Data Intelligent Temperature Optimization

(Temp. Opt. v.4.0)

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Software solutions

Software for combined physical and statistical modelling

Continuous Time Stochastic Modelling (CTSM) is a software package for modelling and simulation of combined physical and statistical models. You find a technical description and the software at CTSM.info.

Software for Model Predictive Control

HPMPC is a toolbox for High-Performance implementation of solvers for Model Predictive Control (MPC). It contains routines for fast solution of MPC and MHE (Moving Horizon Estimation) problems on embedded hardware. The software is available on GitHub.

MPCR is a toolbox for building Model Predictive Controllers written in R, the free statistical software. It contains several examples for different MPC problems and interfaces to opensource solvers in R . The software is available on GitHub.

Search ...

Latest news

Summer School at DTU, Lyngby, Denmark – July 4th-8th 2016

Summer School – Granada, Spain, June 19th-24th 2016

Third general consortium meeting – DTU, May 24th-25th 2016

Smart City Challenge in Copenhagen – April 20th 2016

Guest lecture by Pierluigi Mancarella at DTU, April 6th

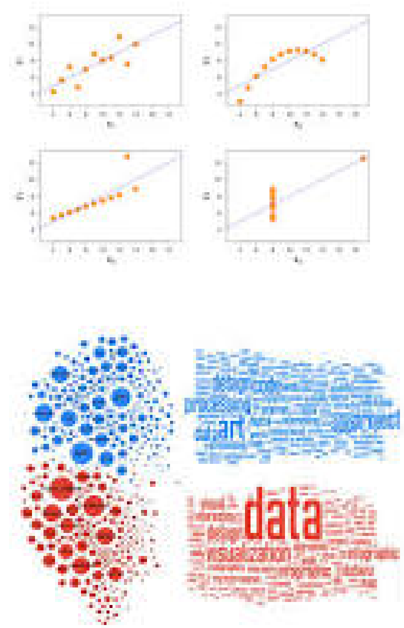
Topics


Energy systems
Data analytics
Policy and regulations
Water
Cloud-based solutions
Mobility
Markets
Smart buildings

Data Management and Cloud Based Solutions

Big Data value chain

Sense		Think		Act
Data Origins The Internet, sensors, machines, etc.	**Data Collection** Web log, sensor data, images/audio, RFID and videos, etc.	**Data Storage** Technologies supporting data storage	**Analytics:** Predictive analytics, patterns in data, decision making	**Consumers:** Business processes, humans, and applications



CITIES Data Management System

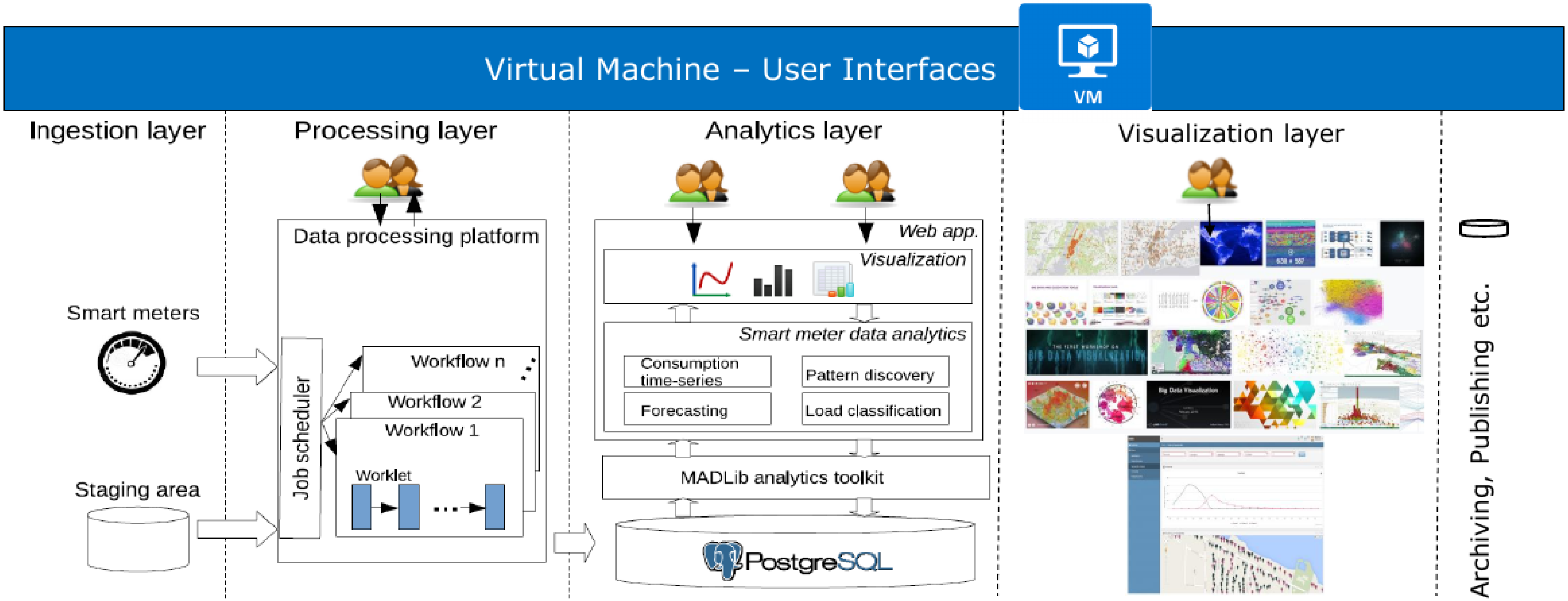
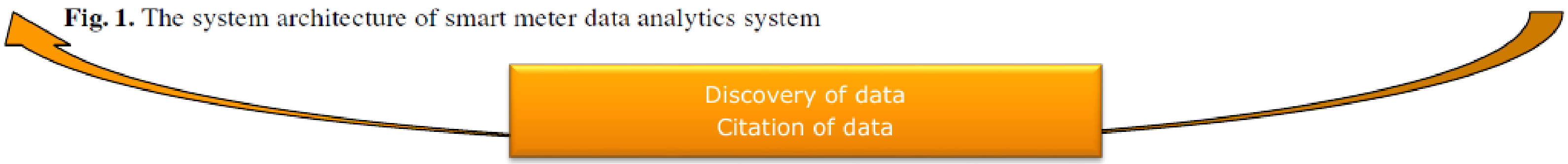


