



Wanda DMI

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Uncertainty analyses with WANDA

Motivation

- WANDA models become larger and more complex
- Not certain which parameter values are conservative
- Insight in uncertainty results necessary for probabilistic design

Status 2006

- Monte Carlo Simulation for parameter variation well known
- General tool not available

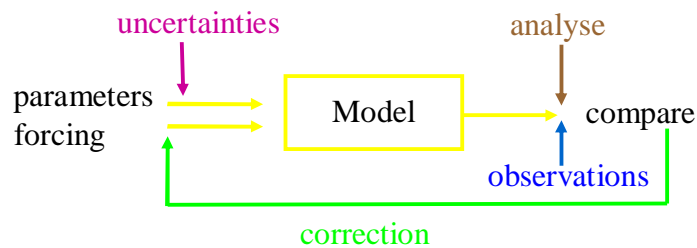
Status 2008

- UATools/OpenDA developed, and coupling WANDA
 - > Partly financed by Min. EZ
- General tool soon (intern) available
 - > Robust
 - > Need / wish, beta-users can come forward

DMI, Uncertainty Analyses & Calibration

Data, Models and their integration

- Models contain **uncertain parameters**, often related to friction or boundary conditions
- **Analyse** the effect of variation in uncertainty analyses
- Calibration of output against **observations**
- **Correction** with optimisation methods



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Uncertainty Analyses

Run Wanda model several times while automatically varying the uncertain parameters

Vary uncertain parameters, such as

- Wall roughness
- Initial fluid level Air Vessel, Laplace
- Valve position

Specify variation method, such as

- Range (and stepsize) per parameter
- PDF per parameter, Monte Carlo Simulation (N computations)

Analyze user specified output (monitor points), such as

- Max and min pressure in system
- Min fluid level in air vessel, etc

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Calibration: Optimization of a costfunction

- Calibration is defined as an optimization problem
- Elaborate background in statistics

$$\min_{p,x(0),w(t)} J = \min_{p,x(0),w(t)} J_o + J_p + J_i + J_s$$

- Measure misfit of model to observations
- Depends on uncertainty of observations (and quality)
 - There is a limit to what can be extracted from observations
 - Number of parameters < independent observations
 - Common sense, knowledge about the application

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Calibration: Optimization methods

Simplex

- Try mirror point with largest value
- Try to extend

Powell

- One line-search per parameter each outer iteration
- Update search directions

Dud

- Start with modifying each parameter
- Linearize the problem
- If it improves update linearization with new point
- Else do a line-search (only until improvement)

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WandaDMI & OpenDA

What is OpenDA?

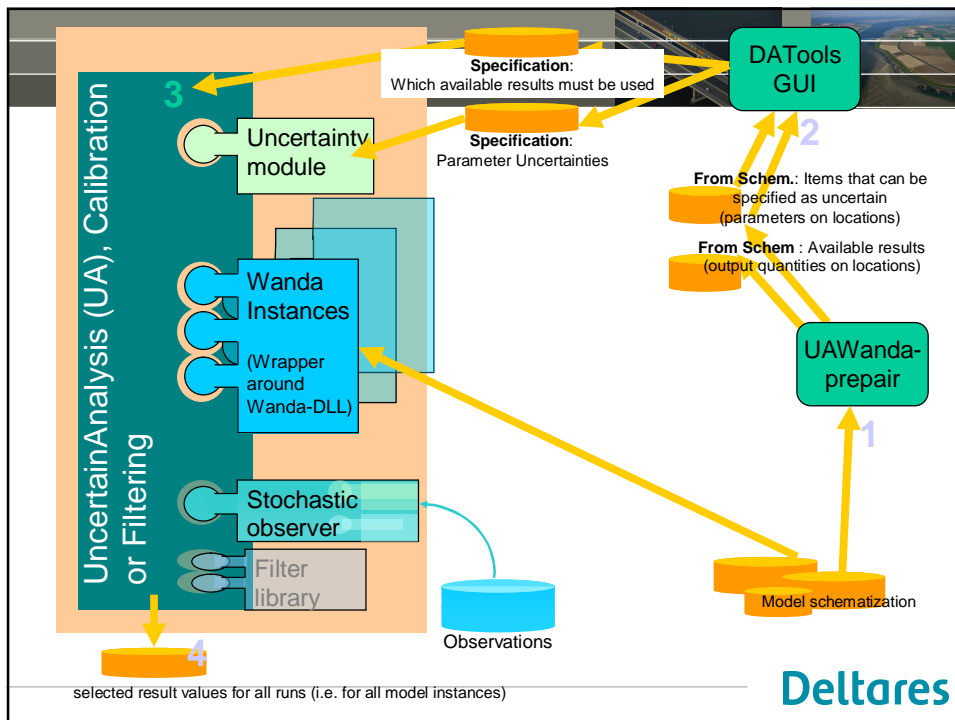
- Set of software interfaces in java
- Set of data-assimilation algorithms
- Open source (algorithms from TUD, etc)

Communication with Wanda

- OpenDA wrapper for Wanda
- Calls Wanda functions in Wanda.DLL (instead of executable)
 - Prepare
 - Steady
 - Unsteady
- Communication via Get & Put functions

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