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## Forward deterministic pricing of options using Gaussian radial basis functions

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### 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

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