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Improving configuration and planning optimization: Towards a two tasks approach.

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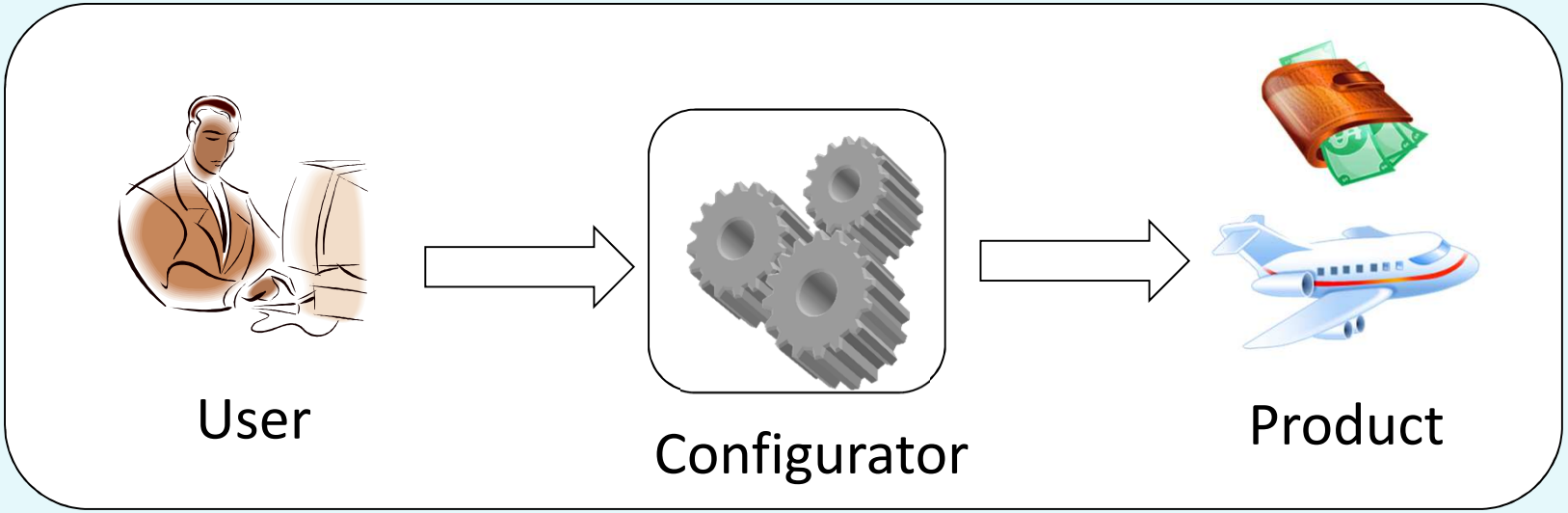
Overview

- Work situation
- A very simple example and a normal one
- Goal of the paper
- Results: large problem
- Results: optimizing with a zoom
- Conclusions

