Linköping, February 6th 2012

OMOPTIM PRESENTATION

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WHAT IS OMOPTIM ?

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What OMOptim intends to be ?

Optimization **platform** designed to :

- Facilitate algorithms development
- Share optimization functions
- Apply optimization easily and efficiently

End-user oriented

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Two main users

Academics

A platform to **develop and test optimization methods**

Industrial

A user-friendly tool to **perform process optimizations**

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OMOptim – Model-based optimization with OpenModelica

Hubert Thieriot

Applications

- ☑ Design optimization
  - ☑ Parameters optimization
  - ☑ Components selection (*beta)*
- ❑ Sensitivity analysis
- ❑ Optimal control
- ❑ Hybrid systems

Planned Optimization Methods

- ☑ Evolution strategies (e.g. genetic algorithms)
- ❑ Gradient based methods (e.g. SQP)
- ❑ Relaxation techniques
- ❑ Hybrid algorithms

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What OMOptim can do ?

STATIC PARAMETERS OPTIMIZATION

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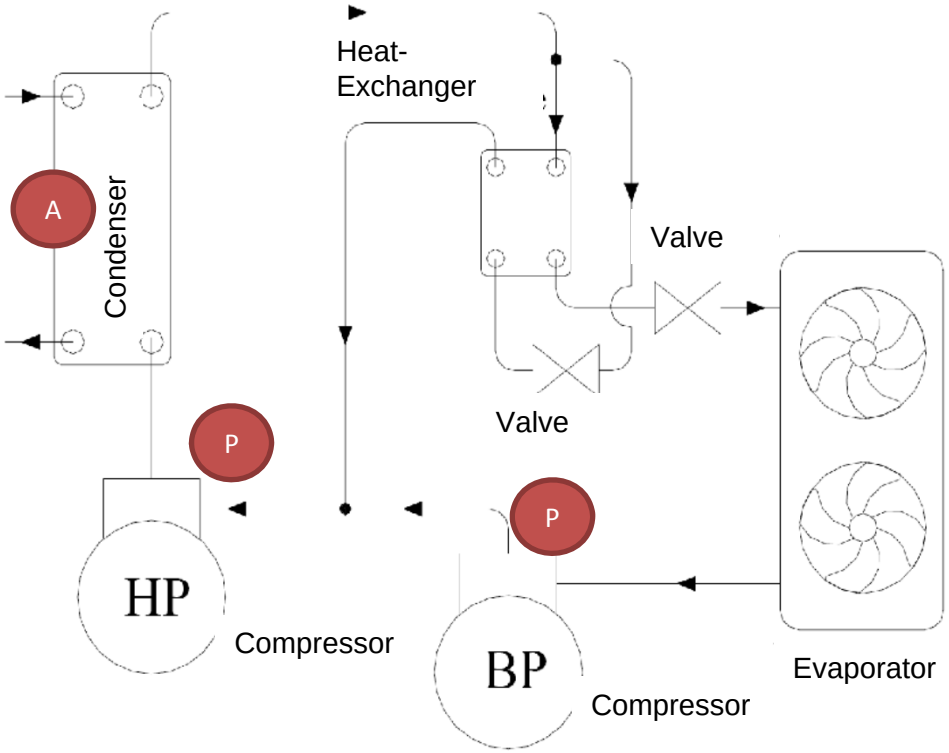
e.g. Optimization of heat-pump parameters



Freedom

•pressure levels

• heat-exchanger area

- Parameters are static : constant during one simulation
- Simulation can still be dynamic
- Objective functions can consider evolution

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What OMOptim can do ?

