

JU OpenTurns

Airbus-CRT



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AIRBUS

Technical Perimeter



Electrification
Technologies



Communication
Technologies



Materials



Artificial
Intelligence



Virtual Product
Engineering



Quantum
Technologies



Blue Sky
Research

Strategic drivers

Sustainability
Safety & Security
Operational Excellence

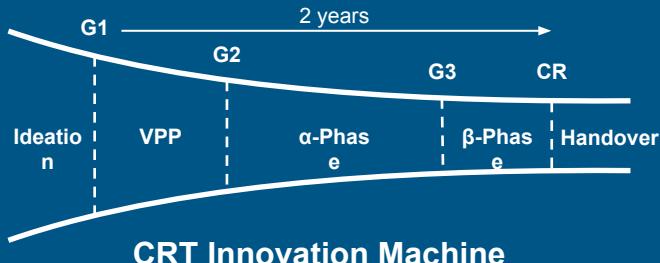
Central R&T Axes

Acting as tech trailblazers
Shaping skills of tomorrow

Central Research & Technology

Mission

Airbus Central Research & Technology pioneers the future of aerospace by exploring and delivering ambitious new technologies for the next-generation portfolio of Airbus and its divisions in collaboration with leading academic and scientific institutions.



based on 6 sites in
Germany, France & UK

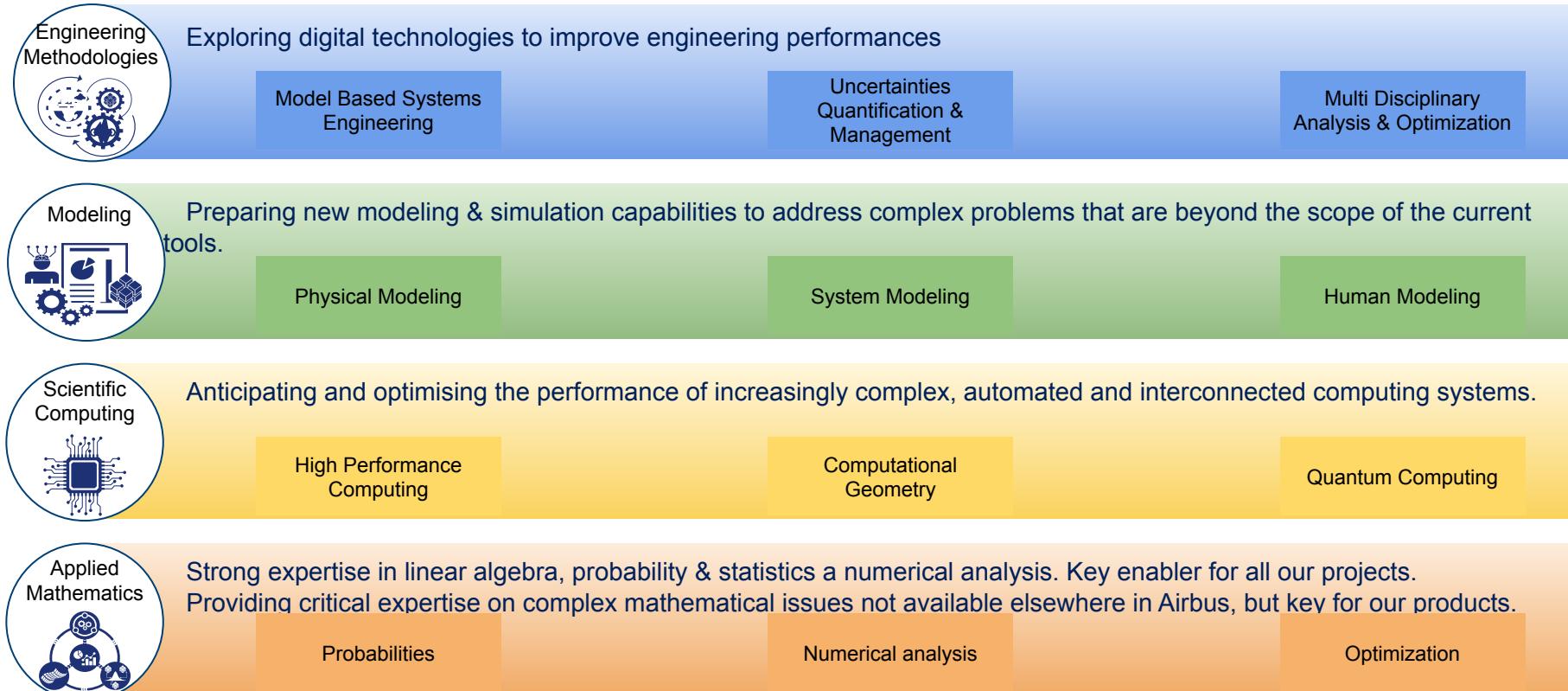
Education
60% PhD



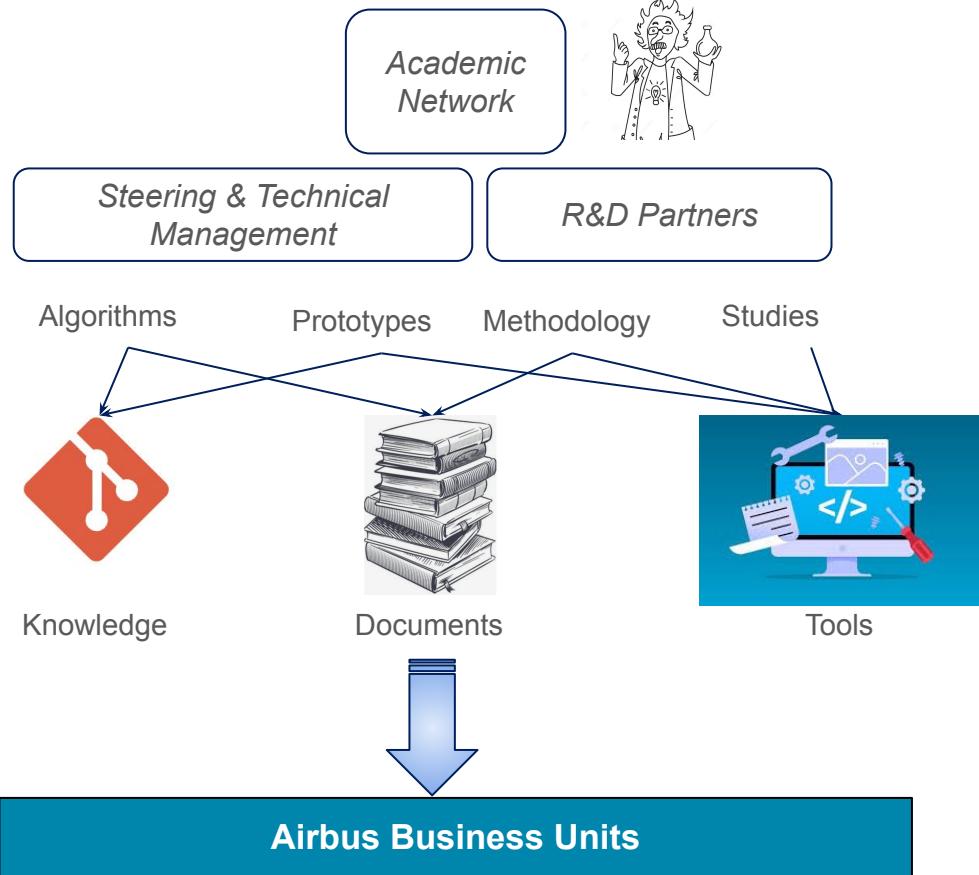
AIRBUS

Virtual Product Engineering

Virtual product engineering explores and optimizes new digital technologies toward a future full digital engineering for all Airbus divisions in collaboration with leading academic and scientific institutions.



OpenTURNS as a KEY asset for capitalization



OpenTurns specificities

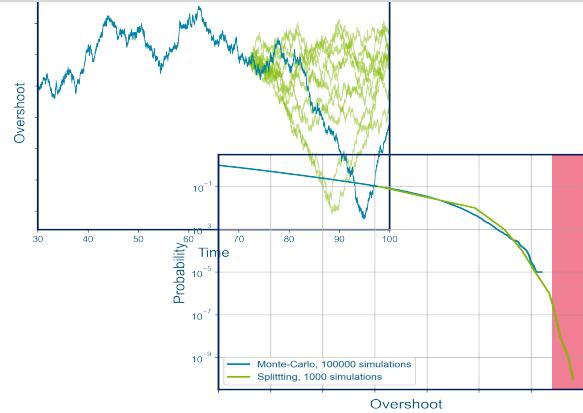
- Consortium (Self funding)
- Specific development team
- Hackathon
- Trainings

