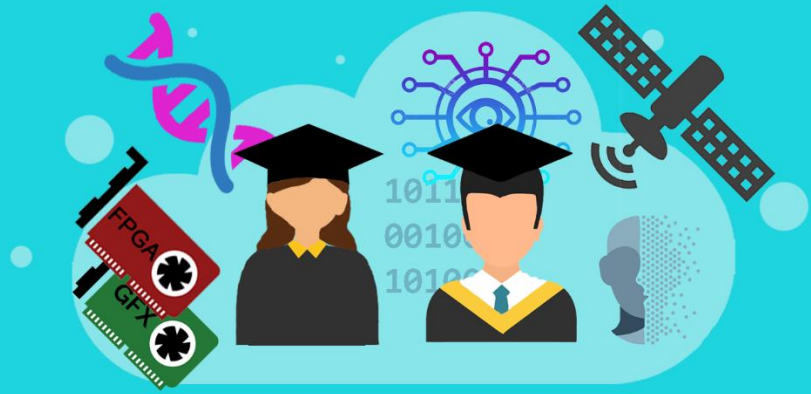


Diploma Thesis

Microprocessors and
Digital Systems
Laboratory



A Stochastic Implementation of an Option Price Estimator on FPGA

In Finance, options allow a buyer to sell (put) or buy (call) a financial asset at a specific price and time. Black Scholes is a mathematical formula that is used to estimate the price of an option given the risk, the volatility, the spot price etc.

The increasing demand for processing large volumes of data and achieving high-performance financial analysis has led to the introduction of hardware accelerators (GPUs, FPGAs) in the tasks of market analysis and stock forecasting. The architecture of GPGPUs and FPGAs can be utilized to parallelize the execution of algorithms that are used in option and stock price estimation.

In Finance, stochastic models such as Monte-Carlo analysis can be used instead of analytical formulas. When a Monte-Carlo simulation is used for estimating the output of the Black Scholes formula, the price of the underlying asset is simulated by random number generation for a number of paths or trajectories. After repeatedly simulating the trajectories and computing appropriate averages, the estimated price of options can be obtained, which is consistent with the analytical results from Black-Scholes model.

In the context of this thesis an FPGA accelerator that implements a Monte-Carlo simulation for estimating the output of the analytical Black Scholes model will be developed. The implementations will target high and low-end FPGAs. The FPGA designs will be implemented in High-Level Synthesis (HLS)

RELATED MATERIAL:

- <https://kinder-chen.medium.com/black-scholes-model-and-monte-carlo-simulation-d8612ac4519b>
- F. Ortega-Zamorano, M. A. Montemurro, S. A. Cannas, J. M. Jerez and L. Franco, "FPGA Hardware Acceleration of Monte Carlo Simulations for the Ising Model," in *IEEE Transactions on Parallel and Distributed Systems*, vol. 27, no. 9, pp. 2618-2627, 1 Sept. 2016, doi: 10.1109/TPDS.2015.2505725.
- <https://www.youtube.com/watch?v=KWTSRjMLuk&t=468s>
- L. Ma, F. B. Muslim and L. Lavagno, "High Performance and Low Power Monte Carlo Methods to Option Pricing Models via High Level Design and Synthesis," *2016 European Modelling Symposium (EMS)*, 2016, pp. 157-162, doi: 10.1109/EMS.2016.036.

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