STRUCTURE OPTIMIZATION

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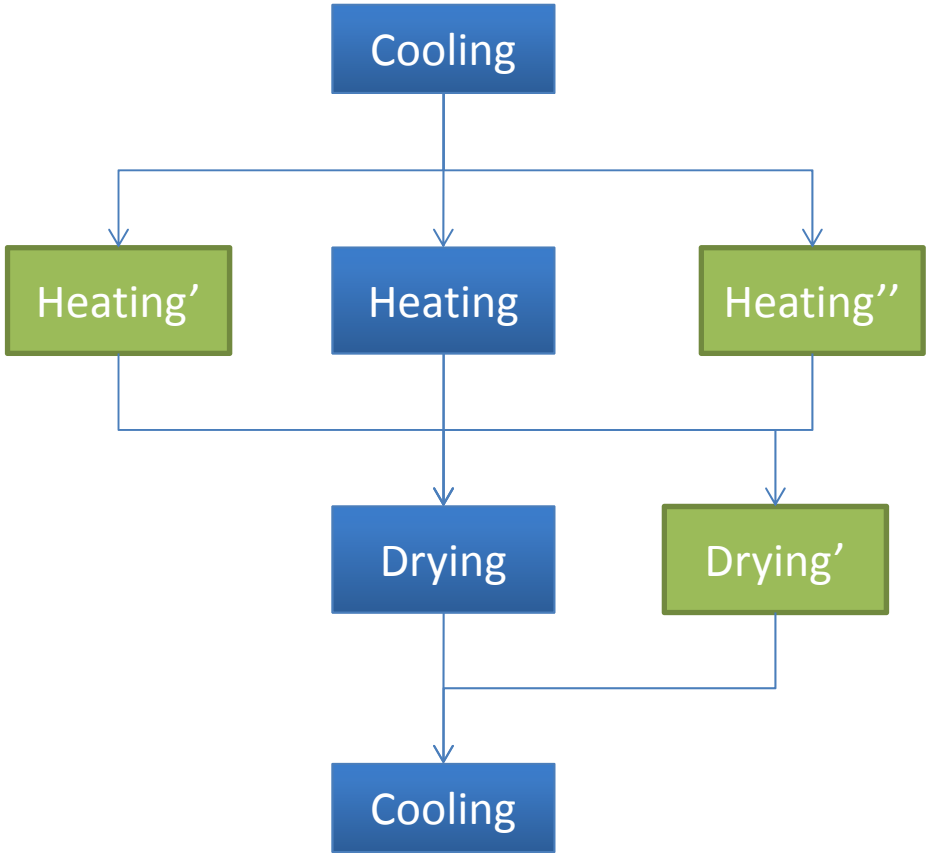
Structure optimization



- Introduction of alternative options
- Optimal choice

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What OMOptim can do ?

WHICH OBJECTIVES ?

