MAX-PLANCK-INSTITUT
FÜR DYNAMIK KOMPLEXER
TECHNISCHER SYSTEME
MAGDEBURG

CSC Seminar

SPEAKER

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TITLE

Data Driven Modeling of Non Linear Dynamics in a Rotating Detonation Combustor via Finite Dimensional Approximations of the Koopman Operator

ABSTRACT

A rotating detonation combustor (RDC) is a promising device for improving efficiency in applications such as propulsion and power generation. The dynamics of the RDC are characterized by steady detonation waves wich are traveling within an annulus combustion chamber. Various operating modes are observed in the RDC, exhibiting phenomena such as non linear interactions of counter rotating detonation waves and standing waves. The Koopman Operator Theory provides a framework to globally linearize non linear dynamics by considering the evolution in the space of observables instead of the state. To this end In this work finite dimensional approximations of the Koopman Operator are computed through variants of the Dynamic Mode Decomposition (DMD) on data taken from high speed video images of the natural flame luminosity of the detonation waves generated at the RDC at TU Berlin. By introducing time delay embedding as the space of observables it is demonstrated how the limitation of standard DMD methods such as accurately reconstructing standing wave patterns and non linear interaction can be overcome. Furthermore a method is presented that addresses the presence of noise in the luminosity data. Finally it is shown how the dynamics learned by the DMD model can give insight into the different operating modes by decomposing the reconstructed signal into its characteristic features.

Tuesday, June 3, 2025 at 2 pm
seminar room Prigogine