

# Hardware accelerated Margin Calculations based on the CME SPAN methodology.

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## INTRODUCTION

In finance, a margin is the collateral that the holder of a financial instrument has to deposit to cover some or all of the credit risk of their counterparty, mostly a broker or an exchange. The collateral can be in the form of cash or securities, and it is deposited in a margin account. The SPAN (Standard Portfolio Analysis of Risk) methodology developed by CME is used worldwide to calculate margins on options & futures.

Minimum margins are calculated in SPAN by the determination of appropriate parameters, such as margin scan ranges and volatility scan ranges, for each underlying futures contract traded on the exchange. An exchange may elect to change its margin requirements as often as daily, or may never change them after they have been initially set if the underlying contract price is stable.

In the next step, Risk arrays are calculated for each futures contract by using the available options pricing models in SPAN. A risk array is a table showing the gain or loss on the contract, for each of the specified set of changes in the underlying price and volatility. These risk arrays are then combined to create a risk parameter file.

The actual margining of an account's portfolio takes place after a firm or service bureau receives the risk parameter file from the exchange's Internet web site or through a direct file transmission.

But currently, due to the high complexity, the SPAN using organization or the clearing exchange evaluates the risk arrays for all of its products at least once a day, and prepares a SPAN risk parameter file (also called a SPAN array file). The span risk parameter file contains parameters such as delivery risk & intra commodity risk parameters.

## SPAN METHODOLOGY

The overall portfolio risk is calculated by evaluating the worst possible loss that instruments in a portfolio may incur over a trading day. This is done by computing the gains and losses of portfolio, influenced by the various market conditions. The SPAN risk array, which is a set of numerical values, indicates a particular contract gaining or losing value under various conditions. Each condition is called a risk scenario. The numeric value for each risk scenario represents the gain or loss that that particular contract will experience for a particular combination of price (or underlying price) change, volatility change, and decrease in time to expiration.

The SPAN margin files sent out by the exchange to the organizations implementing SPAN, and are plugged into a SPAN margin calculator. For the futures options, they are assumed to have risk until they expire out of account or are closed. SPAN takes into account all the market scenarios and cases of extreme market volatility, to evaluate the margin impact of these futures options. The SPAN margin requirements are compared against broker's pre-defined extreme market move scenarios and the greater of the two are utilized as margin requirement.

In standard pricing models, three factors most directly affect the value of an option at a given point in time:

1. Underlying market price
2. Volatility (variability) of underlying instrument
3. Time to expiration

## MARGIN CALCULATIONS

Based on the risk array available & implementing the algorithms based on the CME Globex trading platform, we will be computing the minimum margin requirements for various trading instruments in a portfolio. Our inputs for the implementation will be the risk array parameters

from a clearing organization, portfolio data & market data affecting the instruments in the portfolio.

#### HARDWARE/SOFTWARE METHODS

In the initial part of the project, we would be testing the algorithms used by SPAN to calculate margins on a given set of instruments in the portfolio. To innovate upon the classical software solution of SPAN, we would be implementing the margin calculation algorithms in Hardware using the Stratix V FPGA board.