Other examples (same direction)



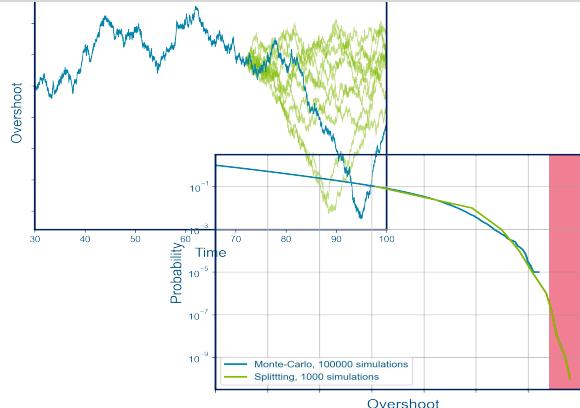
Groundbreaking Studies

FellowFly: certification of the control system using advanced splitting algorithms & distribution algebra

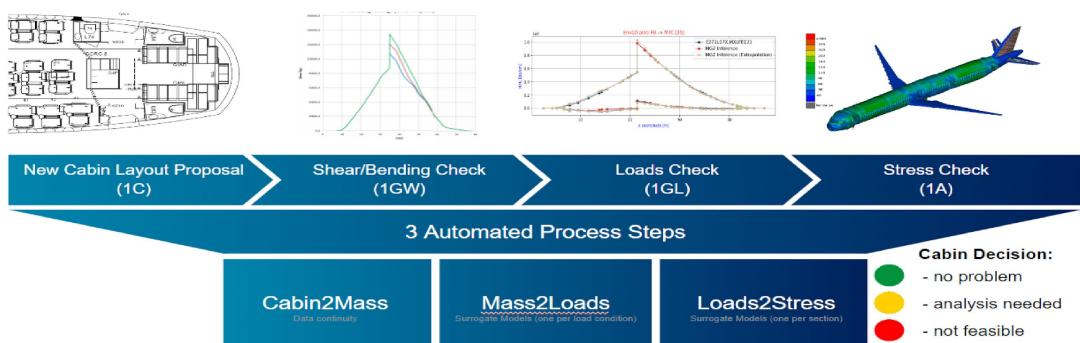


Groundbreaking Studies

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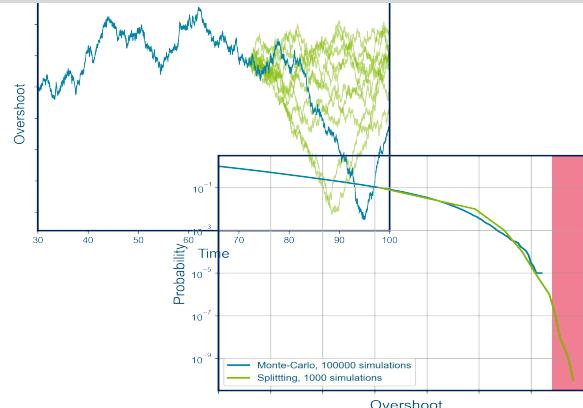


Cabin2Stress: machine learning on constrained domains. More details this afternoon.



Groundbreaking Studies

FellowFly: certification of the control system using advanced splitting algorithms & distribution algebra



Vision Landing Application:
OpenTURNS used for the complex
CoE based on conditional
distributions and the certification of
the automatic recognition of the
runway
Collaboration with the AI team



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Modeling



MODELING PERIMETER

Physical Modeling

System & Industrial Modeling

Human Modeling

Increment

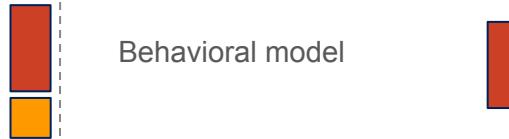
DESIGN:
Robust

Multi-Disciplinary
Optimisation



New Project

Industrial Design:
Decision Making



Production

Robust Planification:
Operational Research



MOC

Crack Propagation
Sensor Analysis



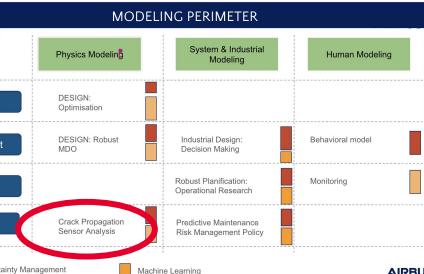
Predictive Maintenance
Risk Management Policy



