Numerical Methods for Nematicon Equations

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The governing equations for solitary wave evolution in nematic liquid crystals comprise a nonlinear Schrödinger equation, for the evolution of the light pulse, coupled with Poisson's equation (called the director equation in this application), which describes the elastic response of the medium.

There are two broad classes of suitable numerical techniques, which will be reviewed. These are pseudo-spectral methods, as originally developed by Fornberg and Whitham, and finite difference methods. Both need to be combined with an iterative method, such as Gauss-Seidal iteration with successive over relaxation, for the director equation.

Existing serial codes take many hours of CPU time, so parallelisation of both codes is examined. The speed up in computation time by using parallel code for multiple processor nodes will be reported for examples of nematicon evolution in one and two space dimensions.

The effectiveness of a possible alternative iterative method, the pre-conditioned conjugate gradient scheme for sparse matrices, will also be discussed.