Title: Forward deterministic pricing of options using Gaussian radial basis functions

Author: Jamal Amani Rad Josef H*öö*k Elisabeth Larsson Lina von Sydow

PII: S1877-7503(17)30553-7
DOI: http://dx.doi.org/doi:10.1016/j.jocs.2017.05.016
Reference: JOCS 685

To appear in:

Received date: 19-11-2016
Revised date: 16-4-2017
Accepted date: 10-5-2017

Please cite this article as: Jamal Amani Rad, Josef H*ddotoddoto*k, Elisabeth Larsson, Lina von Sydow, Forward deterministic pricing of options using Gaussian radial basis functions, *<![CDATA[Journal of Computational Science]]>* (2017), http://dx.doi.org/10.1016/j.jocs.2017.05.016

Forward deterministic pricing of options using Gaussian radial basis functions

Jamal Amani Rad[a], Josef Höök[b], Elisabeth Larsson[b,*], Lina von Sydow[b]

[a] *Dept. of Computer Sciences, Faculty of Mathematical Sciences and Dept. of Cognitive Modeling, Institute for Cognitive and Brain Sciences, Shahid Beheshti University, G. C. Tehran, Iran*

[b] *Dept. of Information Technology, Uppsala University, Box 337, SE-751 05 Uppsala, Sweden*

Abstract

The price of a fixed-term option is the expected value of the payoff at the time of maturity. When not analytically available, the option price is computed using stochastic or deterministic numerical methods. The most common approach when using deterministic methods is to solve a backward partial differential equation (PDE) such as the Black-Scholes equation for the option value. The problem can alternatively be formulated based on a forward PDE for the probability of the asset value at the time of maturity. This enables simultaneous pricing of several contracts with different payoffs written on the same underlying asset. The main drawback is that the initial condition is a (non-smooth) Dirac function. We show that by using an analytical expansion of the solution for the first part of the time interval, and applying a high-order accurate radial basis function (RBF) approximation in space, we can derive a competitive forward pricing method. We evaluate the proposed method on European call options and barrier options, and show that even for just one payoff it is more efficient than solving the corresponding backward PDE.

Keywords: option pricing, Fokker-Planck equation, radial basis function, Dirac delta function, Kolmogorov forward equation
2000 MSC: 65M70, 91G60

*Corresponding author
Email addresses: j_amanirad@sbu.ac.ir (Jamal Amani Rad), josef.hook@it.uu.se (Josef Höök), elisabeth.larsson@it.uu.se (Elisabeth Larsson), lina.von.sydow@it.uu.se (Lina von Sydow)