Uncertainty Management

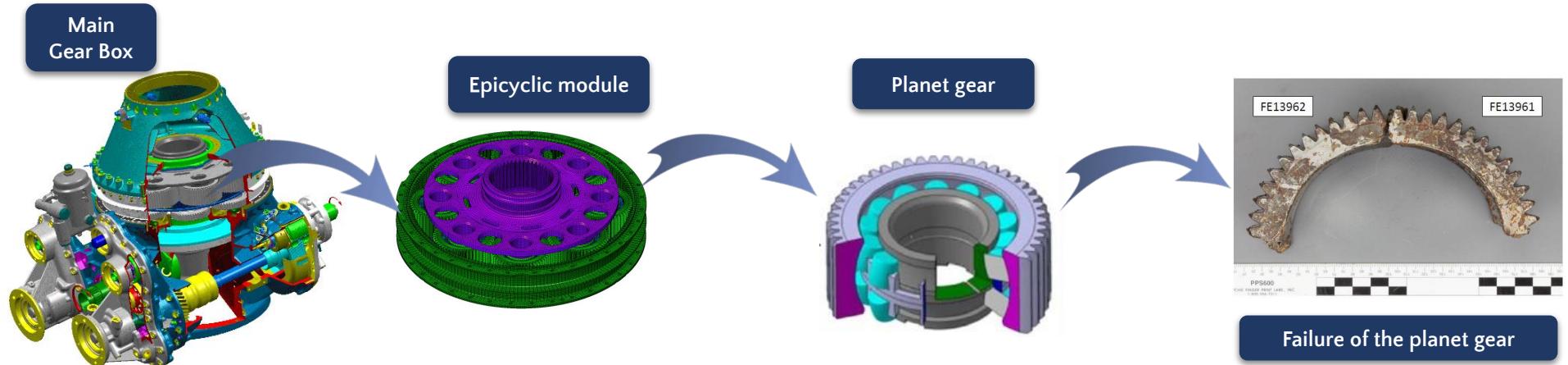
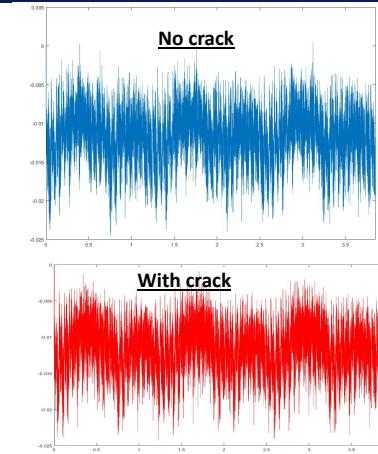


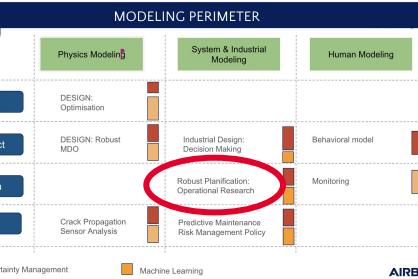
Machine Learning



ILLUSTRATION

Vibration-based condition monitoring in gear systems in order to detect cracks before the occurrence of failure





