ID de Contribution: **99** Type: **Contributed talk**

# Robust stochastic optimization via regularized PHA: Application to Energy Management Systems

*mardi 29 juillet 2025 14:30 (30 minutes)*

This paper deals with robust stochastic optimal control problems. The main contribution is an extension of the Progressive Hedging Algorithm (PHA) that enhances out-of-sample robustness while preserving numerical complexity. This extension involves adopting the widespread practice in machine learning of variance penalization for stochastic optimal control problems. Using the Douglas-Rachford splitting method, the author developed a Regularized Progressive Hedging Algorithm (RPHA) with the same numerical complexity as the standard Progressive Hedging Algorithm (PHA) and improved out-of-sample performance. In addition, the authors propose a three-step control framework consisting of a random scenario generation method, followed by a scenario reduction algorithm, and a scenario-based optimal control computation using the RPHA. Finally, the authors test the proposed method by simulating a stationary battery's Energy Management System (EMS) using ground-truth measurements of electricity consumption and production from a primarily commercial building in Solaize, France. This simulation demonstrates that the proposed method is more efficient than a classical Model Predictive Control (MPC) strategy, which in turn is more efficient than the standard PHA.

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**Classification de Session:** Sequential decision-making under uncertainty

**Classification de thématique:** Sequential decision making under uncertainty