

Resonance and near-resonance in a wave equation

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Normal mode manifolds, also called Lyapunov manifolds, arise naturally in ODEs and PDEs. A basic question is then whether these manifolds can be continued for small positive ε . A second basic question is whether the Lyapunov manifolds persist for increasing ε and other changes of relevant parameters. Possible tools to study these questions are averaging-normalization and numerical bifurcation theory. As we will show, the combination of both techniques is very powerful.

We will describe two theorems that can be used in an infinite dimensional setting. The technique of averaging-normalization produces a short-cut to normally hyperbolic manifolds that emerge from the normalized equations because of the dominating presence of slow-fast dynamics.

We demonstrate this for a parametrically excited wave equation. Our analysis shows that a complicated bifurcational structure exists for relatively small values of the small parameter ε .