Fig. 1. The system architecture of smart meter data analytics system



Data Intelligent Temperature Optimization for DH Systems (incl. load forecasting)

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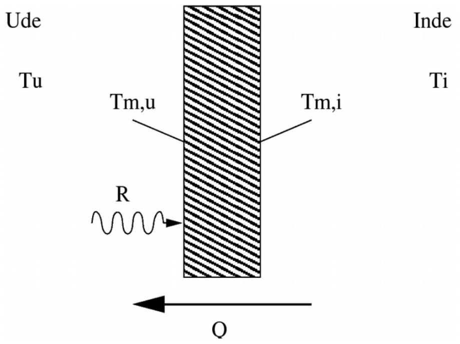
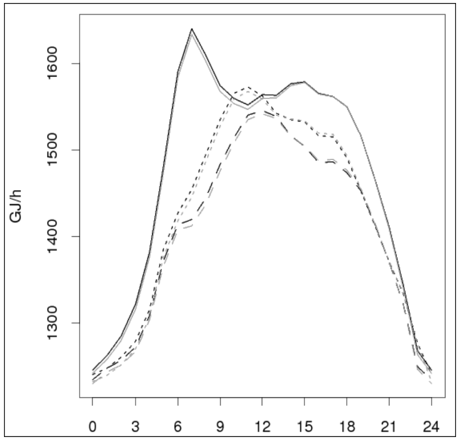
Model components in load forecasting

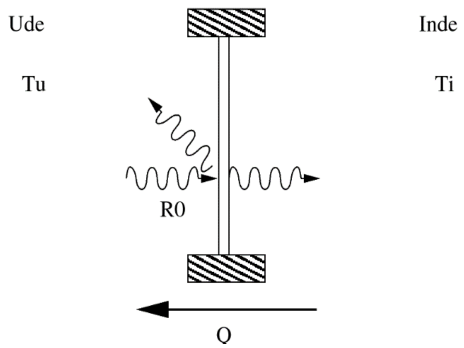
Wall: Slow reaction on climate



Occupant behaviorl



Windows + ventilation: Fast reaction



PRESS Load Forecast
(Model principles)

Load forecast for time t+k, Pp(t+k), is written:

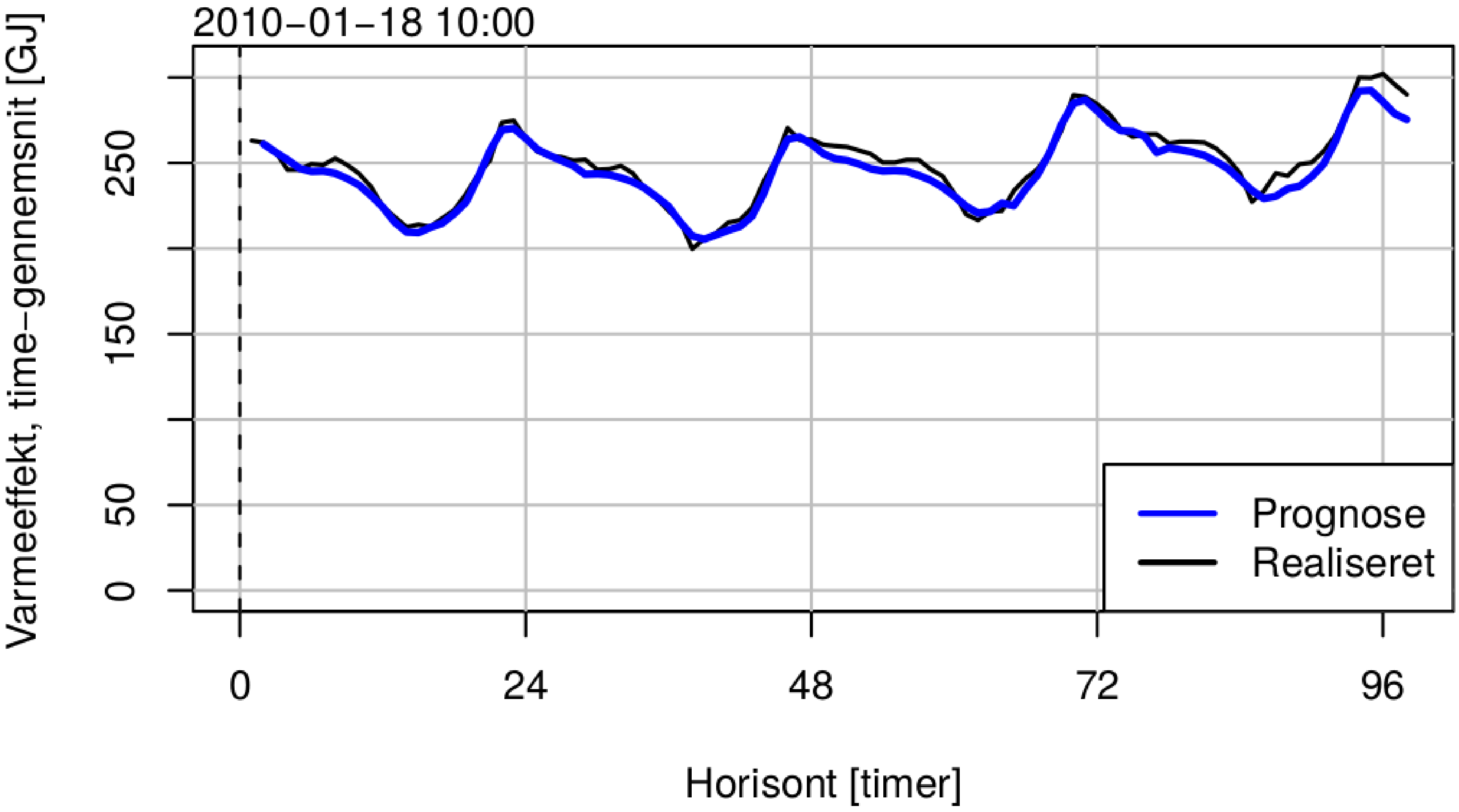
Pp(t+k) = Fmur(Vejr(t+k)) + Fvv(Vejr(t+k) +

