# Semianalytic theory of self-similar optical propagation and mode locking using a shape-adaptive model pulse

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A semianalytic theory for the pulse dynamics in similariton amplifiers and lasers is presented, based on a model pulse with adaptive shape. By changing a single parameter, this test function can be continuously tweaked between a pure Gaussian and a pure parabolic profile and can even represent sech-like pulses, the shape of a soliton. This approach allows us to describe the pulse evolution in the self-similar and other regimes of optical propagation. Employing the method of moments, the evolution equations for the characteristic pulse parameters are derived from the governing nonlinear Schr\"odinger or Ginzburg-Landau equation. Due to its greatly reduced complexity, this description allows for extensive parameter optimization, and can aid intuitive understanding of the dynamics. As an application of this approach, we model a soliton-similariton laser and validate the results against numerical simulations. This constitutes a semianalytic model of the soliton-similariton laser. Due to the versatility of the model pulse, it can also prove useful in other application areas.

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