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Topological classification of recurrences in turbulent flows NAZMI BURAK BUDANUR, GÖKHAN YALNıZ, BJÖRN HOF, IST Austria — In recent years, numerical discoveries of unstable time-periodic solutions in various shear flow simulations have sparked hopes of developing a chaos theoretic understanding of turbulence. For many cases of interest, however, the standard tools of chaos theory, such as Poincaré sections, were insufficient for uncovering a complete picture of turbulent dynamics due to its high dimensionality. As a result, the discoveries of periodic orbits in turbulent flows have remained at an illustrative level with no obvious paths toward their utilization in turbulence modeling and control. One simple question one might ask is whether the turbulent dynamics transiently approximate periodic solutions, and if so, how frequently? We argue that a systematic study of this problem requires a method for unsupervised identification of geometric similarities between periodic orbits and turbulent trajectory segments in the system's state space. We will demonstrate with examples that topological data analysis methods can be employed for this purpose.

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