Far(Pp(t) - P(t)) + DP(t+k)

where

- Fmur, Fvv, Far and DP are semi-parametric functions (estimated by PRESS)
- Vejr(t+k) is weather input (measured + forecasts) for time t+k.
- P(t) is measured heat load for time t.

PRESS Load Forecast
(Example)



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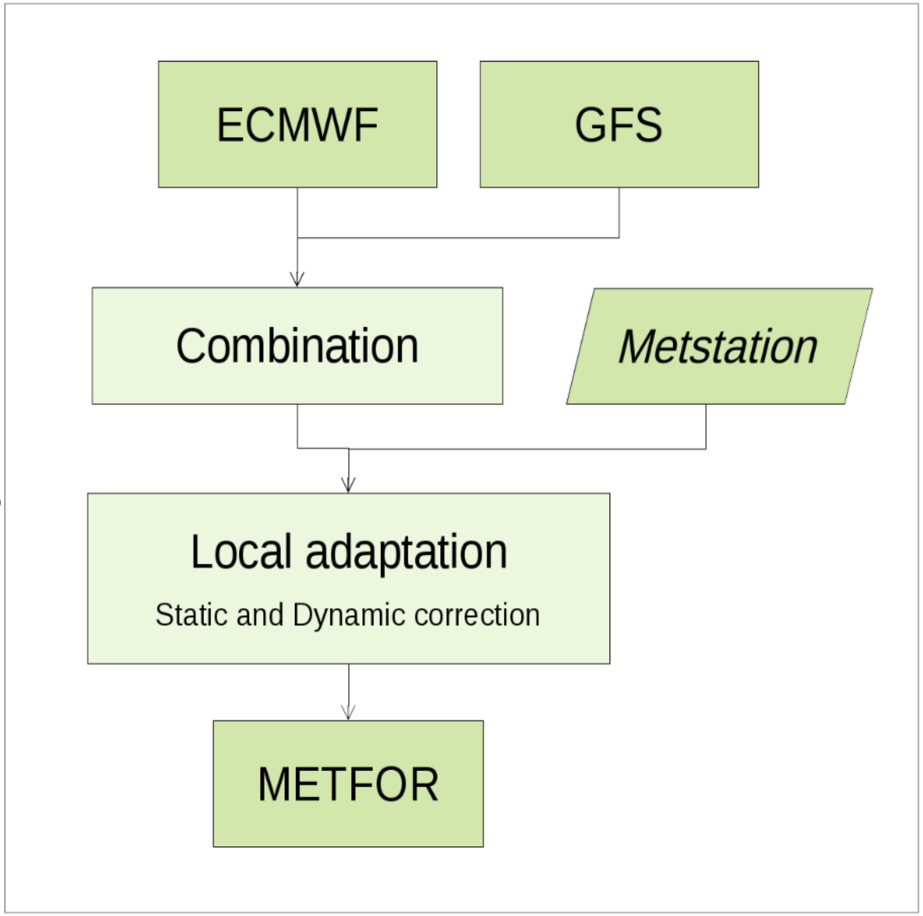
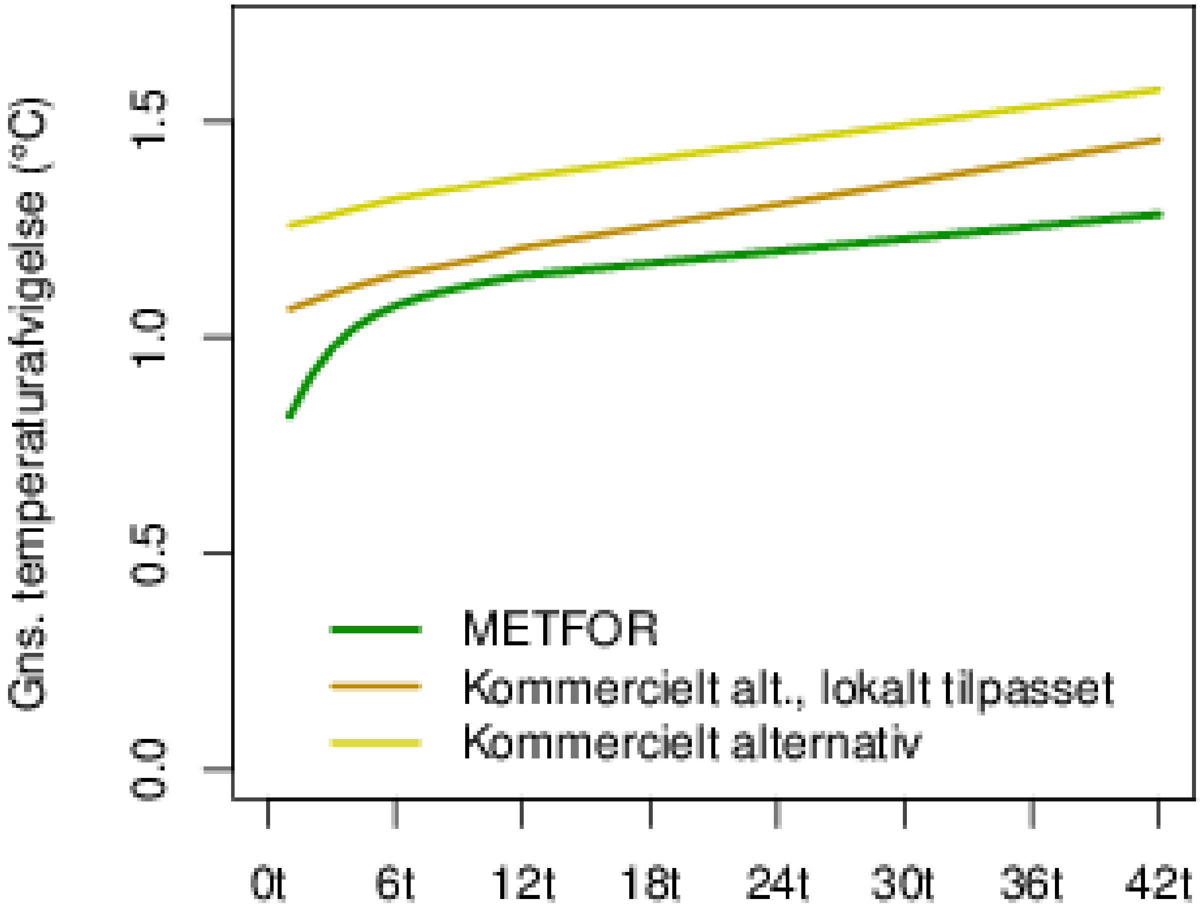
Weather data and forecasts

