as they are observed in experiments. This is joint work with I.G. Kevrekidis, J. Starke and J.L. van Hemmen.

¹ Institute of Applied Mathematics
University of Heidelberg
Im Neuenheimer Feld 294, 69120 Heidelberg, Germany
carmen.ellsaesser@iwr.uni-heidelberg.de