Deep Learning-based Analysis of Basins of Attraction

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The application of machine learning algorithms to complex dynamical systems has opened up new possibilities for predicting the behavior of these systems under different initial conditions. One important aspect of studying dynamical systems is understanding their basins of attraction which are the regions in the phase space where initial conditions lead towards a particular attractor. In chaotic systems, the boundary sets between these basins can be fractal, making the long-term prediction of initial conditions challenging. Basins of attraction can be characterized using various metrics that provide a quantitative understanding of the behavior of dynamical systems, but their prediction involves complex nonlinear operations that are well adapted for machine learning algorithms. Additionally, convolutional neural networks are particularly suitable for this task due to the representation of basins as images, where each pixel corresponds to an initial condition and each color represents a different attractor. The use of machine learning algorithms in this context constitutes an important step towards predicting the sensitivity of the system to initial conditions, and improving our understanding of the behavior of complex dynamical systems.

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