A fast and accurate FFT-based method for pricing early-exercise options

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A fast and accurate method for pricing early exercise and certain exotic options in computational finance is presented. The method is based on a quadrature technique and relies heavily on Fourier transformations. The main idea is to reformulate the well-known risk-neutral valuation formula by recognising that it is a convolution. The resulting convolution is dealt with numerically by using the Fast Fourier Transform (FFT). This novel pricing method, which we dub the Convolution method, CONV for short, is applicable to a wide variety of payoffs and only requires the knowledge of the characteristic function of the model. As such the method is applicable within many regular affine models, among which the class of exponential Lévy models. For an M-times exercisable Bermudan option, the overall complexity is $O(MN\log_2(N))$ with N grid points used to discretise the price of the underlying asset. American options are priced efficiently by applying Richardson extrapolation to the prices of Bermudan options.

With this method we will also price multi-asset options incorporating the sparse grid technique and show some initial results for the Heston model.