Subject line: Talk at Fomo

Title: Enhancing parameter estimation for the nonlinear Schrödinger equation using Möbius transformations

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Abstract:
The nonlinear Schrödinger equation (NLSE) is a rich and versatile model, which in one spatial dimension has stationary solutions similar to those of the linear Schrödinger equation as well as more exotic solutions such as solitary waves and quantum droplets. We present a unified theory of the local NLSE [1], showing that all stationary solutions of the cubic-quintic NLSE can be classified according to a single number called the cross-ratio. Any two solutions with the same cross-ratio can be converted into one another using a conformal transformation. Further, we show that NLSE parameter estimation from noisy empirical data is substantially improved through the use of an optimization afterburner that relies on this conformal symmetry. By utilizing random conformal maps, we can favorably transform the loss function landscape and avoid getting stuck in local minima. The new method therefore has far reaching practical applications for nonlinear physical systems.

[1] Reinhardt et al., arXiv:2306.17720 (2023)