Hardware-Oriented Numerical Algorithms

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One trend in Scientific Computing is to transfer numerical schemes for often used tasks into a hardware implementation. Typical examples are the IEEE floating point arithmetic standard 5.11 including the implementation of special functions, or the Fast Fourier Transform chips in signal processing. Whereas the latter is based on the butterfly representation of the FFT, for special functions new approximation methods were developed, which can be summarized as pseudodivision algorithms. Other problems from image processing use the TODA flow approach to compute the eigenvalues of matrices up to order 64. The TODA flow technique can be interpreted as a continuous version of the discrete QR-algorithm. Opposite to the QR-algorithm the TODA flow can be translated easily into electrical circuits.

A possible hardware implementation of initial value problems of ordinary differential equations based on neural nets is one focus of this talk. It seems that the architecture of standard feedforward neural nets is not flexible enough, therefore partial recurrent nets of Elman type are introduced. Their learning strategy is based on modified Backpropagation, a gradient descent technique. Simulations for an inverter chain from electrical applications are discussed.

The presented results can be understood as a first step to construct customer prescribed chips for solutions of ordinary differential equations. Unless in earlier developments on analogue chips, now the more flexible and cheaper digitial hardware is used. The presentation is a cowork with R. Gerstberger from DASA Company, Munich.

References:

G. Pfaffenzeller, P. Rentrop, G. Schmidt: Robot control based on neural networks. Proceedings of ECMI VI in Limerick, ed. F. Hodnett, Teubner-Kluwer 1992, 247-250

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