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A new mode reduction strategy applied to the generalized Kuramoto-Sivashinsky equation MARKUS SCHMUCK, MARC PRADAS, Department of Chemical Engineering, Imperial College London, London SW7 2AZ, UK, GREG PAVLIOTIS, Department of Mathematics, Imperial College London, London SW7 2AZ, UK, SERAFIM KALLIADASIS, Department of Chemical Engineering, Imperial College London, London SW7 2AZ, UK — The generalized Kuramoto-Sivashinsky (gKS) equation is one of the simplest prototypes modeling nonlinear active media with energy supply, energy dissipation and dispersion. Not surprisingly, it has been reported for a wide variety of physical settings, from reaction-diffusion systems, e.g. propagation of concentration waves and flame-front instabilities, to fluid dynamics, e.g. a viscous film flowing down an inclined plane. We undertake a combined theoretical-numerical study of the gKS equation. We first approximate it with a renormalization group equation. This approximation forms the basis for a non-standard stochastic mode reduction that guarantees optimality in the sense of maximal information entropy. Herewith, noise is rigorously defined in the reduced gKS equation and hence provides an analytical explanation for its origin. These derivations allow us to develop reliable numerical approximations to the gKS equation and a rigorous methodology on how to add noise. Interestingly, noise becomes increasingly important by decreasing the degrees of freedom in the discretization strategy.

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