A variational principle for the extraction of time-dependent modes associated with transient instabilities[1] THEMISTOKLIS SAPSIS, HESSAM BABAEE, MIT — We introduce a variational formulation for the determination of a finite-dimensional, time-dependent, orthonormal basis that captures directions of phase space associated with finite-time instabilities. While these instabilities have finite lifetime they can play a crucial role either by altering the system dynamics through the activation of other instabilities, or by creating sudden nonlinear energy transfers that lead extreme responses. However, their essentially transient character makes their description a particularly challenging task. Here we develop a variational framework that focus on the optimal approximation of the system dynamics over finite-time intervals under the orthonormal basis constraint. This variational formulation results in differential equations that evolve a time-dependent basis so that it optimally approximates the most unstable directions over finite times.

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