Optimize local weather forecast base on:

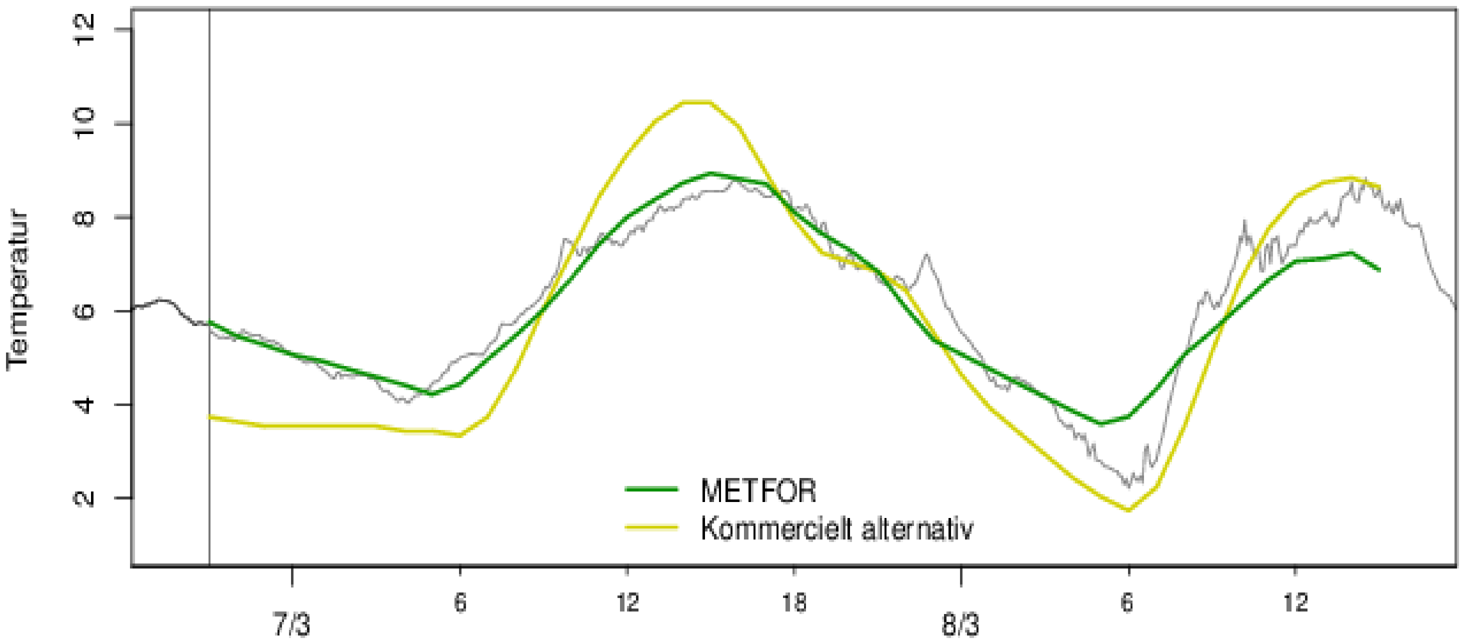
- Local climate data
- Several MET forecasts