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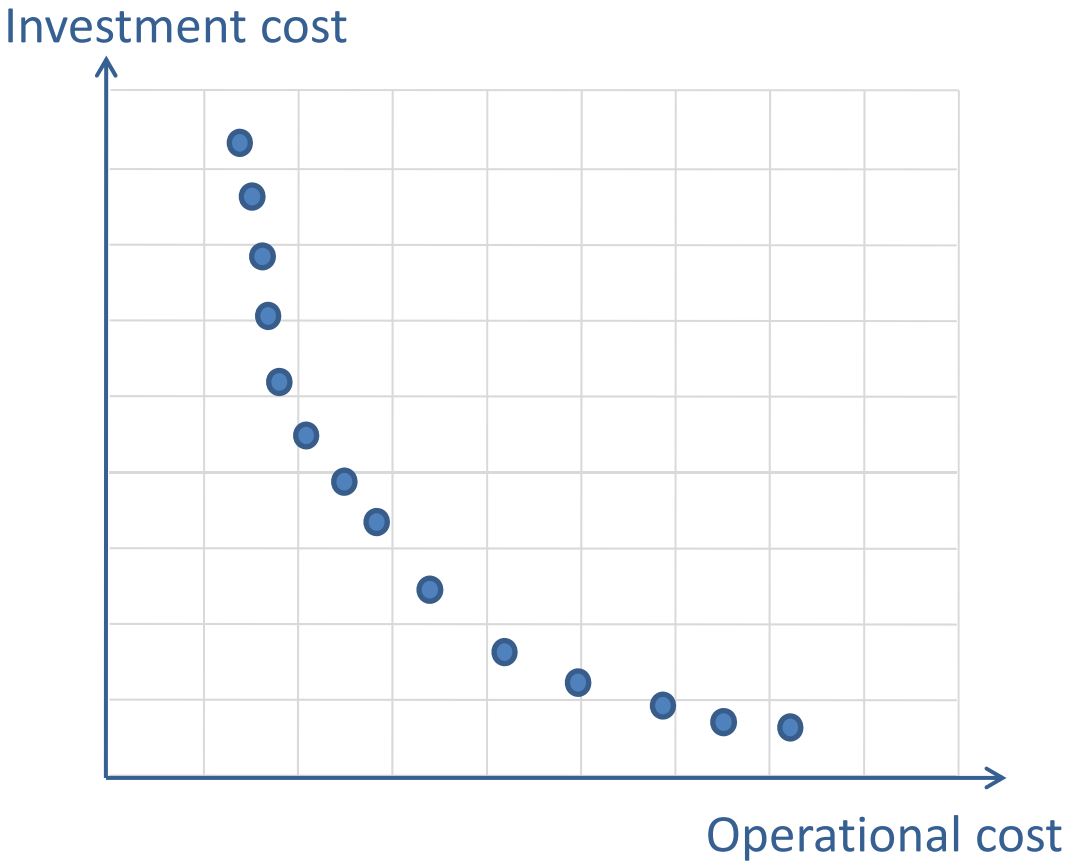
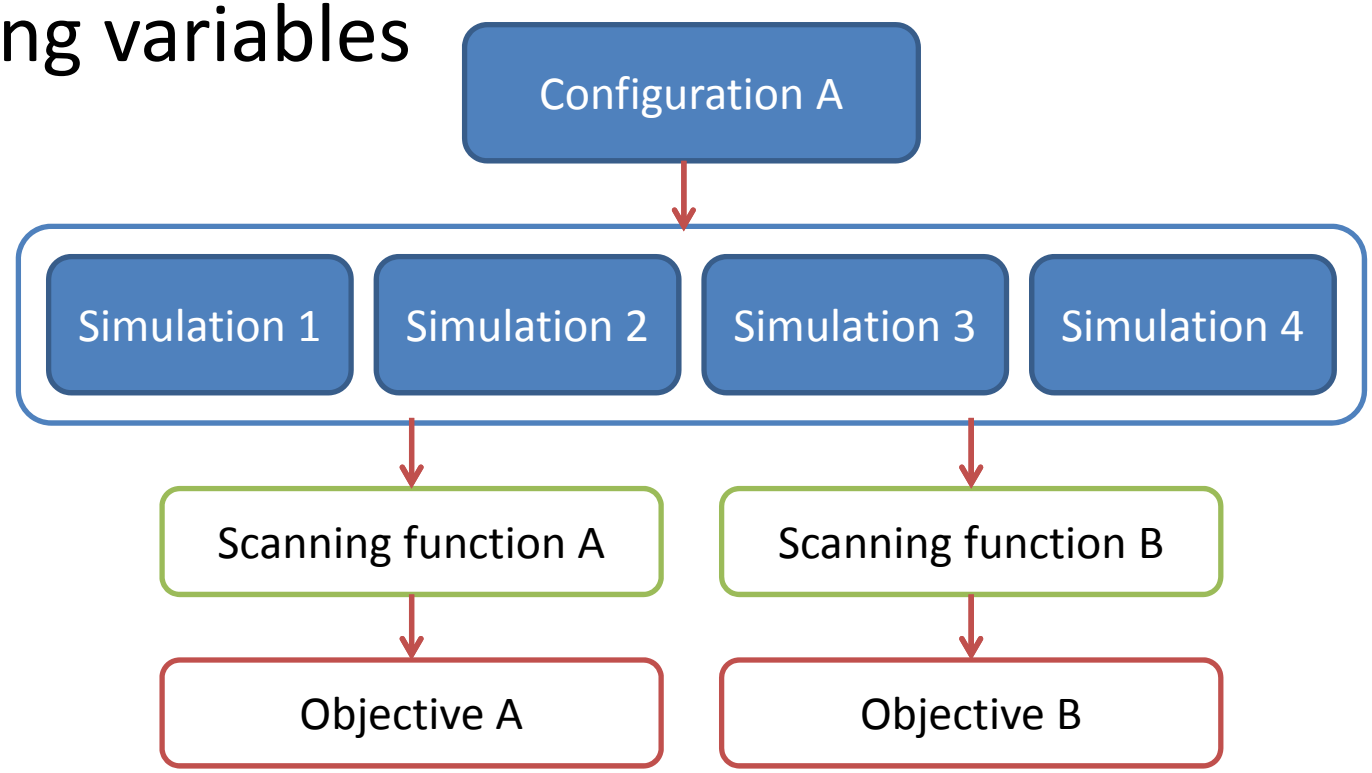
Multi-objectives

Pareto criteria allows several objectives simultaneously



Scanning variables



e.g.

- minimize total energy consumption over the four seasons
- minimize standard deviation of temperature related to mass flow

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PROJECTS

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Two energy related projects

EDOP

- Integration of modelization and optimization

- Dynamic optimal control of startup and load cycles

CERES

-Identify best energy paths within industrial processes

- Design optimization

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OPTIMIZATION ALGORITHMS

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Meta-heuristics	• Many simulations required • Model as a *Black-box*
Gradient based	• Require jacobians
Relaxation techniques	• cf. EDOP project
…	

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Meta-heuristic algorithms implemented

- Evolutionary strategies (SPEA2, NSGA2)
- Particle Swarm Optimization
- Simulated Annealing