ILLUSTRATION

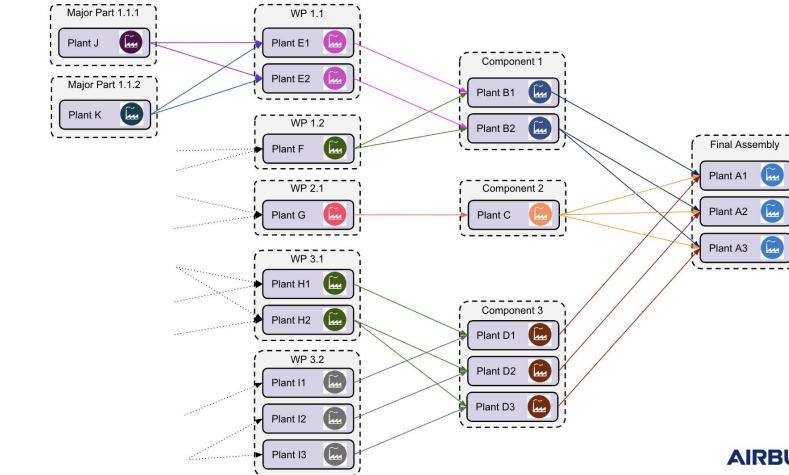
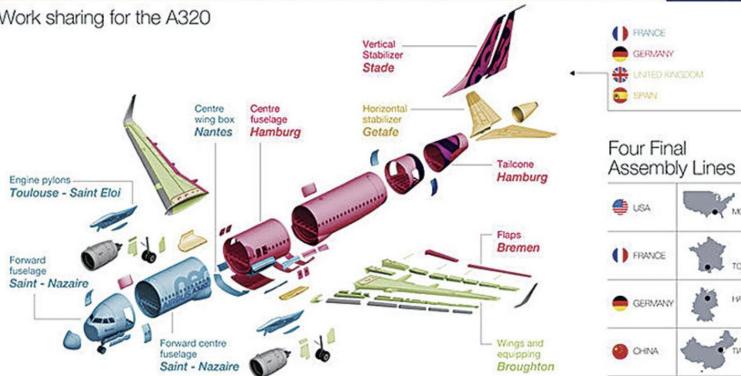
Uncertainties are everywhere:

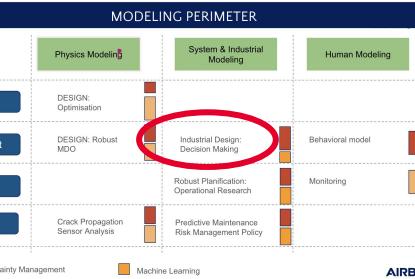
- *Transport*
- *Supply Chain*
- *Ressources*
- ...

but today they are mainly managed thanks to buffers.

Airbus A320, a truly global programme

Work sharing for the A320



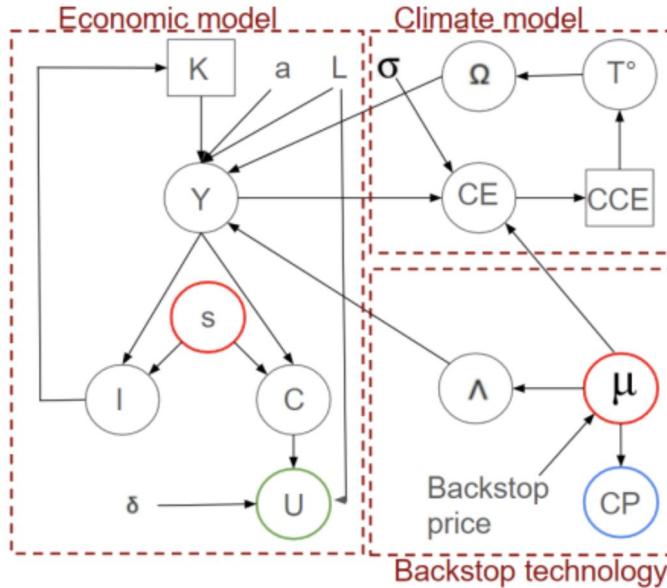


ILLUSTRATION

Very poor quality modelling

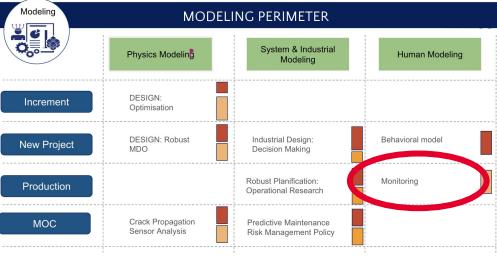
- Models are not validated
- Calibration with historical data and extrapolation into the future
- Huge lack of knowledge

but we want to make the better (or less bad) decision.



