Finding the stability of modelocked pulses over a broad parameter range

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Abstract:

The study of passively modelocked lasers has undergone a renaissance in recent years with the development of a host of new lasers and applications [1]. A key issue in the design of passively modelocked lasers is determining the parameter ranges in which they can operate stably. To date, these studies have been carried out either in limited situations in which the pulse stability can be determined analytically [2] or using computational methods in which an initial pulse shape or initial computational noise are assumed [3]. The former approach cannot be used, except to give qualitative insights, with real-world systems, while we have found that the latter approach is inefficient and often unreliable.

The goal of our work is to develop computational analogs of the analytical methods [2] that are sufficiently powerful and efficient to be applied to real-world systems.

To date, we have applied our approaches to studies of the cubic-quintic modelocking equation with a fast saturable gain and a slow saturable absorber [4]. We have found a rich dynamical structure that includes the following regimes: (1) A regime in which radiation modes are unstable. (2) Two regimes in which a single pulse shape is stable. (3) A regime in which two different pulse shapes are simultaneously stable. (4) A regime in which a shelf instability occurs.

We will discuss how our work to date can be extended to realistic systems that include discrete components and solutions that are only periodically stationary.

References:

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