Error inhibiting schemes for differential equations

Abstract:

Typically, when semi-discrete approximations to time-dependent partial differential equations (PDE) or schemes for ordinary differential equation (ODE) are constructed they are derived such that they are stable and have a specified truncation error $\tau$. Under these conditions, the Lax-Richtmyer equivalence theorem assures that the scheme converges and that the error is, at most, of the order of $|| \tau ||$. In most cases, the error is indeed of the order of $|| \tau ||$. We demonstrate that schemes can be constructed, whose truncation errors are $\tau$, however, the actual errors are much smaller. This error reduction is made by constructing the schemes such that they inhibit the accumulation of the local errors; therefore they are called Error Inhibiting Schemes (EIS).