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Interpreting Turbulent Flows through Statistical Learning Methods

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Two data-driven approaches for interpreting turbulent-flow states are discussed. On the one hand, multidimensional scaling and K-medoids clustering are applied to subdivide a flow domain in smaller regions and learn from the data the dynamics of the transition process. The proposed method is applied to a direct numerical simulation dataset of an incompressible boundary layer flow developing on a flat plate. On the other hand, a novel nonlinear manifold learning from snapshot data for shedding-dominated shear flows is proposed. Key enablers are isometric feature mapping, Isomap, as encoder and, k-nearest neighbors algorithm as decoder. The proposed technique is applied to numerical and experimental datasets including the fluidic pinball, a swirling jet and the wake behind a couple of tandem cylinders.

Keywords

Dimensionality reduction; Clustering; Turbulent flows

Classification

Both methodology and application

Primary authors: GUERRERO, Vanesa (Universidad Carlos III de Madrid); DISCETTI, Stefano; IANIRO, Andrea; DENG, Nan; OBERLEITHNER, Kilian; NOACK, Bernd R.; FOROOZAN, Firoozeh; FARZAMNIK, Ehsan

Presenter: GUERRERO, Vanesa (Universidad Carlos III de Madrid)

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