FONDEMENT DES SYSTÈMES INFORMATIQUES

ID4CS

Integrative Design for Complex Systems

COSINUS 2009

COORDINATEUR : IRIT
PARTENAIRES : AIRBUS, ARMINES, ARTAL Technologies, ICA, IMT, INRIA, SNECMA, UPETEC

PROJECT OBJECTIVES

ID4CS is a software environment dedicated to solve **Multi-Disciplinary, Multi-Objective, Multi-Criteria Optimisation** problems under **uncertainties**

- Based on **Adaptive Multi-Agent Systems**
  ➔ Reacts to change on constraints or objectives or variables values during the execution
- **Natural Domain Modelling for Optimization**
  ➔ Does not require problem reformulation
- **Co-design**
  ➔ Enables interaction with designers at runtime and takes into account any changes provided by engineers. ID4CS does not restart from scratch and can take benefits from the previous solution
- **Generic**
  ➔ Enables the designer to build his customizable workspace
- **Numerous application domains**
  ➔ Complex systems design for aircrafts, engines, submarines, helicopters, cars, …
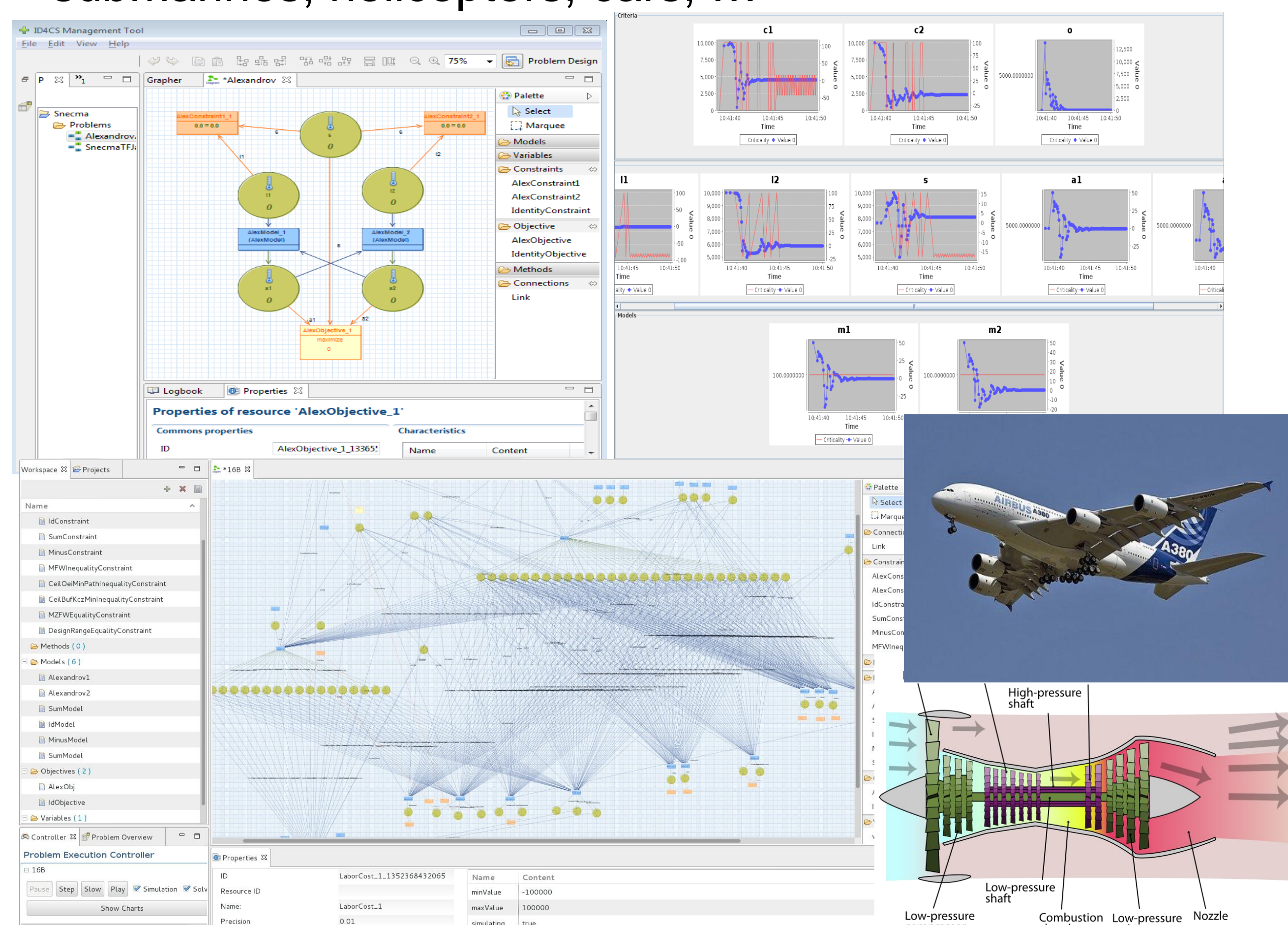
METHODOLOGY AND RESULTS

Adaptive Multi-Agent System Theory
- Decentralised problem solving
- Cooperation between interacting agents: try to help other agents which are less satisfied than themselves
- Local decision at the agent level

- **Model Agent** ➔ a model of the problem
  Goal: to maintain consistency between inputs and outputs
    Relies on external optimizers
    Receives and sends information and requests
- **Variable Agent** ➔ a design variable of the problem
  Goal: to find a value which is the best equilibrium among all the requests it can receive
    Receives requests and sends information
- **Output Variable Agents** ➔ an output of a model
  Goal: to find a value which is the best equilibrium among all the requests it can receive
    Receives and sends information and requests
- **Objective Agents** ➔ an objective of the problem
  Goal: to reach its objective
    Receives information and sends requests
- **Constraint Agents** ➔ a constraint of the problem
  Goal: to satisfy the constraint
    Receives information and sends requests

Generic Uncertainties Propagation and Representation
- Propagation by model, constraint and objective Agents
- Analytical *ad hoc* methods or Monte-Carlo evaluation
- Adaptive, sequential reliability analyses
- Multi-agent adaptive space partitioning

AIRBUS, SNECMA and typical applications
- *Wing Area* and *Engine Size* Optimisation of an aircraft configuration in minimising *Maximum Take Off Weight* under 9 constraints
- Turbo fan optimisation
- Alexandrov problem
- Viennet1 problem
- Rosenbrock problem

CONCLUSION AND PERSPECTIVES
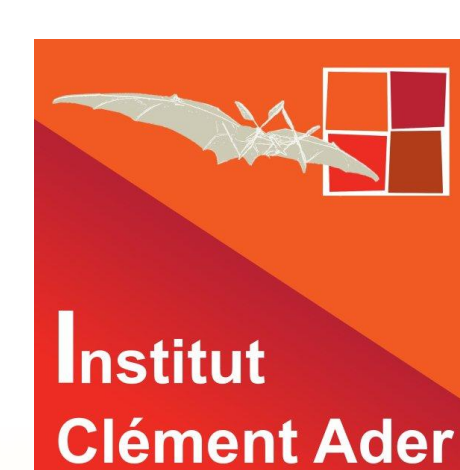
Objectives of ID4CS reached
Future developments:
- To improve the MAS management tool
- To experiment the co-design with engineers
- To experiment optimization under uncertainties
- To take into account multi-level optimisation

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LES RENCONTRES DU NUMÉRIQUE

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