An IMEX-method for pricing options under Bates modell

UPPSALA UNIVERSITET

Arvid Westlund
arwe3171@student.uu.se

European Options are financial instruments that are traded heavily. Fast and accurately pricing are therefore important.

Bates model for asset X and volatility Y is given by:

$$dX_t = (r-q-\lambda\xi)X_t dt + \sqrt{Y_t}X_t dW_t^1 + (J-1)X_t dn$$

$$dY_t = \kappa(\theta - Y_t)dt + \sigma\sqrt{Y_t}dW_t^2$$

Option price model

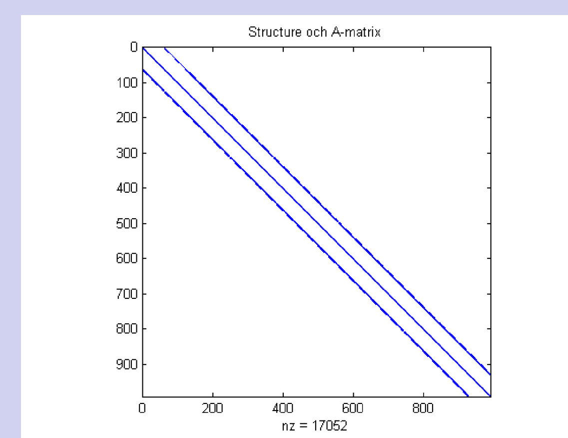
The model for the option price ,u, is a PIDE – problem:

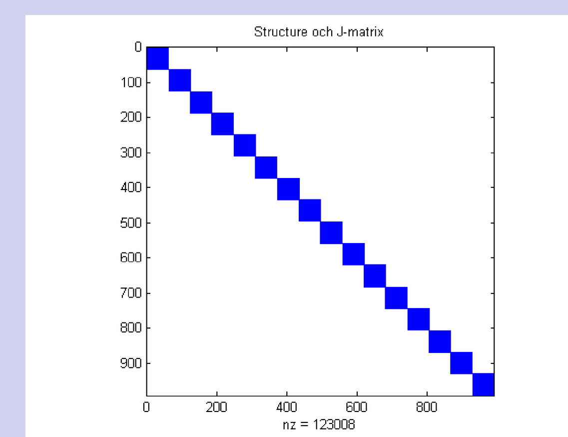
$$\frac{\partial u(x,y,\tau)}{\partial \tau} = \ell_{PDE} u(x,y,\tau) + \lambda \int_0^\infty u(Jx,y,\tau)dJ$$

Adaptive method

Grid points are placed where they are needed for accuracy reasons.

Finite differences gives two matrices, **A** and **J,**





IMEX-CNAB scheme

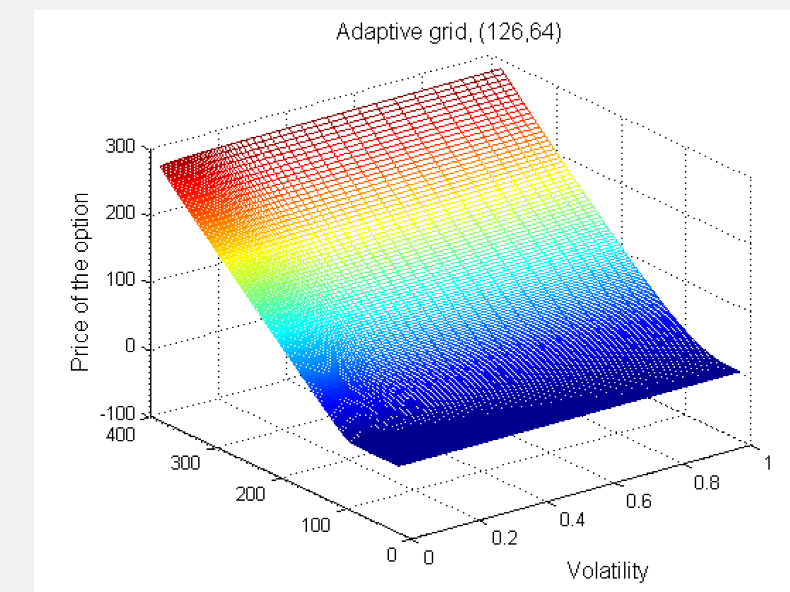
A is treated implicitly and **J** is treated explicitly.