PLUGIN FUNCTIONALITY

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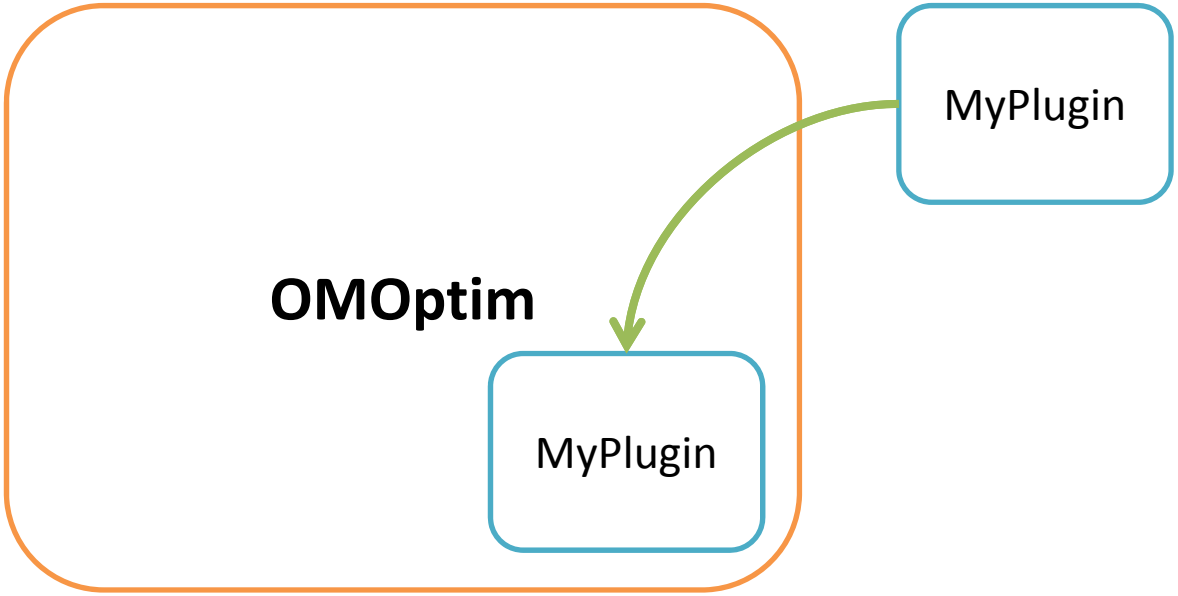
Plugin

- Allows to implement specific functionalities
- Dynamically/Statically linked



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Energy integration plugin

CERES project

- Increase heat recovery within processes
- Select best fitted utilities
- Build heat exchangers network

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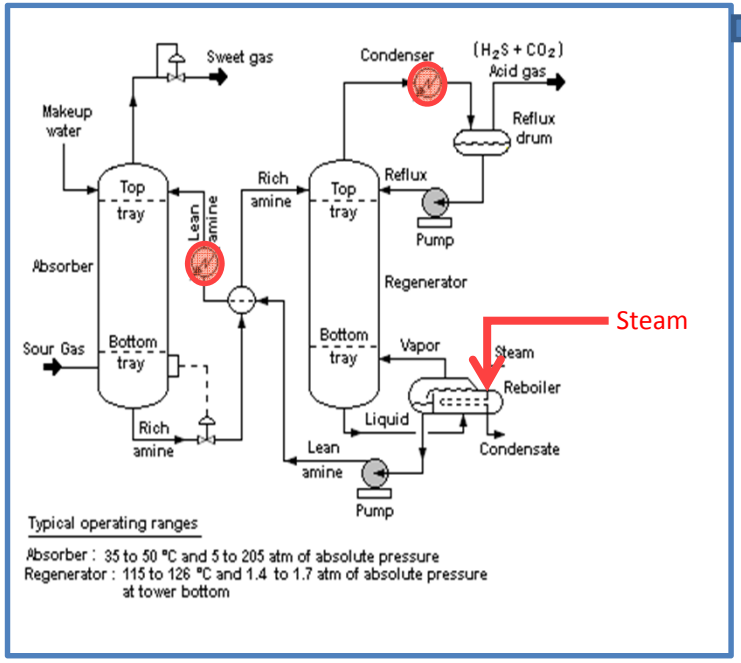
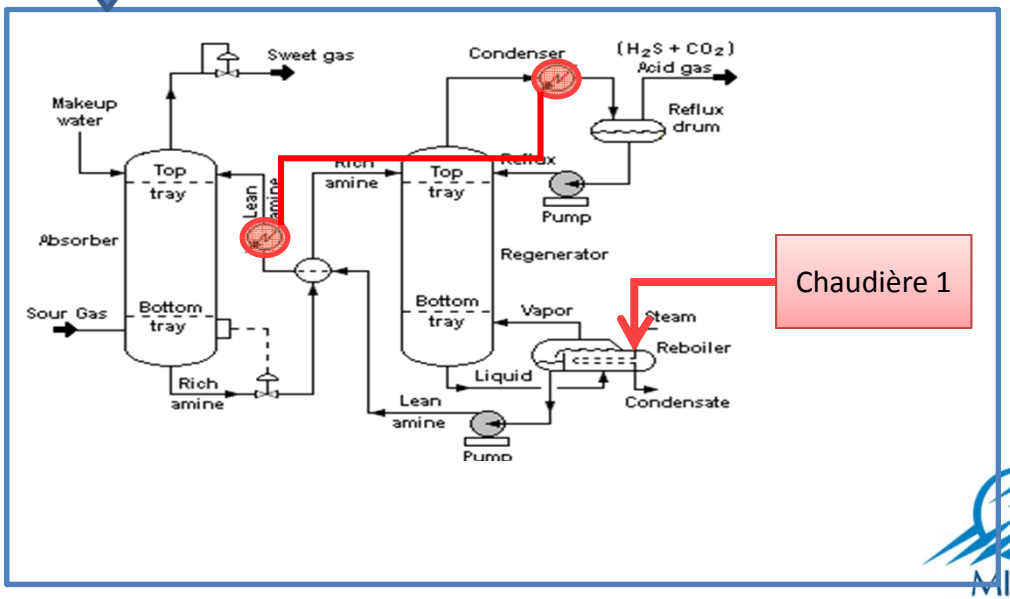
Energy integration - example