Scenario definition

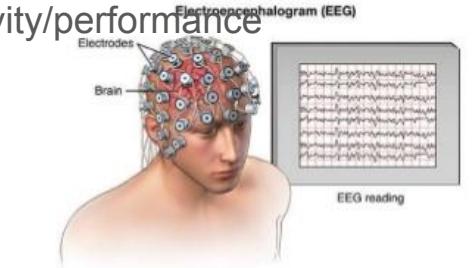




ILLUSTRATION

To :

- Improve monitoring for cockpit design, cockpit certifications, air traffic management, other applications ...
- Provide objective measures of various Human Factors
- Develop robust statistical methods to **quantify** and **predict** mental activity/performance



Ways of working : collaboration within the BUS

CRT projects

- *2 years project running on specific key topic (high dimension modelling, robust optimization, ...)*
- *Capitalization in OT, demonstration on specific use-cases*

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- *Follow-up / Supervision / Co-supervision*
- *Directions, advices, OT awareness, OT-based PoC*

Example: LOLA Voronoï

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- Identify focal points (*train the trainers*)
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MOC / Expertise

- Expertise on hot topic
- Implementation of specific KPI, recommendations
- Demonstrated PoC, reliability analysis ...

UQ core team & communities

Active community

- Chat : Proba&Stats + UQ&M ~ 130 active members; ML ~ more than 1200 active members
- Gsite up to date (projects running / events / tuto...)
- Annual newsletter !



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A screenshot of a Slack channel titled "Probability & Statistics". The channel has 68 members and is part of the Airbus organization. The message shown is:

Hi, you can try the two samples Kolmogorov-Smirnov
https://openturns.github.io/openturns/latest/theory/data_analysis/smirnov_test.html The test works with samples of different sizes without using any parametric hypothesis. However I don't know how test behave with large datasets as it compares empirical CDFs.

In parallel, instead of comparing the probability density functions (histograms) you're rather compare the cumulative distribution functions. These last ones are applied within the Smirnov test

Below the message is a small image of two green spheres with red 'T' and 'G' symbols, representing the Kolmogorov-Smirnov test.

Internal workshops

- ~ 80 attendees
- ~ 1 ws / 2 years
- 2024 : 2 more workshops to come !



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A collage of images related to internal workshops. It includes:

- A video frame of a man speaking at a podium with an "AIRBUS" logo, labeled "TO-B01-0-Symposium".
- A workshop poster for "Global sensitivity analysis (engineering perspectives, basic methods and recent advances)" by Bertrand Iooss - EDF R&D, held on September 27th, 2022.
- A photograph of a DNA sequencing gel with multiple lanes of green bands.
- A small image of a DNA sequencing gel with a red "R" in the top right corner.

Past trainings

- More than 200 peoples trained !
- Additional trainings done with academia (Liverpool University for example)

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A screenshot of a Slack channel titled "Probability & Statistics". The channel has 68 members and is part of the Airbus organization. A message from a user named "openturns" is displayed, explaining the Kolmogorov-Smirnov test and providing a link to its implementation in OpenTURNS. Below the message is a small image of two green spheres with red "T" and "P" symbols on them.

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Three images showing speakers at internal workshops. The top image shows Bertrand Iooss speaking at the TO-B01-0-Symposium. The middle image shows Sofiane Haddad speaking at the same symposium. The bottom image shows Régis Lebrun speaking at the symposium. To the right of these images are promotional banners for the Global Sensitivity Analysis workshop and the EDF R&D workshop.

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... and an active academic network

AIRBUS

French Eco-System



Centrales-Nantes, GDR
RT-UQ

IRT, GIS Lartiste
Lip6

IRT, CERFACS

Non french partners : (some) key academic focus



- 6 years partnership now on MBSE enabled MDAO, including UQ
- Development of PoC UQ visualisation and propagation
- Application of UQ to design space exploration



Dimension reduction
for aerodynamics
(POD, GappyPOD...)



Partnership in DAWS
developing a [UQ framework](#)
(using mainly [pbox](#))

Collaborative tools,
aircraft sizing using
multiphysics integration



Bristol working on 2 topics linking
UQ to Aircraft design :

- Robust wing flight shape
- Early phase dynamic ground loads.

Airbus wing twist UQ challenge



AIRBUS

Improvements proposal

Objective: increase OpenTurns visibility and impact in academic & professional worlds

Proposals

- Increase interaction with the French eco-system
- Develop the international eco-system
- Build a multi-years roadmap and communicate widely
- Clarify OpenTurn positioning (COTS / Academic)

Steering:

- Quarterly steering committee assembly
- 1 assembly devoted to the strategy with (external) stakeholders