INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: Numerical Methods for Pricing Passport Option

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Thesis Submitted to the Department/ Center : Mathematics

Date of completion of Thesis Viva-Voce Exam : 29th March 2018

Key words for description of Thesis Work : Passport option, Numerical methods

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SHORT ABSTRACT

Passport option is a financial derivative with the contingent claim being dependent on the value of a trading account. The valuation of the passport option can be obtained through the solution of a nonlinear backward pricing partial differential equation (PDE). In this thesis, we examine the numerical approaches to pricing the passport option, by solving the pricing PDE for both the symmetric case as well as the non-symmetric case.

A general introduction and description of the passport option, both theoretical and numerical, along with the pricing PDE and the holder's optimal trading strategy for European passport option is presented. In the symmetric case (when the cost of carry is identical to the risk-free rate), it is observed that the pricing PDE becomes linear parabolic for which a closed form solution exists.The absence of the same in the non-symmetric case motivated the focus on the numerical approaches as presented in this thesis.

A radial basis function approach, along with grid refinement in spatial direction is proposed for European type passport option. The scheme which is first and second order accurate in time and space, respectively, is numerically presented for both the symmetric and non-symmetric case. Next, we consider a three time level scheme that is amenable for non-smooth payoffs and does not produce oscillation for larger time steps (especially in case of Greeks for the symmetric case, which are also derived in the thesis). This scheme is second order accurate in both time and space. Numerical results using three time level scheme for both the cases are presented. We then undertake the numerical valuation of American passport option using three time level schemes with the resulting discretized system of inequalities being solved using the Brennan-Schwartz algorithm and projected successive over-relaxation (PSOR) method.

Finally, we present the higher order compact (HOC) schemes, for both European and American style passport options, with second and fourth order accuracy in time and space, respectively. However, basic numerical approach was able to achieve only second order accuracy in space, which was then improved up to third order in space by making use of grid stretching near the zero accumulated gain, giving higher order compact scheme with grid stretching (HOCGS). The numerical results using HOC and HOCGS schemes for European (both the cases) and American (non-symmetric case) passport options are presented.