Energy integration algorithms

MILP solvers



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Plugin

- Why not a NMPC plugin ?
- Parameter identification

FUTURE DEVELOPMENTS

First developments

- FMI compliance
- Parallelization
- Gradient based methods

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DEMONSTRATION

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INTERESTED IN ?

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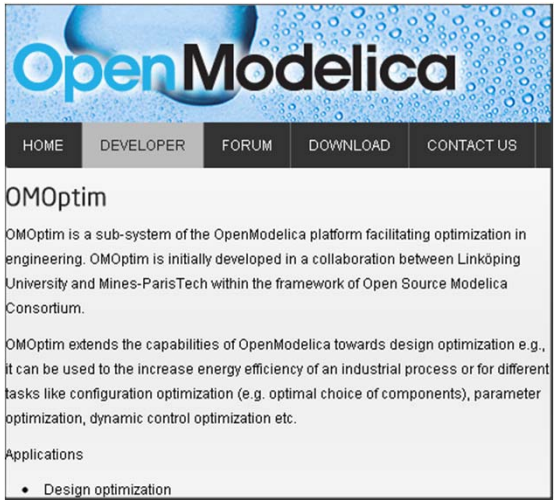
- Website
  - www.openmodelica.org



- Source code

  https://openmodelica.org/svn/OpenModelica/trunk/OMOptim/

- Mail

  hubert.thieriot@mines-paristech.fr

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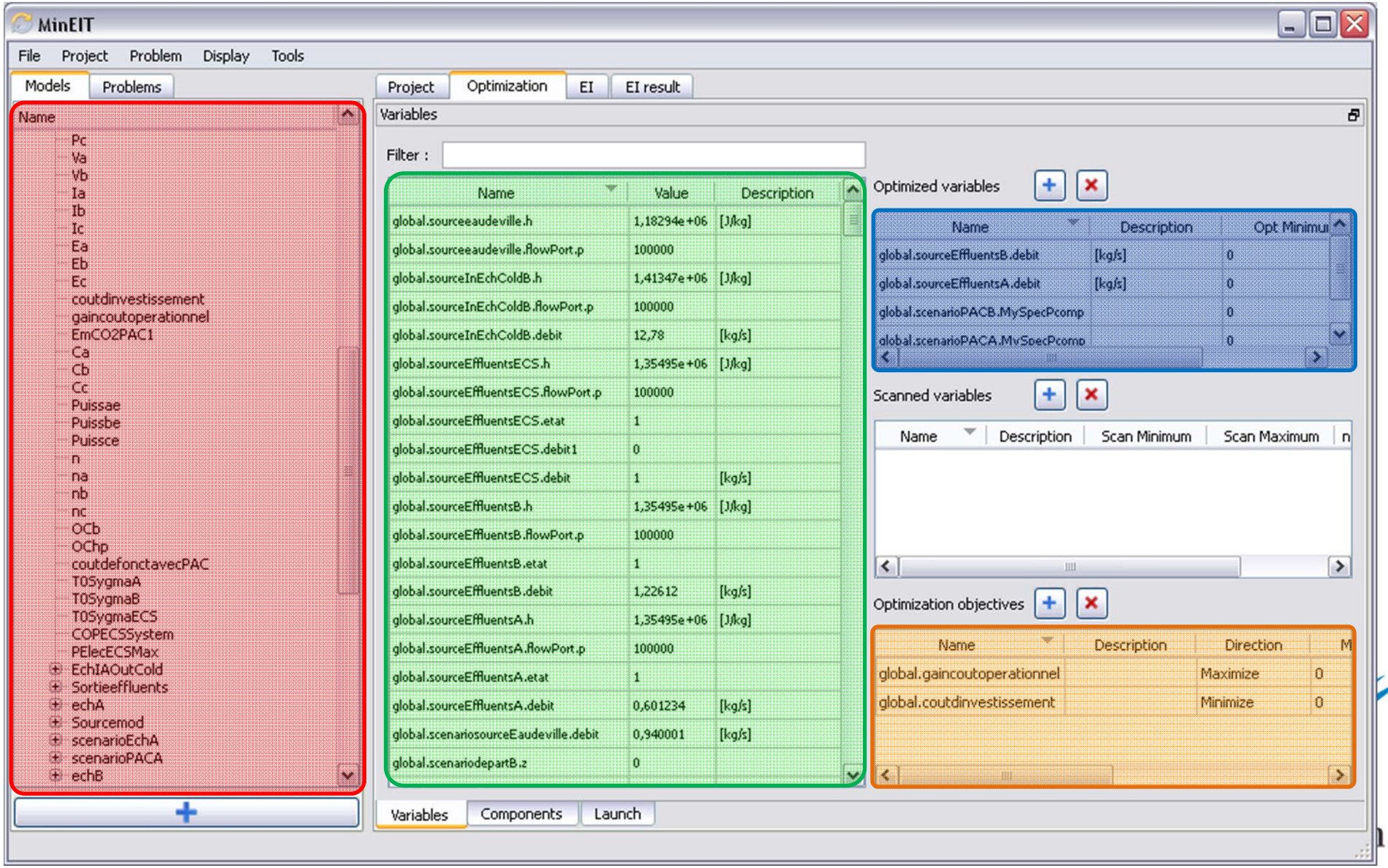
THANKS FOR YOUR ATTENTION