MetFor performance

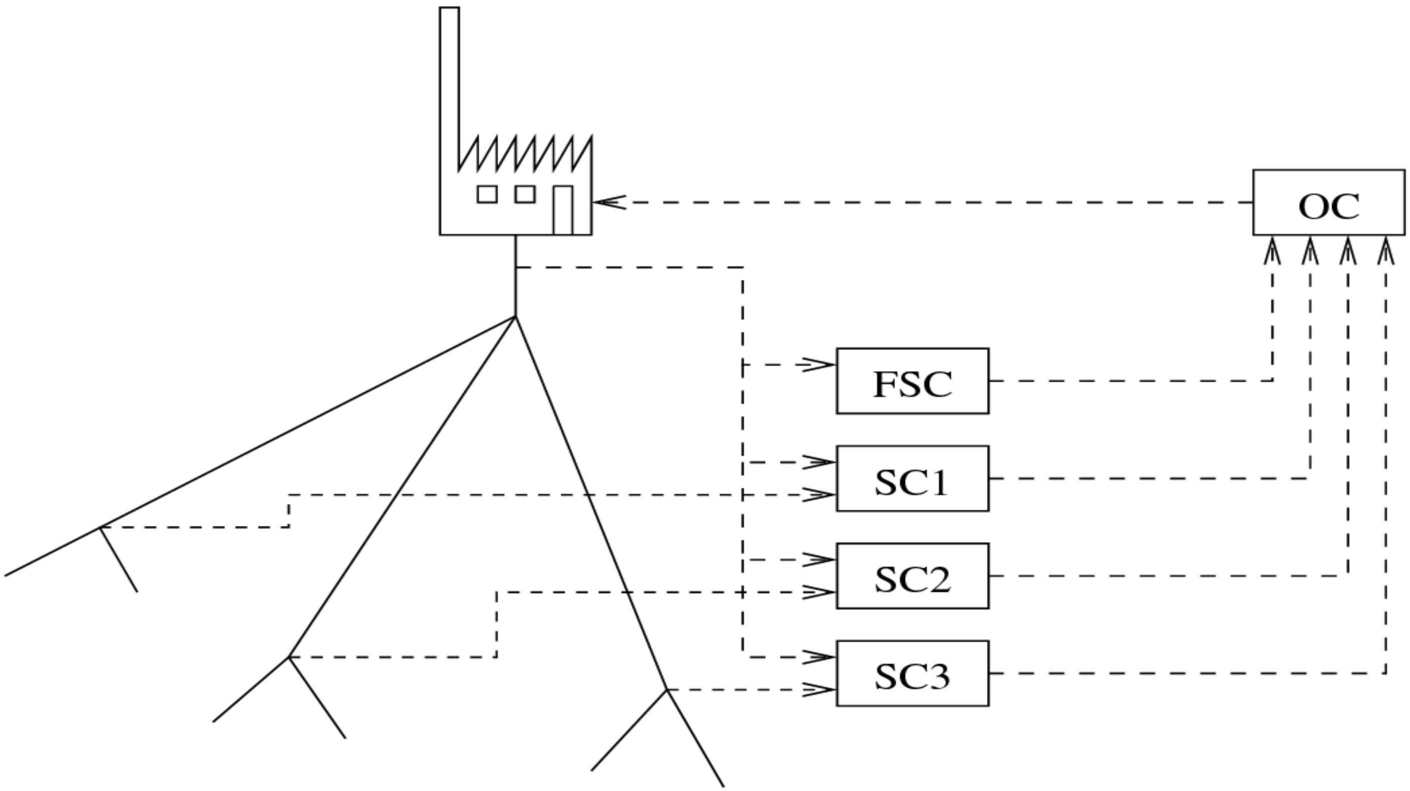


MetFor forecast example



Models and Controllers

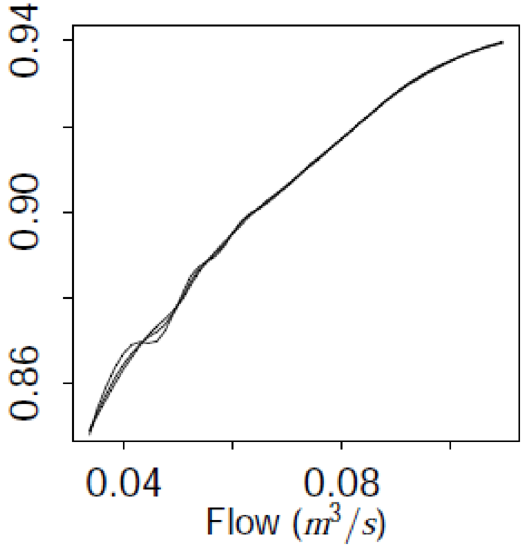
(Highly simplified!)



