A Modified Nonlinear Galerkin Method for Solving Ginzburg-Landau Equation

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For solving the Ginzburg-Landau equation $u_t - \nu u_{xx} + \kappa u^3 - \gamma u = f$, $u(0,x) = u_0(x)$, we introduce a kind of modified nonlinear Galerkin method as follows:

$$\frac{dy_m}{dt} + \nu A y_m + P_m\{\kappa(y_m^3 + 3y_m z_m^2) - \gamma y_m\} = P_m f,$$

$$\nu A z_m + z_m^{(2)} + (P_{2m} - P_m)\{\kappa(y_m + z_m^{(1)})^3 - \gamma(y_m + z_m^{(1)})\} = (P_{2m} - P_m)f,$$

$$\nu A z_m^{(2)} + (P_{2m} - P_m)\{3\kappa(y_m + z_m^{(1)})^2 - \gamma)[P_m f - A y_m - P_m(\kappa y_m^3 - \gamma y_m)]\} = 0$$

$$\nu A z_m^{(1)} + (P_{2m} - P_m)(\kappa y_m^3 - \gamma y_m) = (P_{2m} - P_m)f,$$

$$y_m(0) = P_m u_0$$

The convergence of the modified method is analyzed and some numerical examples are shown in the article.

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