Work situation

Product configuration and project planning

⇨ Configuration : Selection of product components/alternatives



⇨ Many studies about aiding product configuration

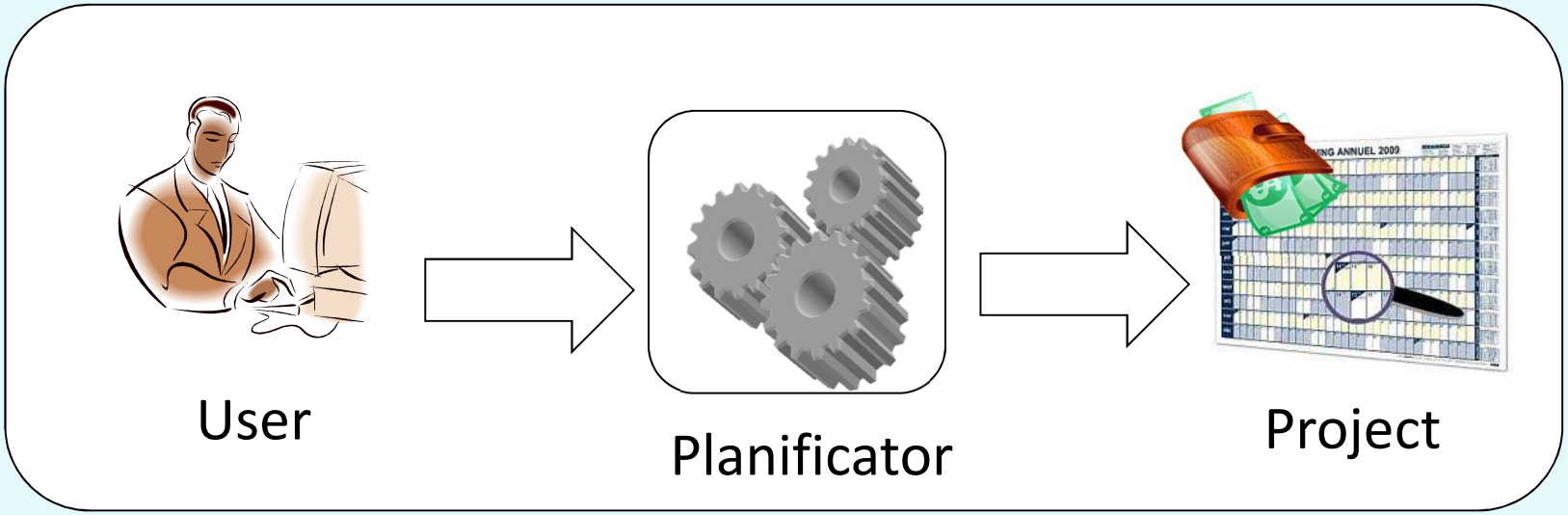
- Among them : constraint based approaches

  [Tsang 1993], [Mittal and Frayman 1989], [Sabin and Freuder, 1996]….