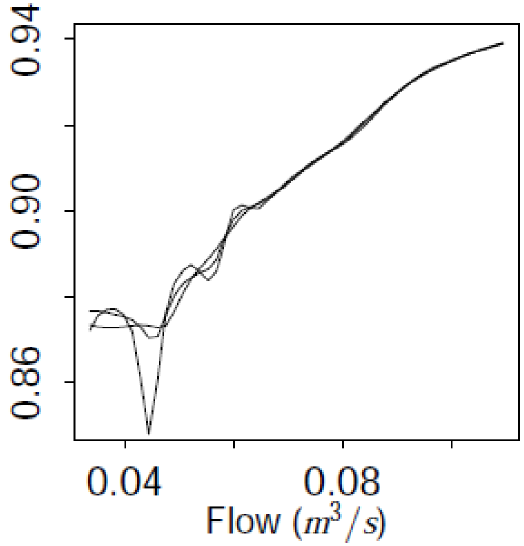
Characteristics

30%, 40%, 50%

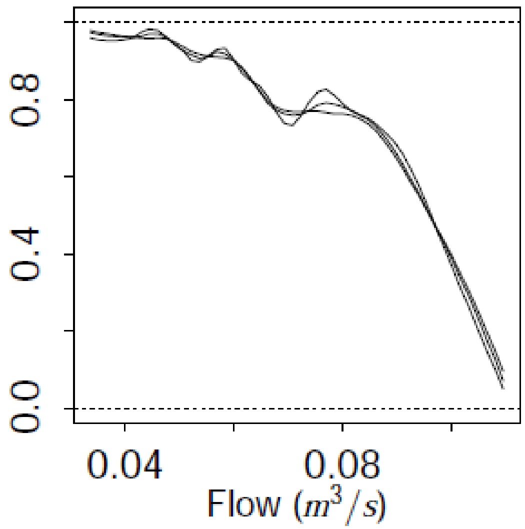
Stationary gain of FIR



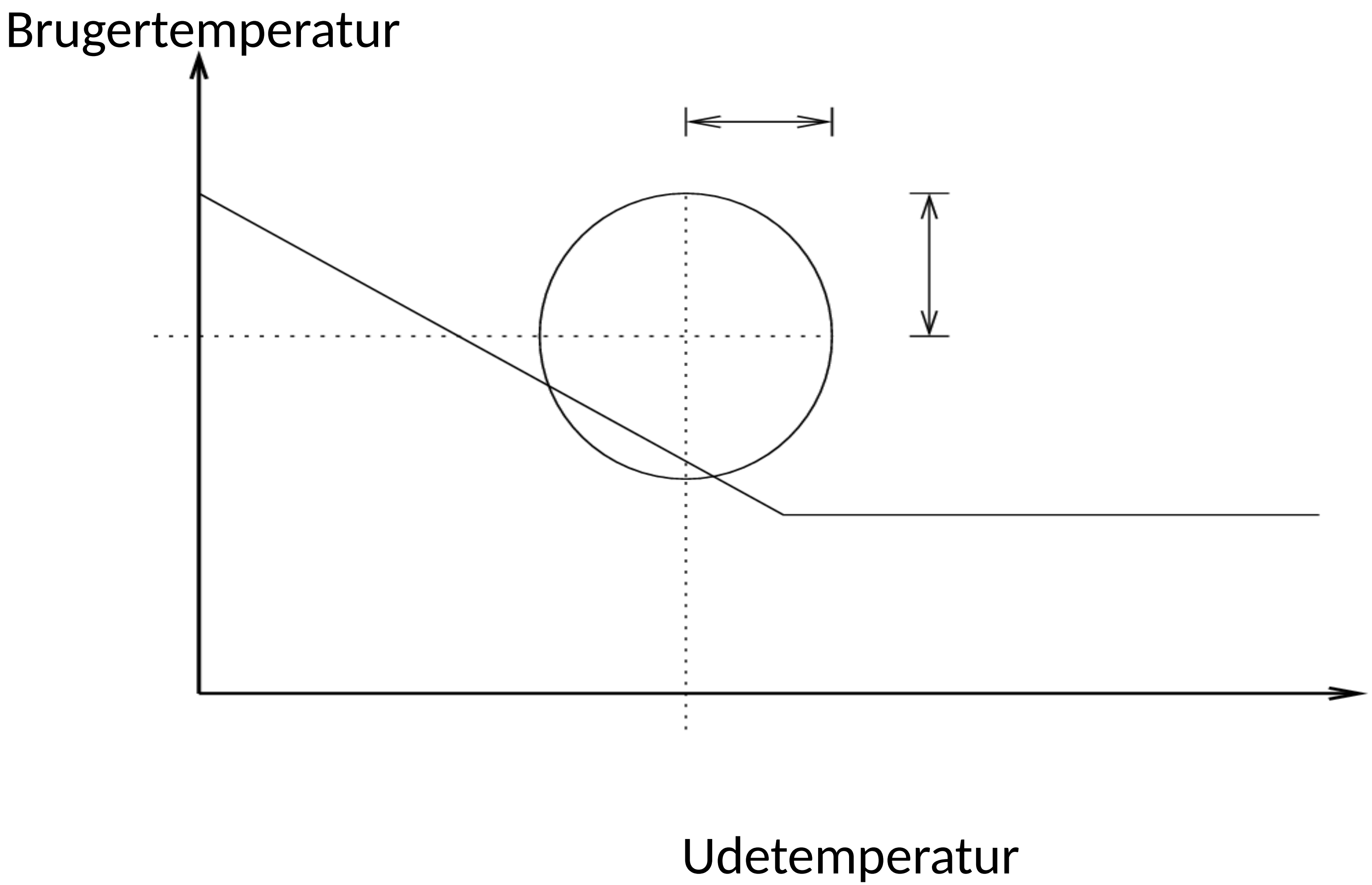
Stationary gain of ARX

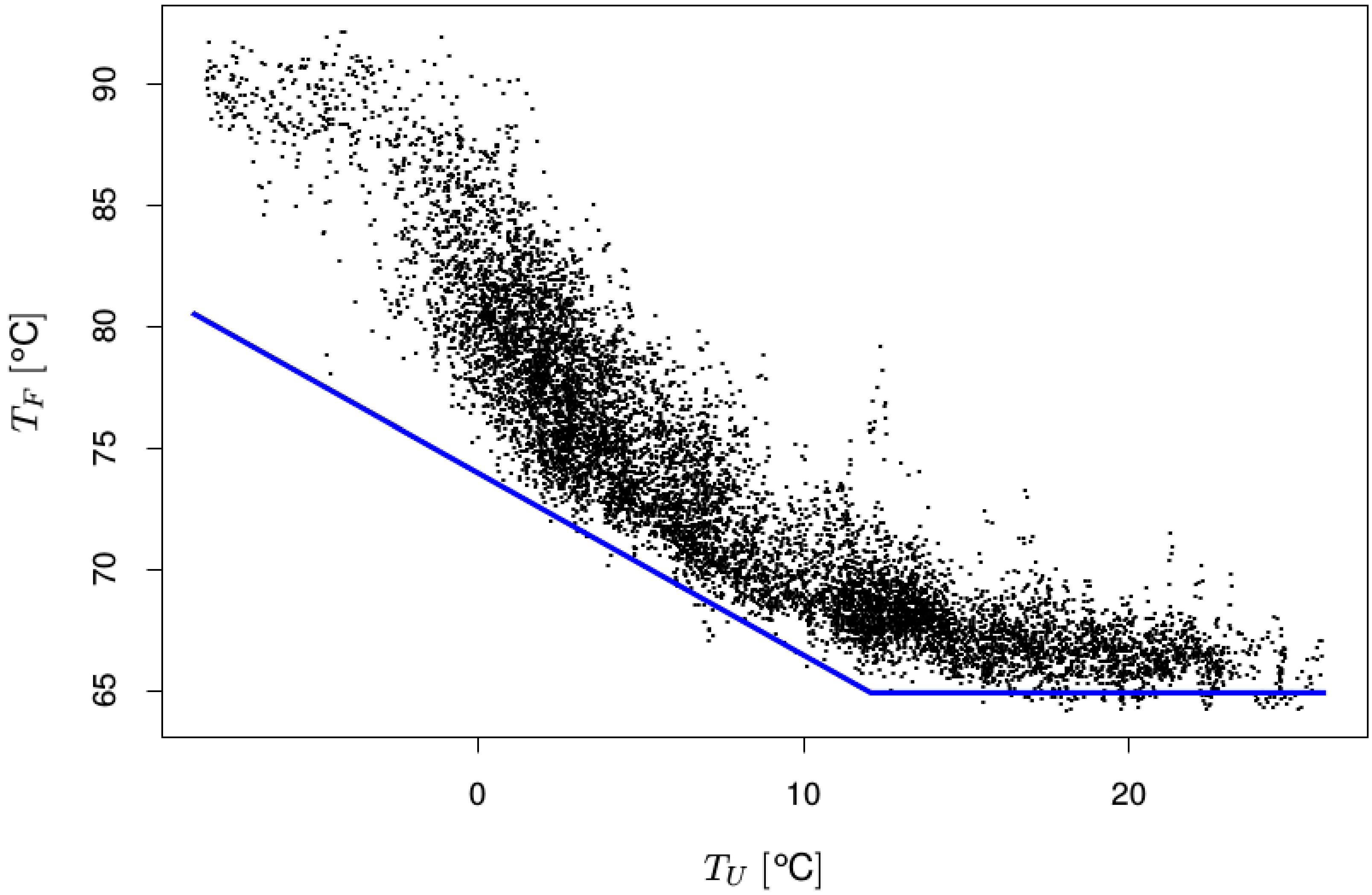


Pole of ARX



Optimal set-point taking uncertainty into account





90
85
80
75
70
65
T_F [ºC]
0
10
20
T_U [ºC]

