LNG portfolio optimization, approach by stochastic programming techniques

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Thèse de doctorat
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Confidentiel

LNG portfolio optimization
approach by stochastic programming techniques

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présentée par
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sous la direction de
J.Frédéric BONNANS
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Jury

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Abstract

The work presented in this Ph.D dissertation is motivated by the problem of management of a fleet of cargos transporting liquefied natural gas (LNG) initially proposed by Total. The holder of the portfolio has to meet its commitments towards its counterparts while trying to generate profits through arbitrating different commodities market. Thus, the management of portfolio can be modeled as a stochastic, dynamic and integer optimization problem.

This Ph.D dissertation is organised as follows:

Chapter I	We first present the LNG portfolio management problem and give the mathematical model. Then we summarize the main results of this work.
Chapter II	We introduce a numerical method for solving continuous relaxation problem. We propose an algorithm based on the combination of the vectorial quantization method as discretization method and the dual dynamic programming approach. We show the convergence of numerical schema and give the error analysis on the discretization by quantization. Some numerical tests on real energy market problem are performed.
Chapter III	We also study the risk averse optimization by using conditional value at risk (CVaR) as criterion. We show that the algorithm proposed in chapter II is also adapted to such formulation. Furthermore, we propose the technique of changes in probability measure in stochastic programming in order to improve rare scenario simulation. Same numerical test as in Chapter II is performed in order to make comparison.
Chapter IV	We study the sensitivity of the portfolio with respect to several parameters in the market price model. We proposed a numerical method to compute sensitivity value based on Danskin's theorem. The convergence of sensitivity value of discretized problem to the one of original problem is proved. Comparison between result obtained by algorithm in chapter II and other classical methods are provided.
Chapter V	We study the stochastic integer programming problem. The integrality cutting plane method is applied to approximate the integer problem. We show that it is impossible to converge to the integer solution because of the non convexity and discontinuity of the Bellman value function. We apply a heuristic method and propose a small improvement. Some numerical tests are also provided.

Keywords: stochastic programming, vectorial quantization method, dual dynamic programming, sensitivity analysis, integer programming, Fenchel cut, portfolio management.