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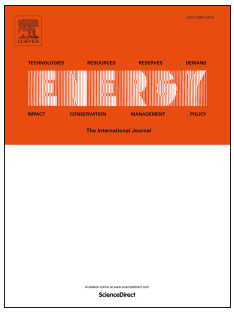

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Evaluation of a Data Driven Stochastic Approach to Optimize the Participation of a Wind and Storage Power Plant in Day-Ahead and Reserve Markets

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Abstract:

A more comprehensive participation of renewable generators in the power market is being practiced in many countries. To add storage capability to these generators is also a major trend nowadays. Decisions concerning the participation in the power market have to be made several hours in advance, which is a key challenge for the renewable energy-based generators. In this work, a decision making framework under uncertainty for a wind and storage power plant participating in day-ahead and reserve markets is developed. Available wind energy and regulation requirements by the system operator are considered as uncertain parameters. To maximize the net income of this system under uncertainty, a two-stage convex stochastic model is developed. In order to create meaningful scenarios to be used in our proposed stochastic model, at first, a Long Short-Term Memory Recurrent Neural Network is designed to generate forecasts for regulation requirements. Univariate and multivariate clustering based on *k*-means algorithms are also used to generate influential scenarios from historical data. Several simulation experiments are carried out to evaluate the quality of the proposed stochastic approach using real-world wind farm data. Simulation result shows the validity and usefulness of the proposed data-driven approaches to handle the uncertainty in regulation requirements.

Keywords: Stochastic optimization, convex programming, influential scenarios; reserve market, wind energy.

1. Introduction

Power markets are becoming more and more competitive and challenging throughout the world. This is due to the increase of variable renewable energy generators such as wind and solar energy-based generators. These generators bring a high degree of uncertainty to the power system itself due to the stochastic nature of wind speed and solar irradiation. In this context, both system operators and