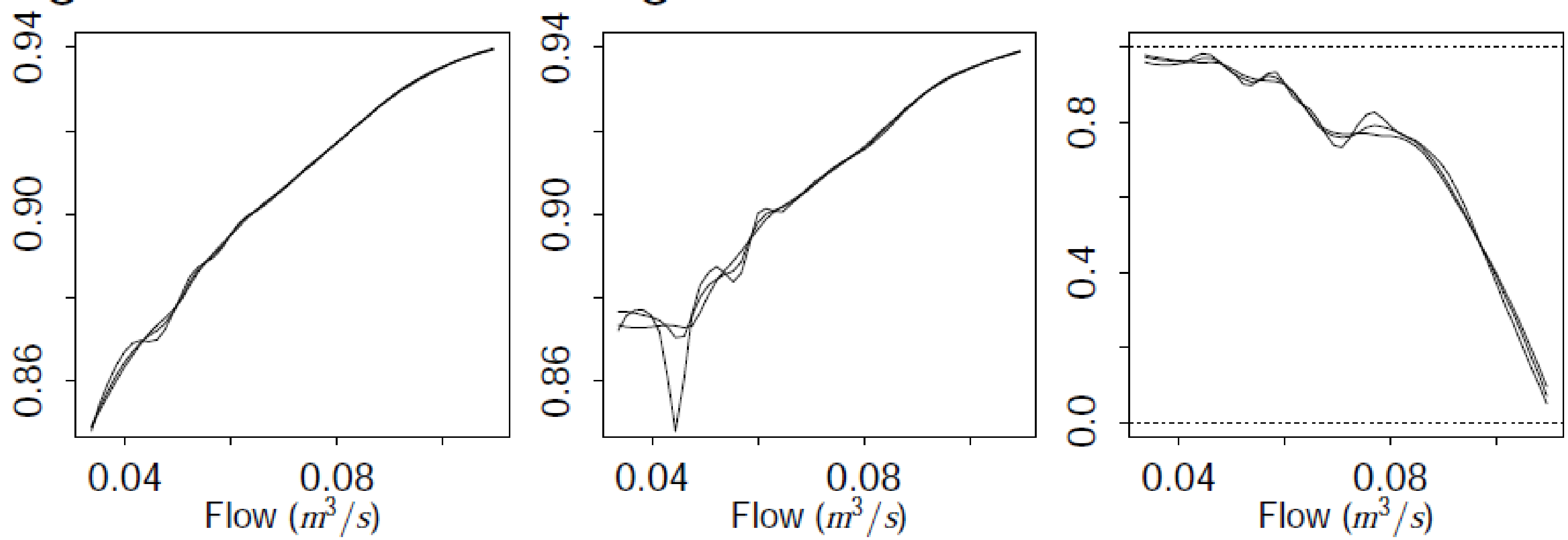
Characteristics

30%, 40%, 50%

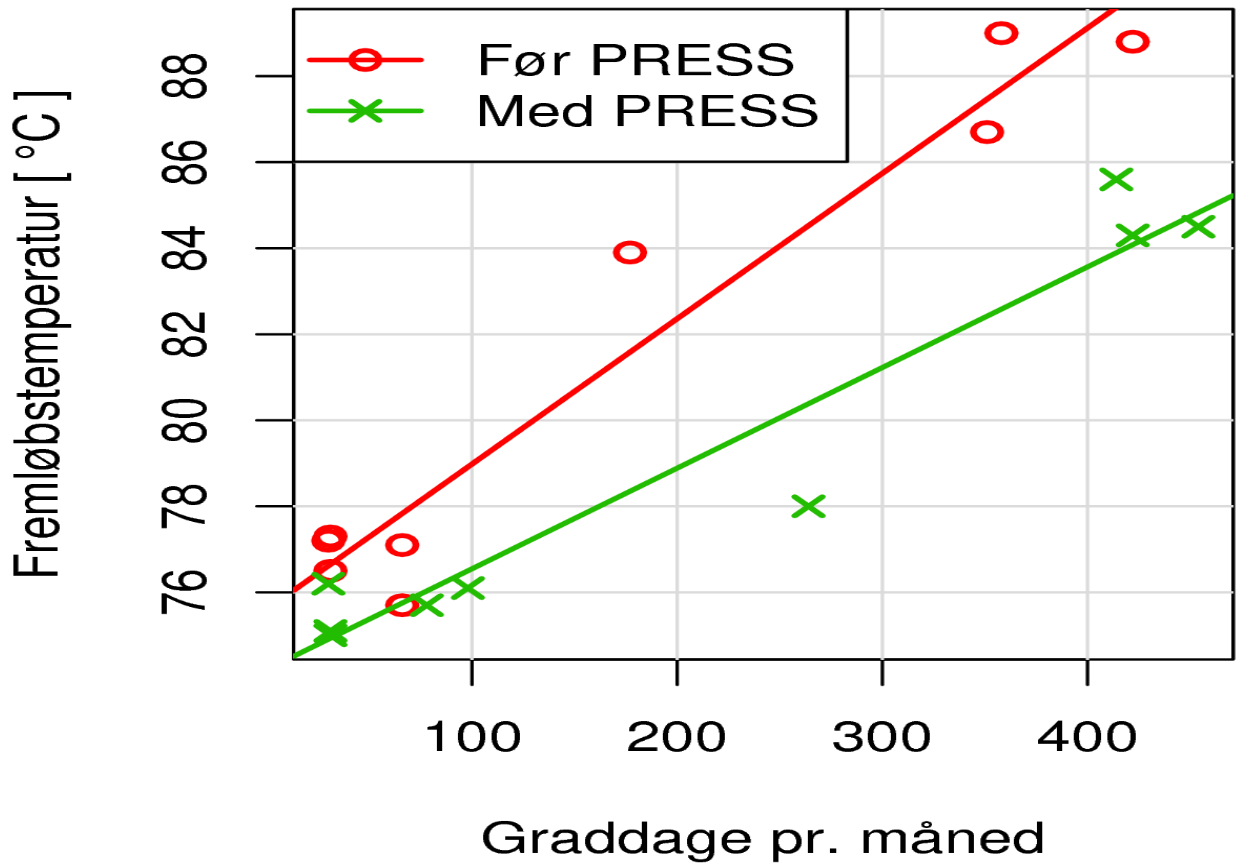
Stationary gain of FIR

Stationary gain of ARX

Pole of ARX



Supply temperature with/without data intelligent control



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Savings
(Reduction of heat loss = 18.3 pct)

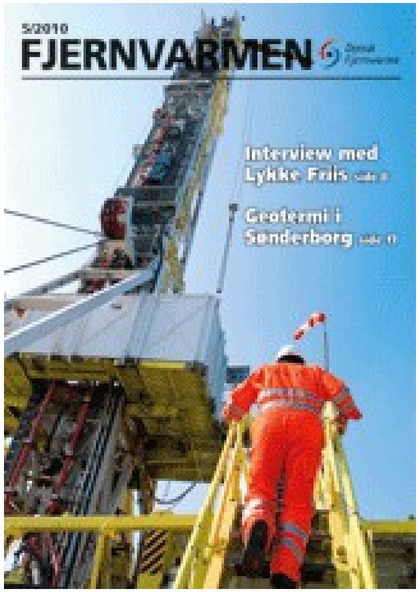
	Varmekøb		Elkøb	
	GJ	1000kr	kWh	1000kr
Før PRESS	653,000	30,750	499,000	648
Med PRESS	615,000	28,990	648,000	842
Forskel	37,400	1,760	-149,000	-194

Total besparelse (9 første måneder af normalår): **1,566,000kr**

Besparelse for et normalår:

- $12/9 \times$ 1,566,000kr $=$ **2.1 mill.**
- Imidlertid står jan.–sept. (75% af året) kun for ca. 65% af graddagen i er normalår.
- 1,566,000kr$/0.65 =$ **2.4 mill.**

Control of Temperatures in DH Systems



FJERNVARMEN | 5 2010

Styring af temperatur rummer kæmpe sparepotentiale

Lesson learned:

- Control using **simulation** of temperature gives **up to 10 pct reduction** of heat loss.
- Control using **data and predictions** gives **up to 20 pct. reduction** of heat loss.

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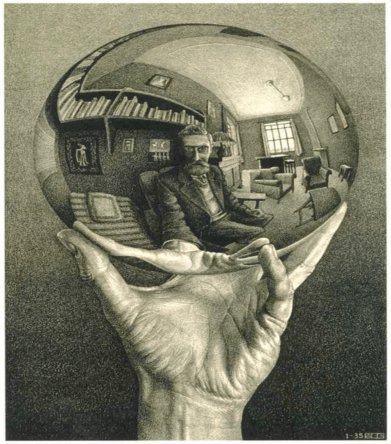
Which approach to use?

