

## Numerical PDE Approach for Pricing Exotic Options

Abdul Q M Khaliq  
Department of Mathematical Sciences  
Middle Tennessee State University  
E-Mail: [akhaliq@mtsu.edu](mailto:akhaliq@mtsu.edu)  
URL: <http://www.mtsu.edu/~akhaliq>

### Abstract:

Options or Derivative securities account for more than half the modern financial market and the basic tools for risk hedging in any portfolio management. The development of mathematical models to understand the relationship among complicated financial instruments has enabled the proliferation of these instruments which enhance the efficiency of worldwide capital markets. It follows that development of new computational techniques for the accurate evaluation of such option pricing models has considerable financial worth in addition to constituting cutting-edge research.

Numerical schemes often develop inaccuracies, when pricing financial derivatives with non-smooth payoff or its derivatives have multiple discontinuities. Moreover, large error may occur in estimating the hedging parameters. Averaging the initial date, shifting the grid, and projection methods have been tried to deal with such discontinuities. These methods are not typically found sufficient to properly restore the expected behavior. A new class of higher order smoothing schemes are developed using diagonal Padé schemes combined with positivity preserving Padé schemes as damping devices which are robust and reliable. Partial fraction decomposition is utilized to address issues with ill conditioning, accuracy, parallel processing, and computational efficiency. Numerical experiments are presented for the accurate valuation of one and two asset problems with high volatility on super share binary options, and butterfly spread. A special smoothing strategy is also presented for the accurate valuation of discrete Barrier options.