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Dynamical System Analysis of Data-Driven Turbulence Models SALAR TAGHIZADEH, FREDDIE WITHERDEN, SHARATH GIRIMAJI, Texas A&M University — Recent advances in machine learning (ML) algorithms, in conjunction with the availability of direct numerical simulation data, have resulted in a surge of interest in data-driven turbulence modelling. The idea with such models is to replace one or more components of a classical closure model with an implicit function obtained through a trained ML procedure. In training such a procedure, data is used to infer unknown turbulence constitutive relationships. However, as the properties of these learned functions are often poorly understood, the set of modelled equations can be internally inconsistent. Specifically, attributes such as fixed point behaviour, realizability, and consistency with other physical and mathematical constraints such as the rapid distortion limit may no longer be preserved. In this work, we introduce a novel procedure based on fixed point analysis for ensuring that the overall set of equations in data-driven turbulence modelling form a self-consistent dynamical system. The procedure will be showcased on a new data-driven Reynolds averaged Navier–Stokes model which we have developed.

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