Happy Birthday Alex!!!

Recurrent neural chemical reaction networks that approximate arbitrary dynamics

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Keywords: Chemical Reaction Networks; Dynamical Systems; Artificial Neural Networks.

Abstract: Many important phenomena in chemistry and biology are realized via dynamical features such as multi-stability, oscillations, and chaos. Construction of novel chemical systems with such finely-tuned dynamics is a challenging problem central to the growing field of synthetic biology. In this paper, we address this problem by putting forward a molecular version of a recurrent artificial neural network, which we call a *recurrent neural chemical reaction network* (RNCRN). We prove that the RNCRN, with sufficiently many auxiliary chemical species and suitable fast reactions, can be systematically trained to achieve any dynamics. This approximation ability is shown to hold independent of the initial conditions for the auxiliary species, making the RNCRN more experimentally feasible. To demonstrate the results, we present a number of relatively simple RNCRNs trained to display a variety of biologically-important dynamical features.

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Made in 2024