Work situation

Product configuration and project planning

⇨ Planification : Selection of project alternatives



⇨ Many studies about aiding project planning

- Among them : constraint based approaches

[Dechter and al. 1991], [Laborie 2003], [Mouhoub et al 2005], [Bartak 2010]…

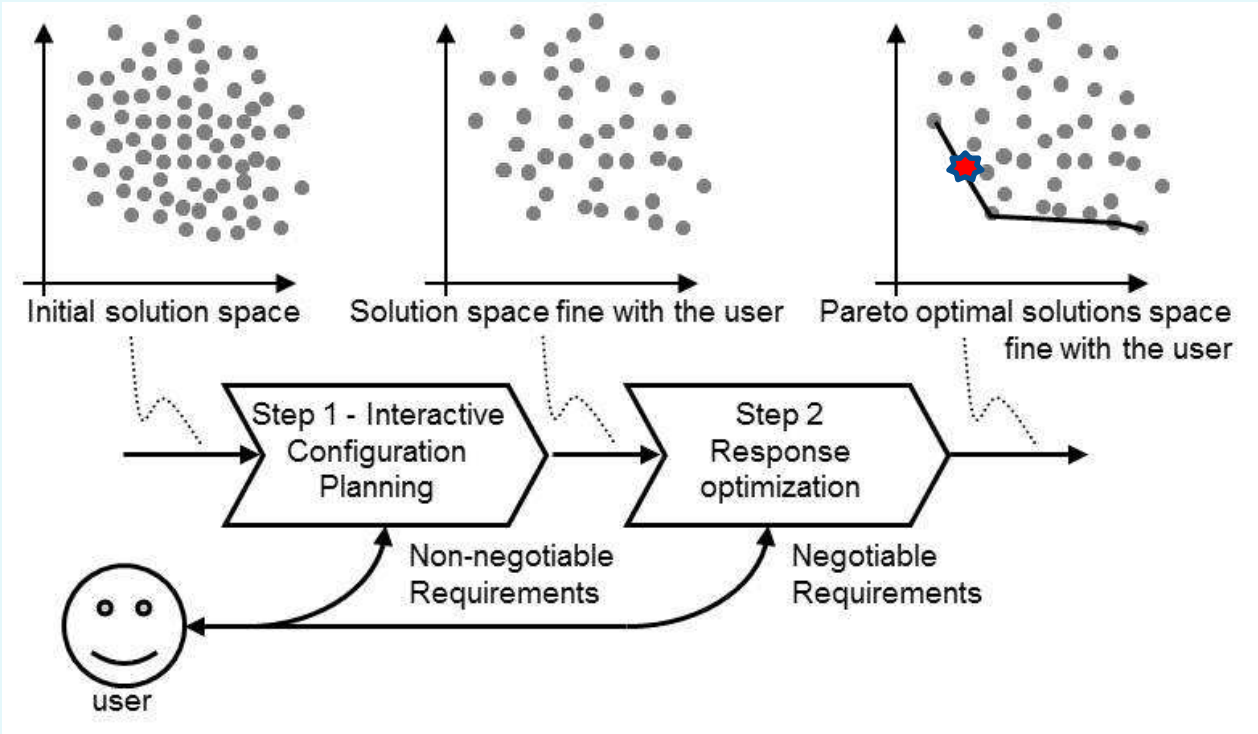
Work situation

- Very few studies
  - Mixing them : [Steward Tate 2000]
  - Optimizing them : [Hong et al 2008, Pitiot et al 2010]
- Our goal : Optimization of configuration **AND** planning
  Some experimental results

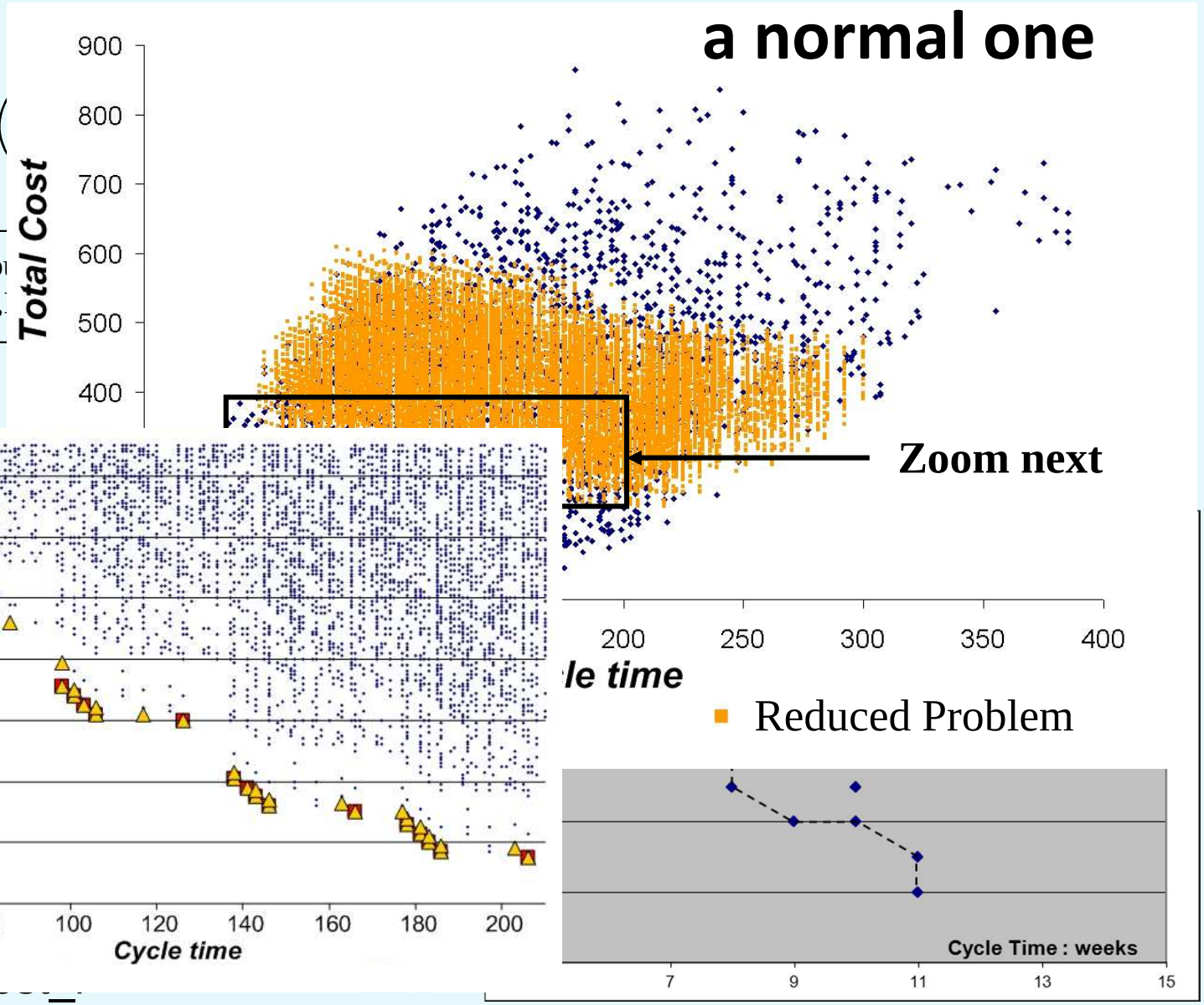
Work situation

- An approach that allows previous interactions :
  - Step 1 : Constraint based interactive configuration and planning
    - ➢ Non negotiable requirements
  - Step 2 : Evolutionary algorithm to find “best” solutions considering antagonist criteria : cost/cycle-time*(Pareto front)*
    - ➢ Negotiable requirements