Model structure

Model Variables

Optimized parameters

Optimized Objectives

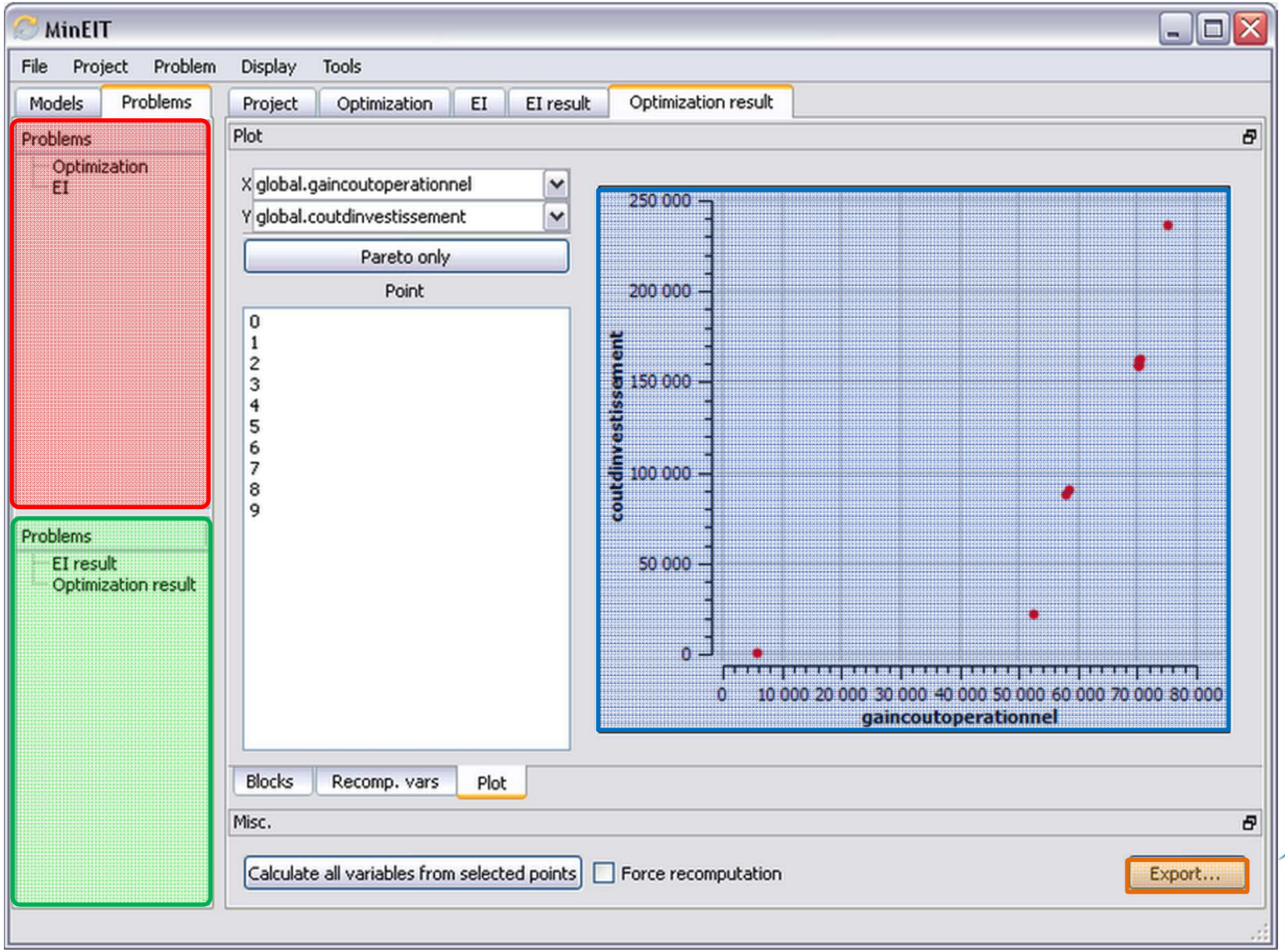


Problems

Solved problems

