PERSALYS, the graphical interface of OpenTURNS

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June 23rd 2023, OpenTURNS User's day

Contents

Bring Uncertainty Methodology to Engineers

- Partnership started in 2015
  - EDF R&D wanted to maximize the use of OpenTURNS® by its engineer/researcher (and improve an existing GUI) → develop a GUI to make more easy to use
  - Phimeca had already developed an "OpenTURNS GUI" (PhimecaSoft®) which satisfies some needs of EDF R&D but not all.
  - EDF R&D and Phimeca decided to start a specific partnership in order to develop a new GUI based on OpenTURNS® and "Salome Tools": Paraview, Yacs, ...

Some expectations regarding the GUI

- As easy to use as possible and, when it is possible, a GUI which can guide the user
- Possibility to use it inside Salome Platform to
  - Use super-computing resources (e.g. Gaïa, 3 052 Tflops peak, 41 000 cores)
  - Connect to EDF numerical code users (Code_Aster for example)
- Take benefit from the advanced visualization capability from Paraview
- Drive the GUI from a python script usable in an "expert" mode

PERSALYS, the graphical user interface of OpenTURNS

- Main goal : provide a graphical interface of OpenTURNS in the SALOME integration platform
- Features
  - Uncertainty quantification : definition of the probabilistic model (including dependence), distribution fitting (including copulas), physical model with vector input and vector output or 1D Fields, central tendency, sensitivity analysis, probability estimate, meta-modeling (polynomial chaos, kriging), screening (Morris), optimization, design of experiments
  - Generic (not dedicated to a specific application)
  - GUI language : English, French

Community

- Website `https://persalys.fr/?la=en`
- Forum `https://persalys.discourse.group`
- First user's day on November 14th 2023
- Commercialization by Phimeca consists in :
  - Providing training, support on projects
  - Developing customized versions (EDF, NavalGroup) or dedicated features (Thales, NavalGroup)

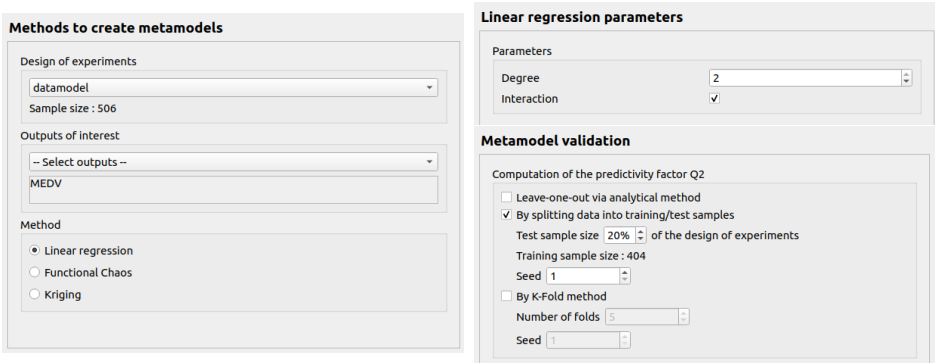
	Level 1	Level 2	Level 3
Content	Provision of the source code and Windows or Linux executables, on request via the mail form. A new version is available at least once a year or when a major update is released. Persalys is also integrated into SALOME platform. You can download it from the SALOME website.	Purchase a 1-year support with access to the updates (minor version, bug fix). This level is a package of 1800€, excluding taxes. It includes 15h of assistance, divided according to your needs: • Training (max. 1 day, for 2 users max.) • Support on projects In need of more support? We provide a customised quotation.	Customised development in the interface: • Custom physical model • Integration of specific methods • ... Feel free to contact us to get a customised quotation depending on your need.
Subscription	Free	1800 € excl. tax	Customised quotation

Summary

- Partners : EDF, Phimeca
- Licence : LGPL
- Schedule : new release twice a year
- Availability :
  - Stand-alone version : for free on demand on `www.persalys.fr`
  - SALOME_EDF in the "CONTRIBUTIONS" section since 2018 on `https://www.salome-platform.org`
  - Debian “bookworm” `https://packages.debian.org/source/bookworm/persalys`
    We thank Pierre Gruet (EDF) for this outstanding work!

