Self-organization and Emergence of Dynamical Structures in Neuromorphic Atomic Switch Networks

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Self-organization of dynamical structures in complex natural systems posses an intrinsic capacity for natural-computation. Based on new approaches for neuromorphic engineering, we discuss the construction of purpose-built dynamical systems based on atomic switch networks (ASN). These systems consist of highly interconnected, physically recurrent networks of inorganic synapses (atomic switches). By combining the advantages of controlled design with those of self-organization, the functional topology of ASNs has been shown to produce emergent system-wide dynamics and a diverse set of complex behaviors with striking similarity to those observed in many natural systems including biological neural networks and assemblies. Numerical modeling and experimental investigations of their operational characteristics and intrinsic dynamical properties have facilitated progress toward implementation in neuromorphic reservoir computing. We discuss the utility of ASNs as a uniquely scalable physical platform capable of exploring the dynamical interface of complexity, neuroscience, and engineering.

References

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