$$\mathbf{u}_{t+1} = \Delta\tau\mathbf{J}\frac{3\mathbf{u}_t - \mathbf{u}_{t-1}}{2} + \Delta\tau\mathbf{A}\frac{\mathbf{u}_{t+1}+\mathbf{u}_t}{2} + \mathbf{u}_t$$

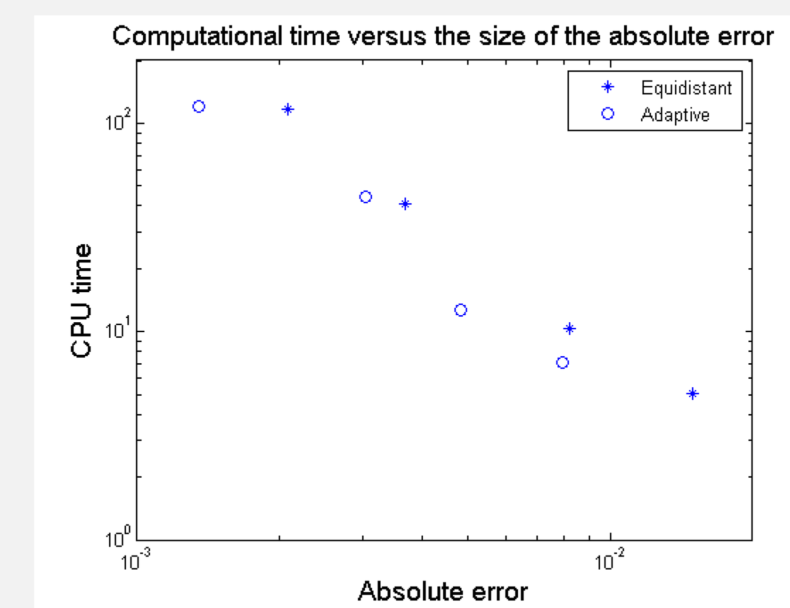
This is compared with a standard implicit scheme (BDF2).

Results

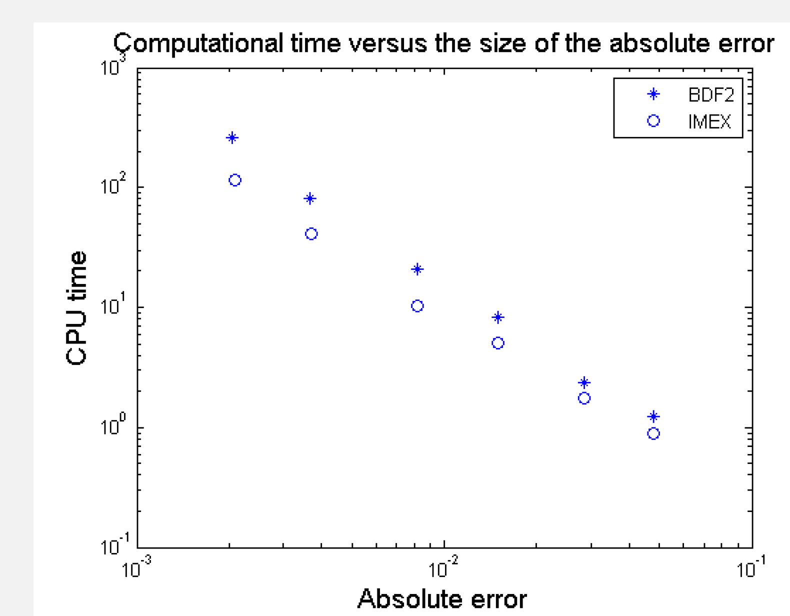
Solution at time T:



Adaptive/Equidistant:



IMEX /BDF2:



Department of
Information Technology

Box 337

SE-751 05 Uppsala

Sweden