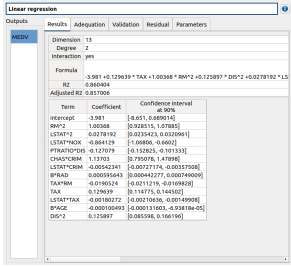
Stepwise linear model - Definition

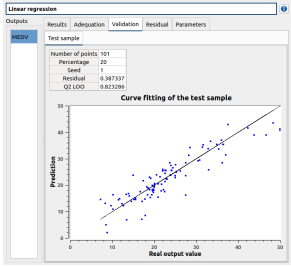
- Uses `LinearModelStepwiseAlgorithm` from OpenTURNS
- From a design of experiment or a data model

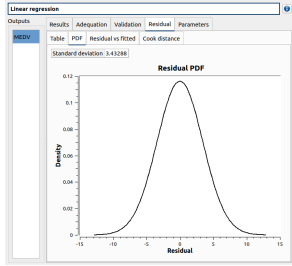


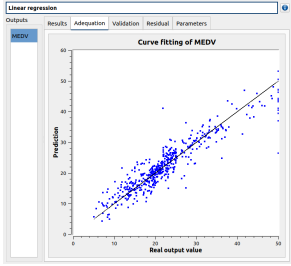
http://openturns.github.io/openturns/latest/user_manual/response_surface/_generated/openturns.LinearModelStepwiseAlgorithm.html

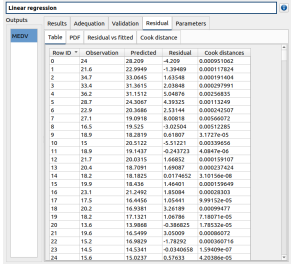
Stepwise linear model - Results and validation

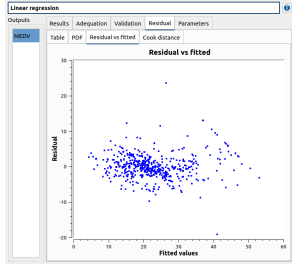






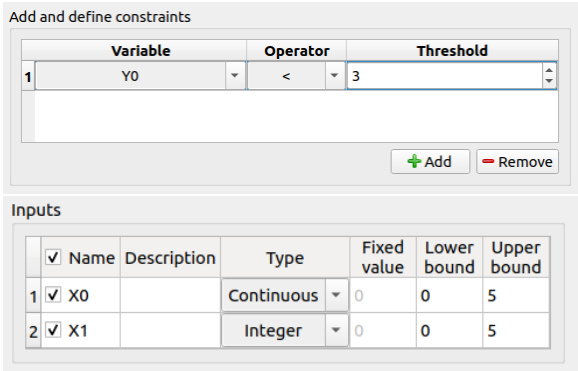






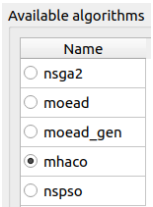
Optimization overhaul (1)

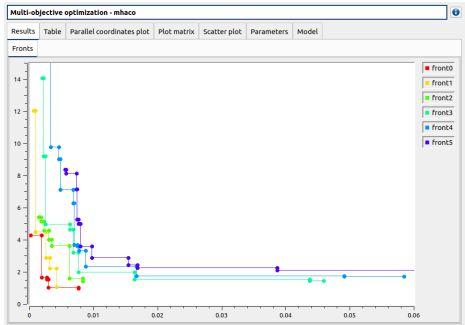
- Added constraints support
- Added variable type definition for mixed optimization

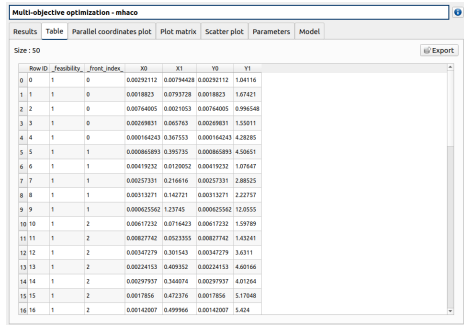


Optimization overhaul (2)

