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Probing Instability using Pattern Control in Rayleigh-Bénard Convection[1] ADAM PERKINS, ROMAN GRIGORIEV, MICHAEL SCHATZ, Georgia Institute of Technology — Identifying and characterizing the mechanisms of instability in spatiotemporally complex systems is of extreme interest, both fundamentally and for real-world applications such as forecasting. We report on a new experimental approach to study instability in a paradigm of such pattern forming systems, Rayleigh-Bénard convection. The convective fluid absorbs incident infrared laser light, thereby altering the fluid flow. Rapid scanning of the light allows nearly simultaneous actuation at many spatial locations of the pattern. This approach is used to impose reproducibly a given convection pattern. Control is demonstrated by preparing repeatedly a pattern near a straight roll instability. Selected perturbations are applied to this ensemble and decay lifetimes are measured as the system relaxes to the base state. We find that decay lifetimes give a quantitative measure of distance from instability and observe expected critical slowing down as the instability boundary is approached. We also extract the spatial structure of the modes governing the instability and the corresponding growth rates.

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