Parametric stochastic optimization for day-ahead and intraday co-management of a power unit

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Abstract: Our work is motivated by day-ahead load scheduling mechanism in energy markets. Typically, we consider renewable power units equipped with a battery and engaged in day-ahead load scheduling. In this context, the unit manager must submit a day-ahead power production profile prior to every operating day, and is engaged to deliver power accordingly. During the operating day, the unit manager is charged penalties if the delivered power differs from the submitted profile.

First, we model the problem of computing the optimal production profile as a parametric multi-stage stochastic optimization problem. The production profile is modeled as a parameter which affects the value of the intra-day management of the power unit, where the photovoltaic production induces stochasticity. Second, we introduce parametric value functions for solving the problem. Under convexity and differentiability assumptions, we are able to compute the gradients of these value functions with respect to the parameter. When the differentiability assumption breaks, we propose two approximation methods. One is based on a smooth approximation with the Moreau envelope, the other one is based on a polyhedral approximation with the SDDP algorithm. We showcase applications in the context of the French non-interconnected power grid and benchmark our method against a Model Predictive Control approach.

References:

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