Solitons and spectral renormalization methods in nonlinear optics

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The equations governing optical systems are typically variations of the nonlinear Schrödinger equation. Additional, linear or nonlinear, terms are added to model different phenomena, such as, gain, loss, filtering etc. In more than one dimensions these equations may also be used to describe localized modes in photonic lattices. Moreover, these equations may exhibit solutions that do not necessarily vanish at infinity, giving rise to so-called dark solitons. Solving these equations analytically is often not possible and one needs to refer to numerical methods. We will discuss a numerical technique, called spectral renormalization (SPRZ), used to find localized waves to a variety of problems that arise in nonlinear optics. The main idea is to renormalize variables and obtain an algebraic system coupled to a nonlinear integral equation. The method is implemented in the Fourier domain and the localized mode is determined from a convergent fixed point iteration scheme. We have found this method of coupling to be remarkably effective and straight forward to implement.

References

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