Result plot

Export result data .csv



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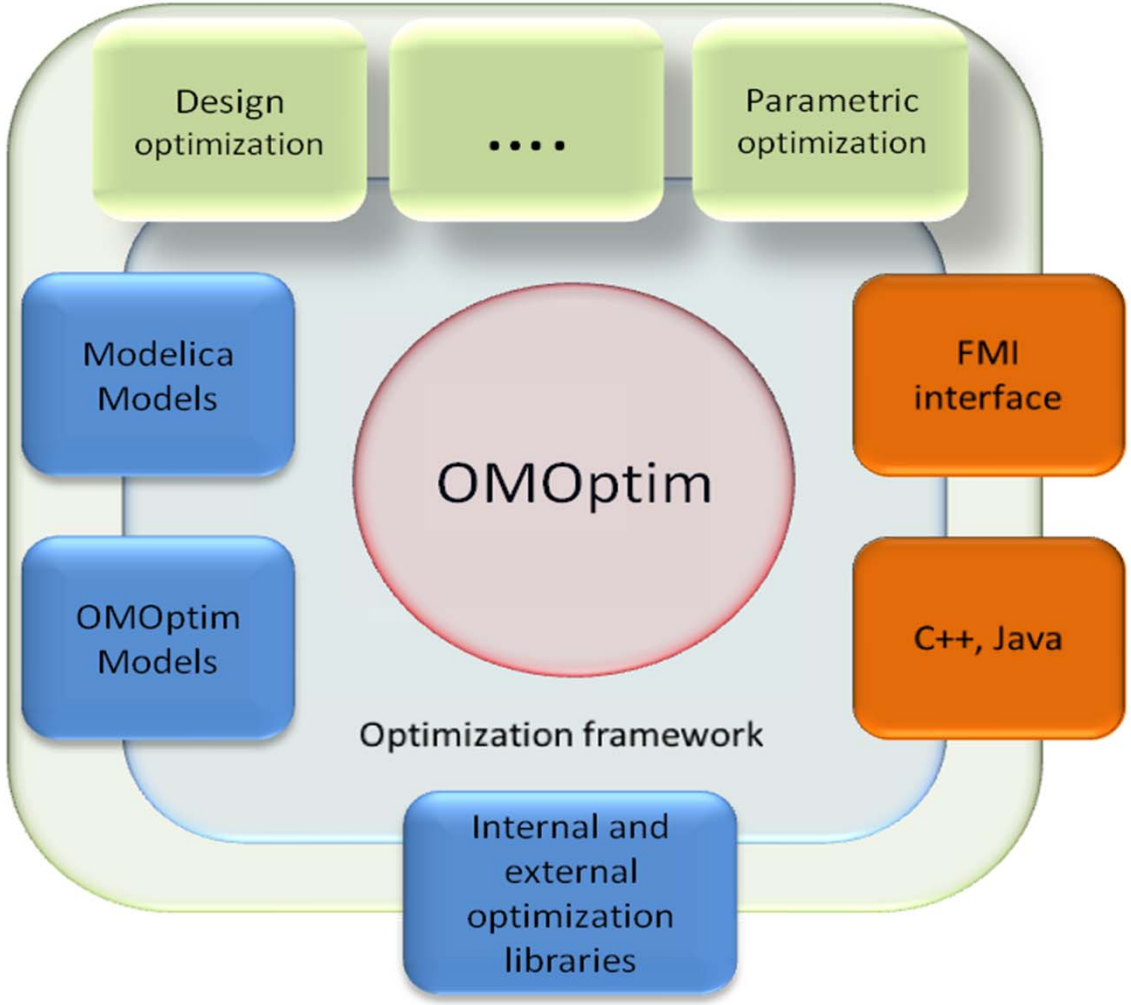

