Application of Neuro Dynamics to Signal Processor and Image Processing

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This thesis describes the application of neuro dynamics to the signal processor and image processing to explore the novel computational capability of neural networks.

After the introduction, in chapter 2, the discrete Walsh transform processor is designed by using Hopfield neural network to solve the linear programming problem. The discrete Walsh transform(DWT) is one of the most significant techniques as well as discrete Fourier transform (DFT) in the field of signal processing. In chapter 3, it is proved that the rapid convergence and the high accuracy of DWT processor both by theoretical analysis and by simulations. These results show that both the convergence speed and the accuracy are improved when the number of sample points increases. In chapter 4, DWT processor is implemented on the breadboard. From the experimental measurements, it is found that the DWT processor on the breadboard requires several micro-seconds to do DWT, which is caused from the propagation delay of the operational amplifiers. In chapter 5, the high speed DWT neuro chip is designed by using CMOS-OTA circuits. SPICE simulation results show that the DWT neuro chip has only the error less than 1% and carries out the DWT within 30 nano-seconds. Consequently, DWT neuro processor can be regarded as a high performance signal processor. In chapter 6, the sparsely interconnected neural network(SINN) for associative memory using 2-dimensional DWT is proposed as an another application of neuro dynamics. It is confirmed by computer simulations that the proposed SINN system can associate the desired memory pattern, which the conventional SINN fails to do. In chapter 7, the conclusions of this thesis are described.