Fully Nonlinear Global Modes in Spatially Developing Media

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Abstract:

Global modes on a doubly-infinite one-dimensional domain $-\infty < X < +\infty $ are studied in the context of the complex Ginzburg-Landau equation with slowly spatially varying coefficients. A fully nonlinear frequency selection criterion is derived for global-mode solutions under the assumption of weak inhomogeneity of the medium. The global mode is found to be governed by the fully nonlinear equations in a region of finite size, and by the linearized equations in the vicinity of $X=\pm\infty$. Asymptotic matching techniques are used to relate the WKB approximations in the linear and nonlinear regions through appropriate transition layers. The *real* global frequency is determined by requiring that spatial branches issuing from $X=-\infty$ and $X=+\infty$ be continuously connected at a saddle point of the local nonlinear dispersion relation $\omega=\Omega^{nl}(k,R,X)$ between the frequency ω, the wavenumber k and amplitude R at a given station X. The results constitute a fully nonlinear generalization of the linear frequency selection criteria previously obtained by Chomaz *et al.* (1991), Monkewitz *et al.* (1993), and Le Dizès *et al.* (1996).