

Lyapunov Integrability Test (LIT): a numerical framework for exploring integrability in continuous dynamical systems. [online]

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We introduce the Lyapunov Integrability Test (LIT), a new numerical framework for exploring integrability in parameter-dependent nonlinear dynamical systems. Inspired by the philosophy underlying the Mandelbrot set, the proposed approach shifts the focus from analyzing individual trajectories to investigating the global organization of parameter space. Instead of identifying regions associated with stable periodic motion, the LIT searches for parameter values compatible with the existence of additional first integrals by analyzing the structure of the Lyapunov spectrum. The method is simple to implement, computationally efficient, and applicable to both Hamiltonian and non-Hamiltonian systems. Its performance is demonstrated on several benchmark models, including the ABC flow, the heavy top, quantum dots, a helically symmetric Hamiltonian system with three degrees of freedom, and the classical double pendulum. The results show that the LIT reliably identifies known integrable cases while providing a practical tool for discovering new candidate integrable regimes and investigating the transition from integrable to chaotic dynamics.

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