- Added multi-objective optimization analysis
  As a service for NavalGroup
  Evolutionary algorithms from `Pagmo`







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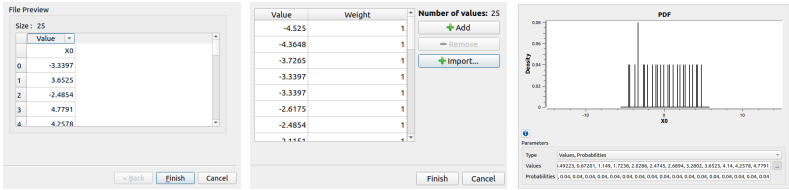
1	1	1	0	0.0018823	0.0793728	0.0018823	1.67421
2	2	1	0	0.00764005	0.0021053	0.00764005	0.996548
3	3	1	0	0.00269831	0.065763	0.00269831	1.55011
4	4	1	0	0.000164243	0.367553	0.000164243	4.28285
5	5	1	1	0.000865893	0.395735	0.000865893	4.50651
6	6	1	1	0.00419232	0.0120052	0.00419232	1.07647
7	7	1	1	0.00257331	0.216616	0.00257331	2.88525
8	8	1	1	0.00313271	0.142721	0.00313271	2.22757
9	9	1	1	0.000625562	1.23745	0.000625562	12.0555
10	10	1	2	0.00617232	0.0716423	0.00617232	1.59789
11	11	1	2	0.00827742	0.0523355	0.00827742	1.43241
12	12	1	2	0.00347279	0.301543	0.00347279	3.6311
13	13	1	2	0.00224153	0.409352	0.00224153	4.60166
14	14	1	2	0.00297937	0.344074	0.00297937	4.01264
15	15	1	2	0.0017856	0.472376	0.0017856	5.17048
16	16	1	2	0.00142007	0.499966	0.00142007	5.424

`https://esa.github.io/pagmo2/`

Miscellaneous features

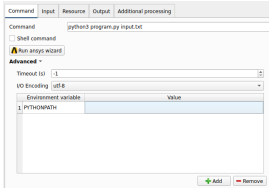
- Sampling using existing data



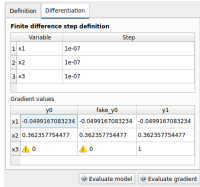
- NormalCopula can be parametrised w. shape and Kendall matrices (only Spearman was available)

Miscellaneous features

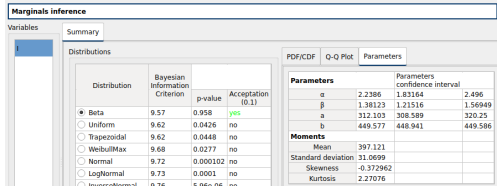
- Coupling model command environment override



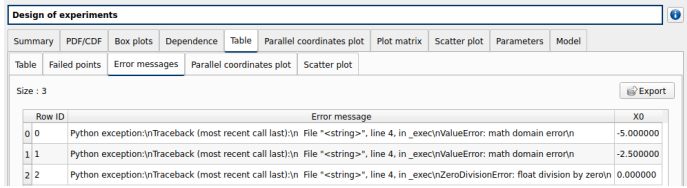
- Gradient evaluation



- Inference :
  - Optional distribution parameters confidence interval estimation
  - Lilliefors fitting test (only Kolmogorov-Smirnov was available)



- Design of experiment error handling



Miscellaneous features

- Confidence interval length as analysis stopping criterion
- Sample tables partial copy pasting
- Ansys intermediate parameters detection

- Coming soon
  - Data field model
    Import model mesh and data from already evaluated firld samples
  - Calibration QQ-plots

- Design of experiments overhaul
- Detach-attach jobs on distant cluster - interrupt (instantly) running analysis
- Python/YACS physical models merge

The end

Thanks !

Questions ?