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Nonstandard Finite Difference (NSTD) Schemes for Wave Equations: A Review

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Many phenomena in the natural and engineering sciences can be understood in terms of representations by partial differential equations. Particular examples of such equations include the linear and nonlinear unidirectional wave equations, Burger's equation, the Fisher equation, and the full wave equation. These PDE's can also include damping and reaction terms, along with nonlinear advection. Since few of these PDE's have known general solutions, numerical methods are the only practical way to obtain accurate solutions for given sets of initial or boundary conditions. A widely used procedure for calculating numerical solutions is finite differences. We demonstrate that the NSFD methodology provides a concise and dynamic consistent procedure for constructing finite difference schemes for wave equations. Our major focus is on PDE's for which a positivity condition holds.