
Oliver Roehrlé
**A Projection Multilevel Method for Quasilinear Elliptic
Partial Differential Equations**

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A projection multilevel method is developed for direct treatment of the nonlinearity for two-dimensional elliptic partial differential equation systems. The nonlinearity is assumed to be of the type $u\partial v$, which includes the Navier-Stokes equations as an important representative. Using a first-order system least squares (FOSLS) approach and introducing a new variable for ∂v , we obtain a formulation in which the nonlinearity appears as a product of two different variables. The result is a system that is linear within each variable but nonlinear in the cross terms. The design of the projection method allows us to treat the nonlinearity directly, without linearization. We report on theory and numerical experiments that show its efficiency.