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Data-driven modeling for unsteady aerodynamics and aeroelasticity

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Aerodynamic modeling plays an important role in multiphysics and design problems due to its low-dimensional representation of unsteady aerodynamics. However, in the traditional study of aerodynamics, developing aerodynamic and flow models relies on classical theoretical (potential flow) and empirical investigation, which limits the accuracy and extensibility. Recently, with the rapid growth of data from high-fidelity simulation and advanced experimental measurement, very large and diverse fluid data has become available, making data-driven modeling a popular and promising research direction. Data-driven models are not only more accurate than theoretical models, but also require very low computational cost. At the same time, they help to gain physical insights on flow mechanisms, and have shown great potential in engineering applications like flow control, aeroelasticity and optimization. In this talk, I will give an overview of my research work on three typical data-driven methods, including system identification, feature extraction and data fusion. Applications of data-driven methods in unsteady aerodynamic prediction, unsteady flow modeling and aeroelastic analysis will be discussed.