New features of otgui 2018

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OpenTURNS users day #11, Saclay, France
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Advanced visualization

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otgui overview

otgui summary

- Generic "OpenTURNS" gui
- Aims at exposing uncertainty methods to non-experts
- Partnership EDF-Phimeca
- Distributed since 2016 at EDF through Salome
otgui methods

- Data analysis (moments, visualisation, inference)
- Probabilistic modeling (continuous marginals, copulas)
- Meta modeling (chaos, kriging), Optimization
- Sensitivity analysis (Sobol’, SRC, Morris)
- Reliability (Taylor, Monte Carlo, FORM, SORM, FORM-IS)
study example 1/13: math model

The flood model of a river compares the water level to the dike height:

$$S = \left( \frac{Q}{K_s \times 300 \times \sqrt{(Z_m - Z_v)/5000}} \right)^{3/5} + Z_v - 55.5 - 3$$
study example 2/13: physical model definition
study example 3/13: study diagram
study example 4/13: math model

Probabilistic model:

- $Q \sim \text{Gumbel}(\alpha=0.00179, \beta=1013)$, flow rate [$m^3s^{-1}$]
- $Ks \sim \text{Normal}(\mu=30.0, \sigma=7.5)$, strickler [$m^{1/3}s^{-1}$]
- $Zv \sim \text{Uniform}(a=49, b=51)$, downstream depth [m]
- $Zm \sim \text{Uniform}(a=54, b=56)$, upstream depth [m]
study definition 5/13: probabilistic model definition
study example 6/13: study diagram
Failure occurs when $S$ is positive, let's estimate $P_f = \mathbb{P}(S(X) > 0)$. 
study example 8/13: study diagram
study example 9/13: simulation wizard
study example 10/13: simulation wizard
study example 11/13: simulation wizard
study example 12/13: simulation result window
study example 13/13: simulation result window
FMI models

Different types of models already available:

- Symbolic
- Python
- YACS (Salome execution engine)
FMI models

New model type:

- Evaluate system models in the FMI standard
- Open FMU binaries from Modelica simulation IDEs (OpenModelica, Dymola, ...)

![FMI models diagram]
FMI models

Inspect model properties (tools, author, version, ...)

```
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```

Number of variables: 5

Causality: parameter:0, input:4, output:1, local:0
FMI models

Inspect model variables (type, causality, ...), select inputs/outputs
Advanced visualization

- Using Paraview graphics library
- Interactive widgets
- Model/view paradigm: several views on the same data
- Help visualize DOEs (Monte Carlo simulation, outliers, ...)

EDF-Phimeca (Phimeca)  otgui 2018
Advanced visualization

Cobweb plots
Scatter plots
Matrix plot
### Table

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<thead>
<tr>
<th>Row ID</th>
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Dependency treatment

- Only Normal copula was available (Spearman)
- Now all parametric copulas available
- Copula inference
Dependency treatment

Copula inference 1/5: data import
Copula inference 2/5: study diagram
Dependency treatment

Copula inference 3/5: dependency blocs

Firstly, define groups of variables. Then for each group, list copulas to infer from the sample.

- Variables
  - x1
  - x2
  - x3
  - x4

- Groups
  - [x1, x4]
  - [x2, x3]

- Copulas
  - Normal

Finish
Cancel
Copula inference 4/5: Kendall plot
Copula inference 5/5: pdf
Dependency treatment

Probabilistic model copulas
Future work

- Vector-Field models (first 1-d meshes)
- Parallel evaluation (Python)
- Remote computations (YACS engine)
Thank you for your attention!
Any questions?
Bibliography

- Airbus, EDF, Phimeca Engineering, IMACS. OpenTURNS, a scientific library usable as a Python module dedicated to the treatment of uncertainties, [www.openturns.org](http://www.openturns.org).