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Construction of an Optimal Background Profile for the Kuramoto-Sivashinsky Equation using Semidefinite Programming ANDREW WYNN, GIOVANNI FANTUZZI, Imperial College London — The Kuramoto-Sivashinsky (KS) equation has been derived in many physical contexts to describe systems whose dynamics are characterised by long-wavelength instability, for example flame-front instabilities or flow stability for thin liquid films on inclined planes. It is known that the KS equation has chaotic solutions if the governing parameter (typically the length L of the domain) is sufficiently large. Furthermore, numerical evidence suggests that the asymptotic energy of the solution scales according to $L^{\frac{1}{2}}$ although, despite much effort, it has not yet been possible to prove such a bound analytically. We present a novel method of proving bounds on the asymptotic energy of the KS equation, by constructing a 'background profile' using Semidefinite Programming. The advantage of the method is that the background profile may be searched for automatically by solving a standard optimization problem, while coupling the numerics to a careful mathematical analysis of the PDE ensures that the bounds hold analytically. The obtained scaling of $L^{\frac{3}{2}}$ agrees with the previous best results using the background profile method. Interestingly, the obtained profiles closely resemble the 'viscous shock' solutions which are known to exist for destabilized KS equations.

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