Modul: Intelligent Software Systems
Topic: A survey of stochastic optimization techniques for the unit commitment problem

Supervisor: Ogun Yurdakul
WS 2019/20

Summary of Literature

Part 1

Carolina Schorn (392137)

21. November 2019

Inhaltsverzeichnis

1 Notes to Papers

1.1 Paper 14

Title of Paper Data-Driven Adaptive Robust Unit Commitment Under Wind Power Uncertainty: A Bayesian Nonparametric Approach [2]

Adaptive Robust Optimierung für Integration von Windenergie Dirichlet-Prozessgemischmodell datengetriebener Unsicherheitssatz -¿ unsicherheitssatz ermittelt: steht für alle unsicherheiten zusammengefasst

Ziel: robustes UC-Modell finden(mithilfe von Unsicherheitssatz und Windleistungsprognosen)

Mathematical Formulation Two-Stage adaptive robust UC model Model

- First Stage: Commitment Status of Generators
- Second Stage: Dispatch Decision of conventional Genrators and renewable wind power
- Goal: Minimize total operating cost
- Disadvantages:
  - No full use of complex uncertainty data information
  - Does not account correlation
  - Does not account asymmetry
  - Does not account multimodal nature of wind power forecast errors
  - Limited modeling flexibility
  - $\rightarrow$ Remedy: Data driven adaptive robust unit commitment optimization framework

Data-Driven Adaptive Robust Unit Commitment Optimization Framework und Text dahinter

Dirichlet Process Mixture Model
- stochastic process
- Probabillity distirbution over distributions
- Dirichlet distributed finite dimensional marginal distributions

- Motivation:
  - model distributions over observed data
  - unbounded complexity: underfitting is mitigated
- limited by the fact that generalizations from it are discrete distributions

Data-Driven Uncertainty Set Based on posterior predictive distribution

random vector: future wind forecast errors

self adaptive to underlying complexity and structure of given data

Data-Driven Robust Unit Commitment Model

Solution Methodology
- multilevel optimization structure & nonconvex nature of the proposed uncertainty set $\rightarrow$ spezific solution algorythm needed
- reduce four-level optimazation problem into single-lebel full master problem (enumeration of all extreme points)
- hard to calculate (large number of induced UC contraints)
- $\rightarrow$ partial enumeration scheme of extreme pointss
- identify worst-case wind forecast error scenario
- compare optimal values of single subproblems to get largest one

Computational Experiments

Studies on six-bus and IEEE 118-bus systems

Illustrative Six-Bus System

IEEE 118-Bus System

1.2 Paper 15

Title of paper: A Data-Driven Model of Virtual Power Plants in Day-Ahead Unit Commitment [1]

Motivation Ensuring effective integration of distributed energy resources

Solution Virtual power plants: condense them to single entity for wholesale market

Problem to solve Dependence onn distributed pover resources output: time varying and

not exactly known at day-ahead UC engine

Task of this paper Evaluating physical characteristics of VPP

- Max capacity
- Ramping capacity
- Encertainty in wind power output
- Load consumption

1.3 Paper 17

Motivation Solving multistage stochastic unit commitment problem

Solution new type of decomposition algorithm (based on new framework of staochastic dual dynamic integre programming)

label description

1.4 Paper 21

Problem Uncertainty resulting from integration of variable renewable energy generations (wind-, solar power)

1.5 Paper 22

notes

[2]

Literatur

[1] S. Babaei, C. Zhao, and L. Fan. A data-driven model of virtual power plants in day-ahead unit commitment. *IEEE Transactions on Power Systems*, 34(6):5125–5135, Nov 2019.

[2] C. Ning and F. You. Data-driven adaptive robust unit commitment under wind power uncertainty: A bayesian nonparametric approach. *IEEE Transactions on Power Systems*, 34(3):2409–2418, May 2019.