Informationprocessing with Lossless Cellular Neural Networks

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ABSTRACT: The eigenvalues of a symmetric tridiagonal matrix can be computed via an iterative diagonalization with the aid of the QR-algorithm. Interpolating the matrices of subsequent iteration steps with continuous (time) trajectories leads to the concept of matrix flows on manifolds. This can be viewed as the transients of a nonlinear dynamical system. Taking samples from the continuous trajectories results exactly in the matrices given by the iteration steps of the discrete algorithm. Therefore, in the fixed point of the dynamical system, the desired eigenvalues are found.

This could also be used as basis for nonlinear filtering operations based on sorting such as rank order filtering and many more.

Mapping these nonlinear ODE's onto physical structures, i.e. synthesizing a circuit, lossless nonlinear dynamical circuits are obtained. These circuits can be interpreted as CNN's with nonlinear templates.

While these lossless CNNs are interesting by themselves, the important question arises, whether a robust implementation without any power supply and, therefore, without dissipation is practically feasible indeed. Convential realizations would necessitate (nonlinear) inductors and would, therefore, not be well suited for solid state silicon implementations. Any simulation of the inductors with the aid of transistors will not alleviate the problem, because the resulting circuits will not be truely lossless any more. They only will be pseudolossless, which is not sufficient in this context. But future nanoscale quantum devices open up new possibilities of lowloss nanoelectronic computing structures.

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