MAD project

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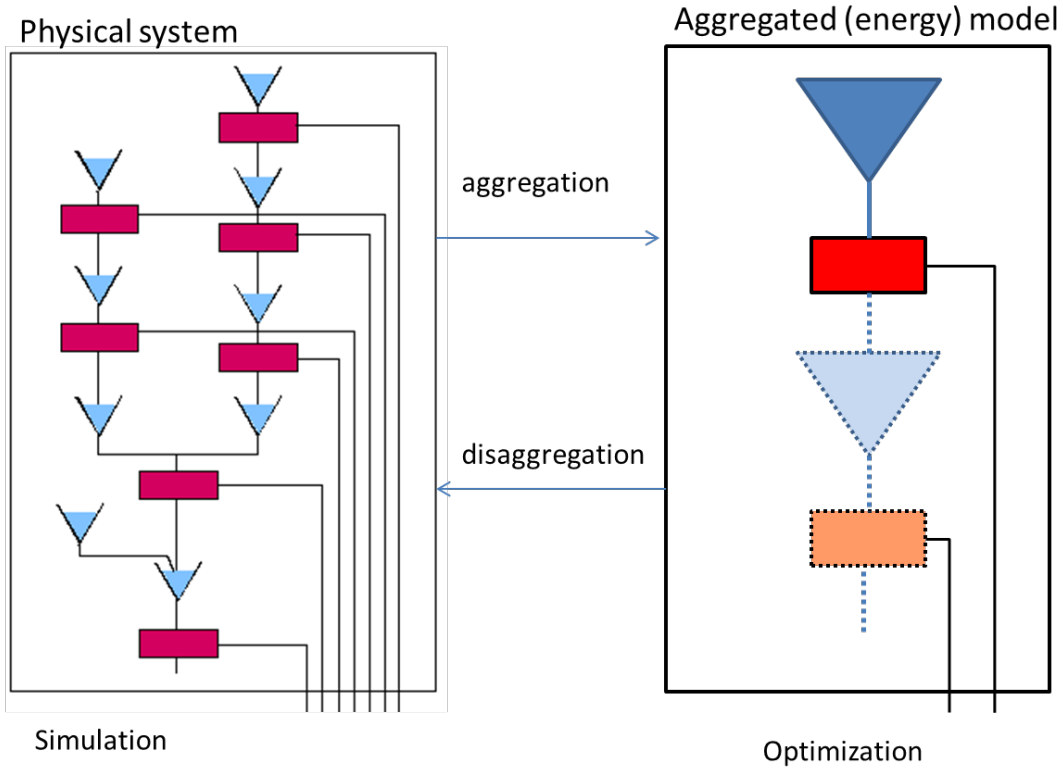
About the project

- IPN project, 2015-June 2019
- Objective:
  - New methods for aggregation and disaggregation
    - Aggregation structure
    - Aggregation method
    - Optimization for aggregated model
    - Disaggregation
- Project participants: Statkraft, Statnett, Vattenfall, BKK, Hydro Energi, Agder Energi, Lyse Produksjon, E-CO, Svenska Kraftnet, NTNU

Aggregation -disaggregation



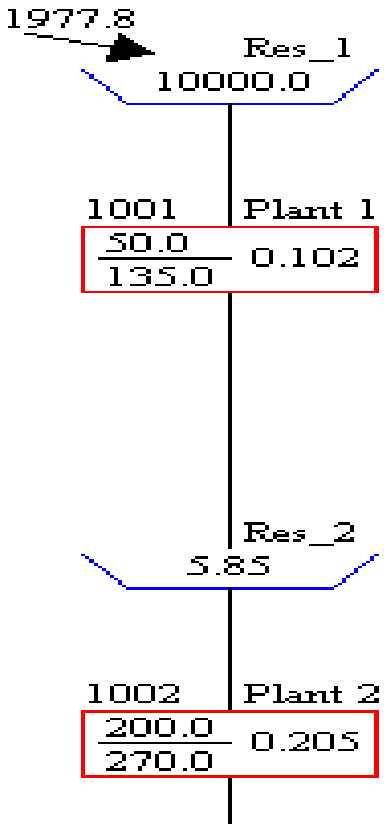
SINTEF

Project background

- Aggregation and disaggregation of hydropower production
  - Used in the following SINTEF models Vansimtap, Samkjøringsmodellen, Samlast, Samnet

