Török Levente

Stability, Optical Flow Estimation and Stochastic Resonance in Cellular Wave Computing

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In the first part of the dissertation, I dealt with the questions of stability of the multi layer Cellular non-linear/neural network.
I have developed 7 new theorems and one strong conjecture along with a methodology that lets some to generalize theorems from single layers to multiple layers.

In the second part I wrote about a fundamentally new OF model which relies on a multi-scale, stochastic description of motion apparent in video sequences.
I showed two ways of formalizing Bayesian incorporation of different scales, leading essentially to the same computation scheme.

The new algorithm was found to be optimally fitting to the architecture of the CNN-UM by the application of which it can be accelerated by 3 orders of magnitude compared to standard single processor digital architectures. The solution performs as good as 10-15 years old digital versions (ref. [28,29]) but outperforms all analog VLSI solutions in terms of accuracy (both simulations and on-chip), speed and resolution. Furthermore, most of those digital solutions apply operations that make nearly impossible to implant them on VLSI or aVLSI.

In the third part, I wrote about a the integro-differential stochastic resonance that aimed to bypass the most common properties of the stochastic resonators, namely their spikiness, with applying a framework for lineary transforming the inherently non-linear problem.
The stochastic resonacne is particularly a interesting phenomana since it these systems, if certain curcumstances hold,
the additive noise helps signal transfer.
I have derived analytically the properties of the new system and also supported by expertiments, and made a conjecture about the appearance of this phenomena in the mammalian visual system.