XIV
BRAZILIAN
WORKSHOP
ON CONTINUOUS
OPTIMIZATION

NOTEBOOK OF ABSTRACTS

AND

OTHER RELEVANT INFORMATION

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Abstract

Energy supply contracts signed by thermoelectric power plants (UTEs) in Brazil include compensation for both actual production and available capacity, aiming to remunerate fuel and investment. The goal of achieving optimal operation is motivated by the desire to maximize revenue through efficiency improvements while avoiding financial penalties outlined in contractual clauses. For example, power generators may strategically stockpile fuel to evade fines for unavailability. The operational policy that maximizes the agent's net income can be strengthened through the use of a mathematical programming model that addresses uncertainties in both the plant's operation and its fuel supply process. This presentation outlines the development of a stochastic mathematical programming model designed to tackle the operational challenges of a thermoelectric power plant responsible for allocating its LNG (Liquefied Natural Gas) loads transported by LNGCs (Liquefied Natural Gas Carriers). The LNG supplies storage tanks in a FSRU (Flonating Storage Regasification Unit), enabling the fuel to be regasified and supplied to interconnected thermoelectric plants. The model also considers additional elements such as onshore LNG tanks, connections to the gas pipeline network, and gas trading, making the program adaptable and conducive to evaluating potential investments in existing plants and projects in the planning stages. In terms of problem modeling, we employ the mixed-integer linear stochastic optimization paradigm. Nonlinearities in the process are addressed through a combination of linearizations and integer variables. Uncertainties are modeled using specialized decision trees known as multi-branch trees. Consequently, the final model is extensive and computationally intricate. The solution strategy is based on the decomposition principle and utilizes the Progressive-Hedging algorithm, compatible with free and commercial mathematical programming packages. One of the main objectives of this presentation is to provide a practical guide on the strategies used to make the Progressive Hedging decomposition of a very large Mixed Integer Linear Programming Model feasible in a production-ready tool. We will focus on strategies to enforce the consensus of state variables and heuristics to get good viable solutions in for the MILPs in less time. In conclusion, the presentation will share key insights into optimal operation under diverse market and weather conditions, along with illustrative examples of operation in each scenario, if operators follow the model's decisions. These insights empower decision-makers with a more accurate alignment of expectations, potentially leading to increased efficiency for the generator's business.

A Jacobi-type Newton method for Nash equilibrium problems with descent guarantees

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Abstract

A common strategy for solving an unconstrained two-player Nash equilibrium problem with continuous variables is applying Newton's method to the system obtained by the corresponding first-order necessary optimality conditions. However, when taking into account the game dynamics, it is not clear what is the goal of each player assuming they are taking their current decision following Newton's iterates. In this presentation, we provide an interpretation for Newton's iterate

as follows: instead of minimizing the quadratic approximation of the objective functions parameterized by the other player current decision (the Jacobi-type strategy), we show that the Newton iterate follows this approach but with the objective function parameterized by a prediction of the other player action. This interpretation allows us to present a new Newtonian algorithm where a backtracking procedure is introduced in order to guarantee that the computed Newtonian directions, for each player, are descent directions for the corresponding parameterized functions. Thus, besides favoring global convergence, our algorithm also favors true minimizers instead of maximizers or saddle points, unlike the standard Newton method, which does not consider the minimization structure of the problem in the non-convex case. Thus, our method is more robust compared to other Jacobi-type strategies or the pure Newtonian approach, which is corroborated by our numerical experiments. We also present a proof of the well-definiteness of the algorithm under some standard assumptions, together with a preliminary analysis of its convergence properties taking into account the game dynamics.

Dual SDDP for Risk-averse problems

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Abstract

Risk-averse multistage stochastic programs appear in multiple areas, and Stochastic Dual Dynamic Programming (SDDP) is a well-known algorithm to solve such problems under time-independence assumptions. However, SDDP produces only a sequence of increasing (and converging) lower bounds. In the risk-neutral setting, it is possible to produce a Monte-Carlo estimate for the cost of the resulting policy, which yields a statistical upper bound. This, however, is not available in the risk-averse setting, due to the nested risk measures. We show how to derive a dual formulation for these problems and apply an SDDP algorithm, leading to converging and deterministic upper bounds for risk-averse problems.

Mixed-Integer Programming Techniques for the Minimum Sum-of-Squares Clustering Problem

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