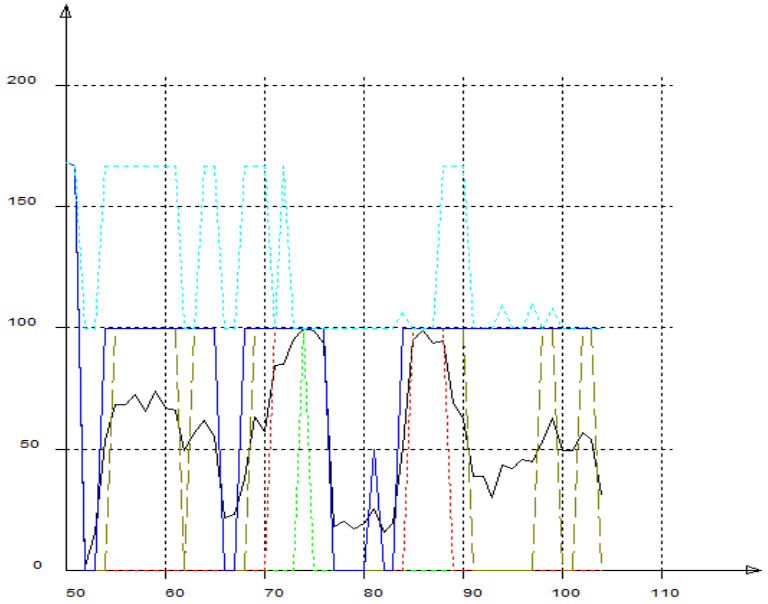
- Existing methods
  - Aggregated model consists of one reservoir, gives too high flexibility
    - New renewables, stronger coupling to Europe –system more often operated at its limits.
    - Aggregated model structure and disaggregation techniques not adapted to short-term pumping
  - Competence on existing disaggregation procedures is too low
    - Main procedures implemented a long time ago

Optimal production in serial water courses

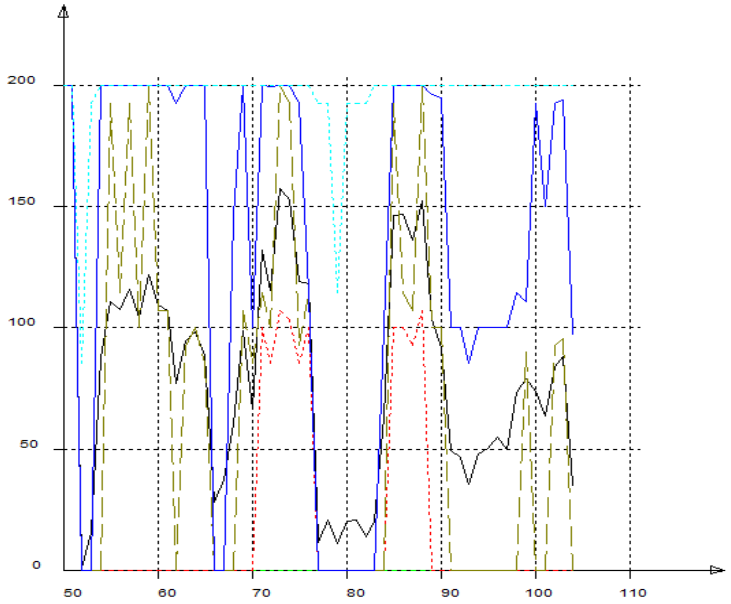


Production in high price period (plant two in example)

