DK Seminar

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University of Vienna, Faculty of Mathematics, OMP 1, HS 2

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High-order compact finite difference methods for parabolic problems with mixed derivative terms and applications in computational finance

Abstract: We consider a class of parabolic partial differential equations with time and space dependent coefficients as well as with mixed second-order derivative terms in n spatial dimensions. Problems of this type arise frequently in computational fluid dynamics and computational finance. We follow a high-order compact finite difference approach and derive general conditions on the coefficients which allow us to obtain a high-order compact scheme which is fourth-order accurate in space and second-order accurate in time. Moreover, we perform a thorough von Neumann stability analysis of the Cauchy problem in two and three spatial dimensions for vanishing mixed derivative terms, and also give partial results for the general case. The results suggest unconditional stability of the scheme. As an application example we consider the pricing of European Power Put Options in the multidimensional Black-Scholes model for two and three underlying assets.