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De-entanglement of complex flows with time delay coordinates
EURIKA KAISER, J. NATHAN KUTZ, STEVEN L. BRUNTON, University of Washington — Time delay coordinates are an important tool to study and model real-world systems. It is well-known that these coordinates can be used to reconstruct an attractor from limited measurements. In this talk, we examine how moderate to long time-delay embeddings de-entangle attractors into simple periodic elements. Many systems, such as chaotic dynamical systems and moderate-Re turbulent flows, exhibit recurrent behavior. During transient phases the flow closely mirrors the motion of periodic orbits before eventually becoming turbulent again. These unstable periodic orbits represent exact solutions of the Navier-Stokes equations and form the skeleton of chaotic dynamics. Here, we use unstable periodic orbit solutions to reveal the de-entanglement of attractors through long time delay embeddings, which may have important implications for the characterization and modeling of complex dynamical systems. This work is demonstrated on several chaotic systems and plane Couette flow of moderate Reynolds number Re=400.

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