ADVANCED MDO AND ROBUST OPTIMIZATION WITH GEMSEO

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Carbon neutrality requires a fundamental rethink of aeronautical design processes. It is becoming necessary to ensure end-to-end digital continuity of these processes, to fully automate them so that a large number of different concepts can be easily compared, and finally to reduce their execution time while preserving the precision and quality required for these comparisons. The open-source MDO software GEMSEO (Generic Engine for Multidisciplinary Scenarios, Exploration and Optimization, www.gemseo.org) [1], developed by IRT Saint Exupéry, has been selected in NEXTAIR to facilitate the integration of complex industrial use-cases while fostering the usability of the most advanced MDO techniques.
While GEMSEO meets the need to fully pushing forward the limits of simulation process automation, enabling multiple design alternatives to be evaluated, NEXTAIR raises the question of the choice of architecture for these processes. Next Generation High Aspect Ratio Wing Transport Aircraft design requires using multidisciplinary high-fidelity methods featuring strong disciplinary couplings. The Bi-level MDO formulation implemented in GEMSEO [2] is proposed as an architecture solution particularly well adapted to industrial constraints such as a distributed computational heterogeneous environment constraint. The use-cases dealt with in the project also required the development of a number of features in GEMSEO:

- an efficient optimization algorithm (mNBI) [3] to compute Pareto fronts,
- a full unsteady adjoint computation based on Petsc (www.petsc.org) for unsteady aeroelastic applications,
- platform capabilities as GEMSEO plugins, enabling or easing the execution of the partner's distributed workflow by leveraging the available partner's services and protocols (SSH, HTTP, Job Schedulers),
- finally, GEMSEO allows to solve MDO use cases in presence of model or design variables uncertainties. The uncertain MDO formulation engine is able to turn all deterministic MDO formulations into uncertain ones, by turning the original objective function and constraints into random variables. The user can estimate their statistics and solve the robust optimization problem with or without the gradient information. NEXTAIR extends these techniques to multi-level MDO formulations, multi-fidelity statistics estimation, and the full differentiation of the uncertainty computation process.

REFERENCES

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