- Use **simulation based** control if:
  - No access to data from the DH network
  - Want an evaluation of new operational scenarios
- Use **prediction based** control if:
  - Access to network data online
  - Want to used meteorological forecasts automatically
  - Want to combine MET forecasts with local climate data
  - Want automated update of models

Data Intelligent Temperature Optimization for DH Systems

- Able to take advantage of information in data
- Self-calibrating models for the DH network
- Shows where to upgrade the DH network
- Fast (real time) calculations
- Use DH net for peak shaving and storage
- Able to use online MET forecasts etc.



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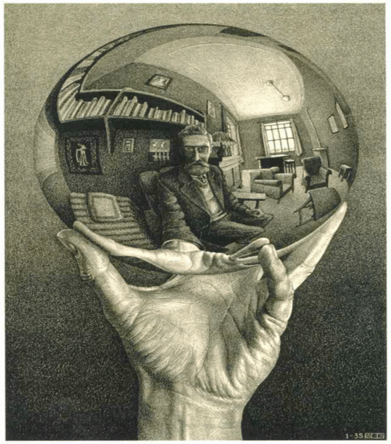
Data Int. Temp. Opt (v.4.0)

- Big Data Analytics – more specific:
- Take advantage of (smart) meter readings
- Use of all available MET forecast
- Combination of MET forecasts with data from local climate stations
- New grey-box models



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For more information ...

See for instance

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...or contact

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