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The role of Exceptional Points in the thermoacoustic spectrum[1]
LUCA MAGRI, University of Cambridge, ALESSANDRO ORCHINI, Technische Universitt Berlin, CAMILO SILVA, Technische Universitt Munich, GEORG MENSAH, ETH Zurich, JONAS MOECK, NTNU Trondheim — It has recently been found that, at specific operating conditions, thermoacoustic eigenvalues are extremely sensitive to small perturbations. We have formally related this high sensitivity to the existence of singularities in the thermoacoustic spectrum known as exceptional points. At exceptional points, two (or more) eigenvalues and their associated eigenvectors coalesce. As demonstrated in recent work, exceptional points naturally arise in longitudinal thermoacoustic systems due to the interaction between modes of acoustic and intrinsic origin. We extend these findings also for annular configurations, which are typical of gas turbines and aeroengines. Starting from a known simple or degenerate eigenvalue, we present general perturbation theory based formulae that can be used to accurately estimate the location of exceptional points in the thermoacoustic spectrum. We demonstrate that knowledge on the location of exceptional points is useful because it explains the strong nonlinear veering of the eigenvalue trajectories, which can be exploited to develop optimization strategies that go beyond current first order gradient descent methods.

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