Top-level conceptual view of OMOptim and its interfaces

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To be done …

- Finalize OMOptim **structure**
- Strengthen **link** Simulation – Optimization
  - Derivative information
  - Structural change
  - Parallelization
- Organize **sharability** of optimization functions

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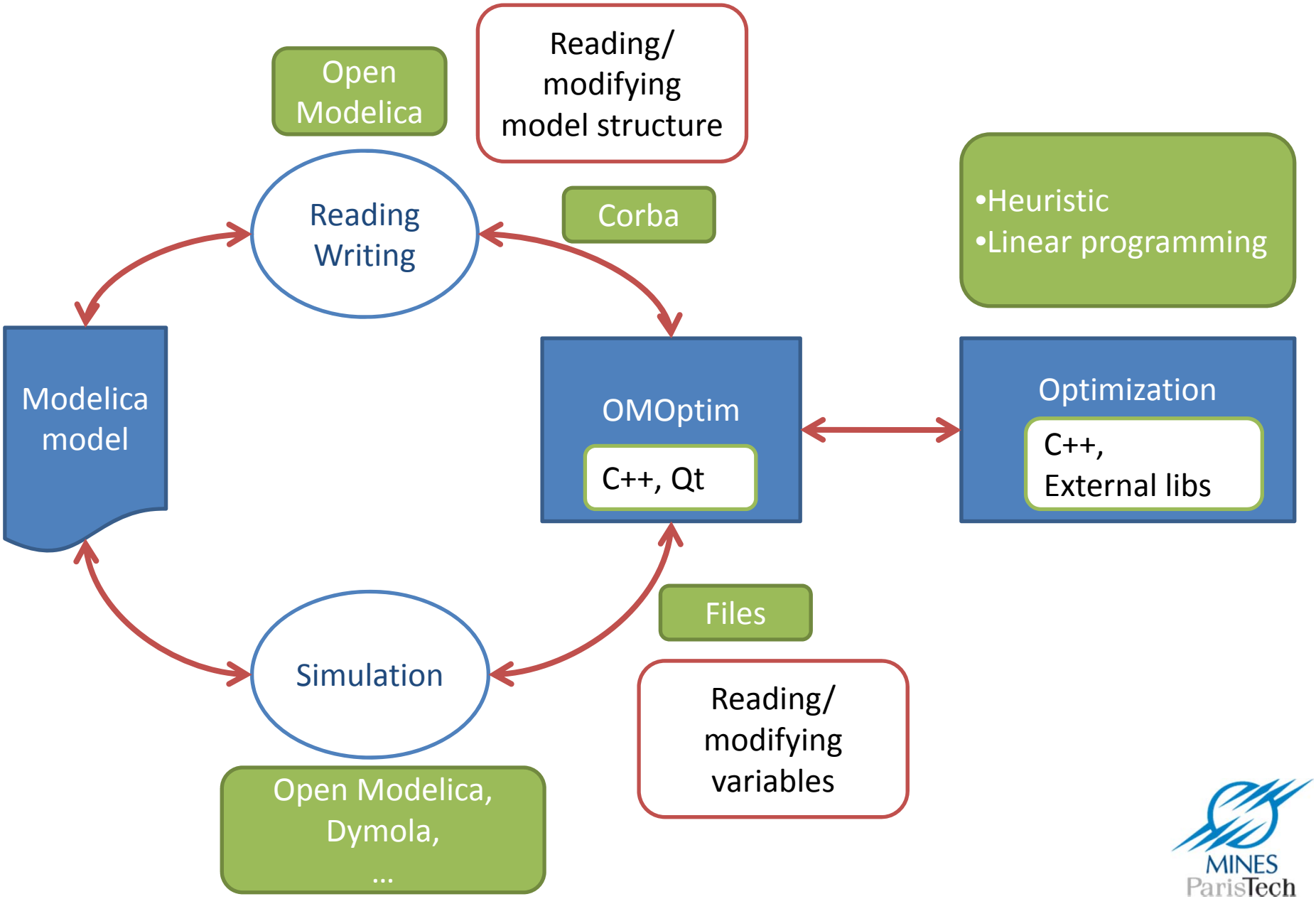

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