Shaping the Dynamics of Recurrent Neural Networks by Conceptors

Herbert Jaeger

Jacobs University Bremen
Campus Ring
28759 Bremen
Germany

Summary

The human brain is a dynamical system whose extremely complex sensor-driven neural processes give rise to conceptual, logical cognition. Understanding the interplay between nonlinear neural dynamics and concept-level cognition remains a major scientific challenge. Here I propose a mechanism of neurodynamical organization, called conceptors, which unites nonlinear dynamics with basic principles of conceptual abstraction and logic. It becomes possible to learn, store, abstract, focus, morph, generalize, de-noise and recognize a large number of dynamical patterns within a single neural system; novel patterns can be added without interfering with previously acquired ones; neural noise is automatically filtered. Conceptors may help to explain how conceptual-level information processing emerges naturally and robustly in neural systems, and may help to remove a number of roadblocks in the theory and applications of recurrent neural networks.