JOURNAL OF INTEGRAL EQUATIONS
AND APPLICATIONS
Volume 20, Number 2, Summer 2008

IDENTIFICATION OF THE LOCAL SPEED FUNCTION IN A LÉVY MODEL FOR OPTION PRICING

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Communicated by Charles Groetsch

Dedicated in honour of Prof. Nashed. The fourth-named author (H. W. E.) dedicates this paper to Prof. M. Z. Nashed, whom he considers to be one of his main teachers and who greatly influenced his way of viewing, doing and writing mathematics.

ABSTRACT. We propose a non-parametric stable calibration method based on Tikhonov regularization for the local speed function in a local Lévy model. The jump term in this model introduces an integral operator into the classic Black-Scholes partial differential equation such that the associated model calibration to observed option prices can be treated as a parameter identification problem for a partial integro-differential equation. This problem is shown to be ill-posed and thus requires regularization. It is proven that nonlinear Tikhonov regularization is a stable and convergent method for this problem. Furthermore, convergence rate results are established under an abstract source condition. Finally the theoretical results are underpinned by numerical illustrations including a real-world example.

1. Introduction. During the last decades, it became more and more obvious that the famous Black & Scholes model cannot adequately describe the stochastic behaviour of financial markets. Hence, much work has been devoted to find more appropriate models, which are able to reproduce the stylized facts of the observed asset price processes, as skewed log-returns and volatility clusters.

One idea of adapting the Black & Scholes model was pioneered by Dupire [13] and Derman & Kani [12], who modeled the volatility as a

Supported by the Austrian Science Fund Project P-18392 and through the SFB F013/F1308 and the Austrian Academy of Sciences via RICAM.
Received by the editors on April 27, 2007, and in revised form on June 15, 2007.
DOI:10.1216/JIE-2008-20-2-161