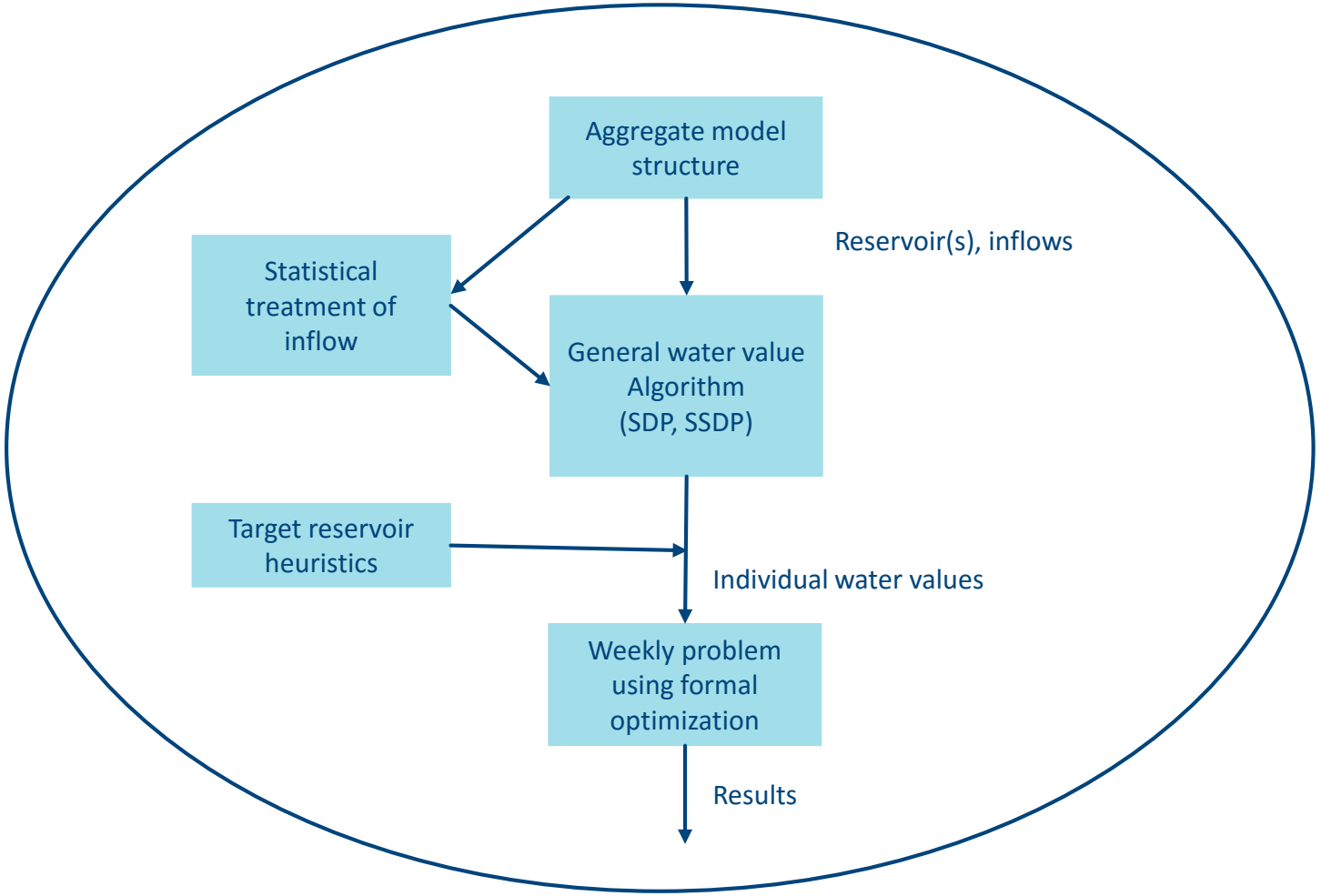
Drawdown heuristic (Vansimtap)



Optimization (ProdRisk)



