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A hierarchy structure of local Koopman spectra WEI ZHANG, MINGJUN WEI, Kansas State University — Local Koopman spectrum is studied for its role in resolving dynamics of a nonlinear system. For typical linear systems, local Koopman spectra and eigenspace are described by linear theories; for nonlinear systems, the proliferation rule is observed in its recursive application in nonlinear observables. A hierarchy structure of Koopman eigenspace is therefore introduced to depict the nonlinear dynamics in general. With the dynamics being decoupled to base and perturbation components, the perturbation is further separated to linear and nonlinear parts. In the hierarchy, the linear part follows linear spectral theories, and the nonlinear part is defined by linear spectra through recursive proliferation. Local Koopman spectra and eigenfunctions evolve continuously in the whole manifold and are derived from operator perturbation theory. The above analyses were applied first to LTI systems, and then to the nonlinear transition of the flow passing a fixed cylinder and its final periodic state. The triad-chain and the lattice distribution of Koopman spectra are observed numerically to confirm the hierarchy structure of Koopman spectra and the critical role of proliferation rule being involved.

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