Synchronous and Asynchronous Integration of Dynamic Neural Fields

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May 21, 2008

Abstract

In [1], we've introduced a dynamic model of visual attention based on the Continuum Neural Field Theory [2] that explained attention as being an emergent property of a dynamic neural field. The fundamental property of the model is its facility to select a single stimulus out of several perfectly identical input stimuli. In the absence of external noise and with a zero initial state, the theoretical mathematical solution of the field equation predicts the final equilibrium state to equally represent all of the input stimuli. This finding is valid for synchronous numerical computation of the system dynamics where elements of the spatial field are computed all together at each time point. However, asynchronous computation, where elements of the spatial field are iterated in time one after the other yields different results leading the field to move towards a single stable input pattern. This behavior is in fact quite similar to the effect of noise on dynamic fields.

The present work aims at studying this phenomenom in some details and characterizes the relation between noise, synchronous evaluation (the "regular" mathematical integration) and asynchronous evaluation in the case of a simple dual-particle system. More generally, we aim at explaining the behavior of a differential equation system when it is considered as a set of particles that may or may not iterated by synchronous computations.
PACS: 02.30.Hq, 07.05.Mh, 84.35.+i

Keywords: Synchronous computation, Asynchronous computation, Dynamic Neural Fields,

References

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