Activities – relation MAD



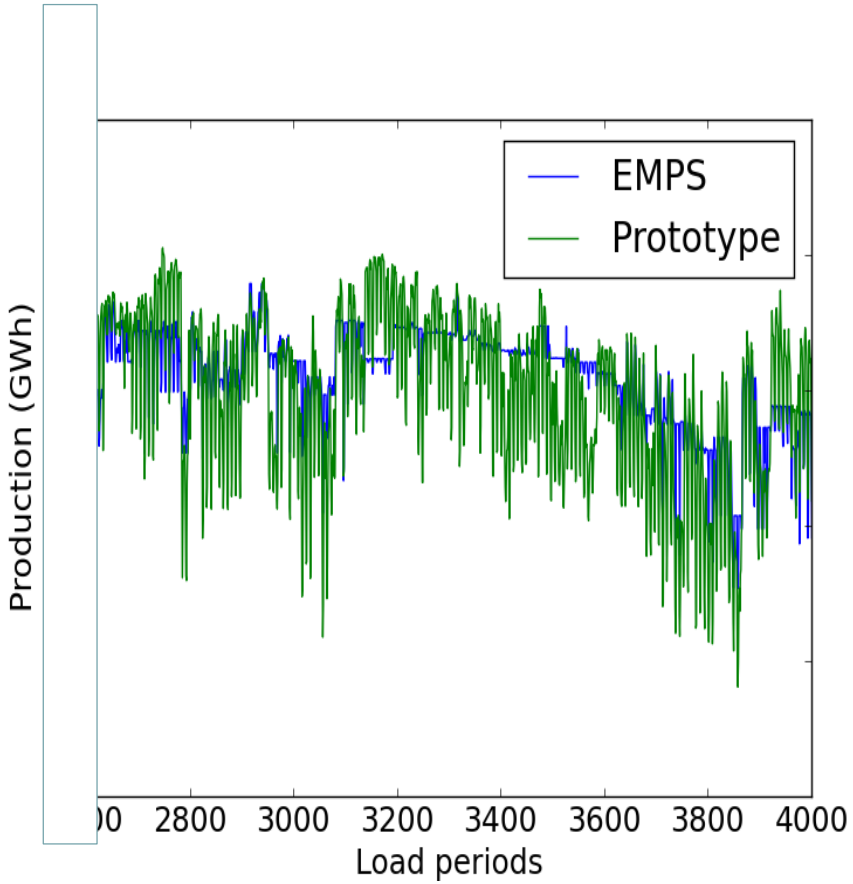
MAD –deliveries

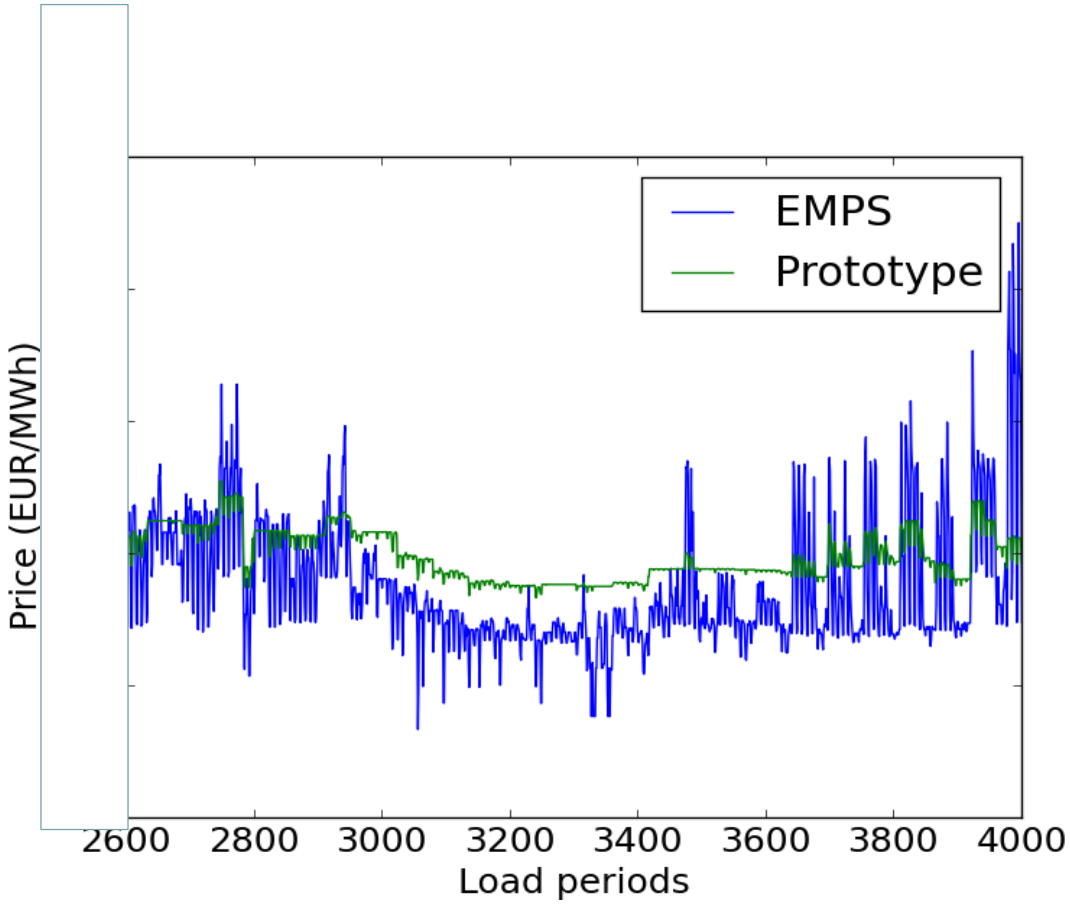
- EMPS-W: A prototype model with formal optimization with individual hydro for the weekly market clearing problem
  - Use drawdown heuristics to individualize aggregated water values
  - A LP problem for the weekly problem
    - Can be hourly resolution
    - Time delays
    - Ramping (transmission and hydro)
    - Daily inflow resolution, hourly reservoir balances
- New functionality in standard EMPS
  - Including avoidable spillage in aggregated inflow used for water value calculation
  - Time dependent calibration factors
  - Allocated market in water value calculation based on "static" production level

Other Mad results

- Internal prototypes:
  - SDP for two storage system
  - Market simulation with two storage models in each area
  - Sampling Stochastic Dynamic Programming (SSDP)
- NTNU part (Paper): Automatic aggregation procedure to general structure

Hydro production an prices example (EMPS and EMPS-W protype)





EMPS –W Properties

- Optimal intraweek utilization of resources (hydro, pumping, flexible load)
- Much longer computation time than EMPS
- About the same socioeconomic surplus for todays system as EMPS
- Believe it is a better model for the future system
- A model that is easier to understand and expand