Boundary Elements and other mesh reduction methods for Finance, Economics, Probability and Statistics

Published Version:
Ballestra, L.V., Guardasoni, C. (2024). Boundary Elements and other mesh reduction methods for Finance, Economics, Probability and Statistics. ENGINEERING ANALYSIS WITH BOUNDARY ELEMENTS, 164(July), 1-1 [10.1016/j.enganabound.2024.105756].

Availability:
This version is available at: https://hdl.handle.net/11585/971806 since: 2024-06-13

Published:
DOI: http://doi.org/10.1016/j.enganabound.2024.105756

Boundary Elements and other mesh reduction methods

for Finance, Economics, Probability and Statistics

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Boundary Element Methods (BEMs) and Meshless Methods have experienced a surge in popularity across scientific and engineering disciplines in recent decades, presenting efficient solutions to modern challenges. This EABE special issue delves into their application in Finance, Economics, Probability, and Statistics, reflecting the expanding research in these areas and the increasing complexity of encountered problems, highlighting the significant advantages of integral and Meshless Methods.

Engineering Analysis with Boundary Elements, a prominent journal specializing in Meshless Methods, offers a prime platform to evaluate the merits and limitations of employing integral and Meshless Methods in Finance, Economics, Probability, and Statistics. This issue specifically aims to shed light on key factors such as error convergence, stability, computational efficiency, mathematical formulation simplicity, numerical implementation, and adaptability to address complex problems. The special issue comprises thirteen scientific papers. By former date of publication:

C.N. Sam, K.X. Zhang and J.M.H. Hon show the efficiency of incorporating Generalized Finite Integration Method with Domain Decomposition Technique in Space-Time in solving free-boundary American option and exchange option pricing problems.

J. Narsoo, N. Thakoor, Y.D. Tangman and M. Bhuruth introduce an efficient procedure employing Gaussian radial basis functions-finite differences for the numerical solution of the two-dimensional partial differential model governing real estate index derivatives pricing assuming stochastic volatility. They numerically demonstrate fourth-order convergence rates on uniform meshes for European options.

M. Abbaszadeh, Y. Kalhor, M. Dehghan and M. Donatelli present a numerical approach to solve a partial integro-differential equation for option pricing. Specifically, they integrate the pseudo-spectral technique with cubic B-spline functions, alongside a second-order strong stability preserved Runge-Kutta procedure, to effectively solve the resulting ordinary differential problem.

D. Damircheli, M. Razzaghi, S.M.M. Kazemi and A. Foroush Bastani analyse a meshfree collocation method based on radial basis functions to approximate the solution of the system of partial integro-differential equations arising from the structural credit risk model for the default probability of a publicly-traded company.

J. Li, X. Yang, T. Qian, Q. Xie investigate the application of adaptive Fourier decomposition for deconstructing financial time series. After decomposing the time series into mono-components, they reconstruct it by piecewise combining these components to obtain the components at different scales.

F. Gatta, V. Schiano Di Cola, F. Giampaolo, F. Piccialli, S. Cuomo propose a Physics-Informed Neural Network for pricing American options. They conduct a comparison with the finite difference method to ensure the consistency of the option values computed by the neural network.

A.H.H. Rasanan, N.J. Evans, J. Rieskamp and J.A. Rad develop a numerical algorithm based on the mesh-free techniques for numerically solving the Fokker-Planck differential equation, which allows to approximate the first passage-time distribution of some important classes of sequential sampling models.

M. Arshad, L.A. Al-Essa, A.M. Galal, A. Moazzam, A. Alhushaybari and F.M. Alharbi propose a method combining the Kamal transform and the Adomian decomposition method for extracting closed form solution in terms of converging series and numerical approximation for non-linear Volterra differential-integral equations.

A. Eabrahimijahan, M. Dehghan and M. Abbaszadeh employ an integrated partition of unity radial basis function approach for pricing options under a jump-diffusion model. They utilize proper orthogonal decomposition to reduce the size of the final algebraic system of equations.

Y. Ma, C.N. Sam, J.M.H. Hon devise a generalized finite integration method with Volterra operator for pricing multi-asset barrier options under the Black-Scholes model. They provide comparisons with existing spectral methods, demonstrating the advantages of the proposed approach in superior accuracy and stability.

R. Yadav, D.K. Yadav and A. Kumar present radial basis function-based finite difference implicit-explicit numerical techniques for pricing option when the underlying asset follows the jump-diffusion process with local volatility. These techniques are developed for the European options and then extended to the American options.

A. Vargas and N. Ureña study the Solow model to consider the spatial diffusion of both physical capital and technological progress by a meshless method in one and two-dimensional bounded domains with regular boundaries.

N.M. Ahmed, F. Soleymani and R.K. Saeed employ the Krylov subspace method together with a hybrid radial basis function–finite difference solver to resolve high-dimensional partial differential equations for multi-asset options.