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ADAPTIVE COMPUTING BY MEMRISTOR CIRCUITS

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Neuromorphic circuits will be considered for energy efficient computing based on biological principles in future electronic systems. Thereby, memristors are assumed in neuron models and for synapses in several recent investigations in order to overcome the limits of conventional von Neumann architectures by taking these devices as memory elements and as well as devices for computation also in bio-inspired artificial neural networks. Cellular Neural Networks (CNN) are universal high-speed computing systems with stored programmability and are already based on the principle of distributed computing with memory. The dynamical behavior of these spatiotemporal systems will be exploited to solve multidimensional signal processing and classification problems. For example, reaction-diffusion systems can be represented by state equations of socalled reaction-diffusion CNN showing the emergence of complex behavior (e.g. pattern formation) based on local activity and especially on a parameter subset called the edge of chaos.

A first approach to the principle of combined sensing and computing will be presented in this contribution. A memristor enhanced control system for a humanoid robot called Myon [1,2] will be shown. For different memristor models new bio-inspired movement control paradigms will be introduced and the performance in achieving a fast energy efficient movement control evaluated for different cases. It will be demonstrated that memristors endow the control system of Myon with the adaptability to changes in its topology.

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