Example : private aircraft



Work situation : a very simple example

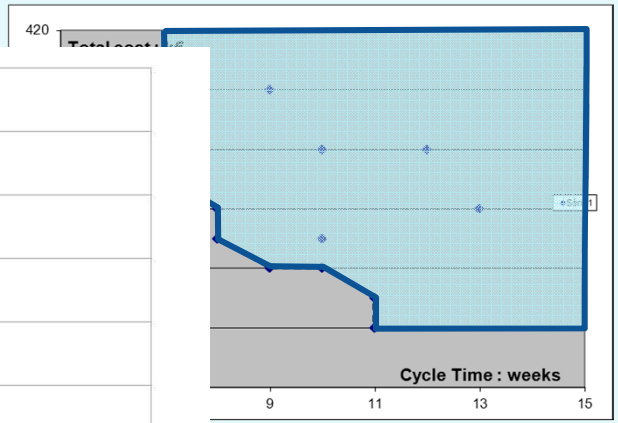


Goal of the paper

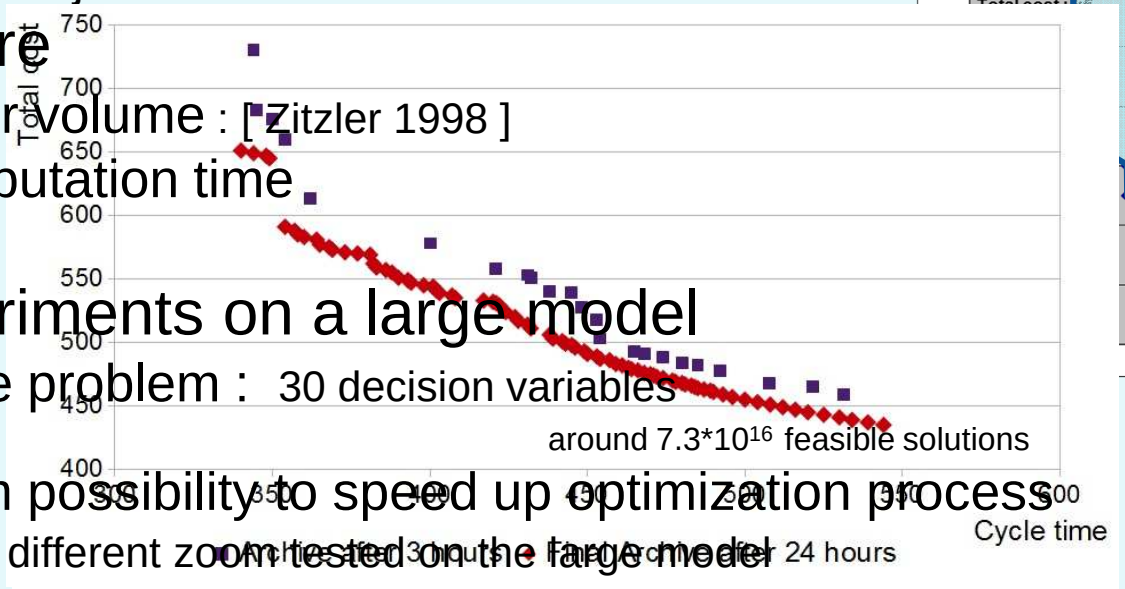
- Present optimization results relevant to this problem
  - Constraints Filtering Based Evolutionary Algorithm (CFB-EA)
- Compare :
  - Single shot “long” optimization using CFB-EA
  - Two tasks optimization : “short” global and zoom

See the paper for details

  - ➢ A first “short” global optimization
  - ➢ Selection of an interesting area by user
  - ➢ Continue optimizing just on zoomed area by adding constraints on objective variables

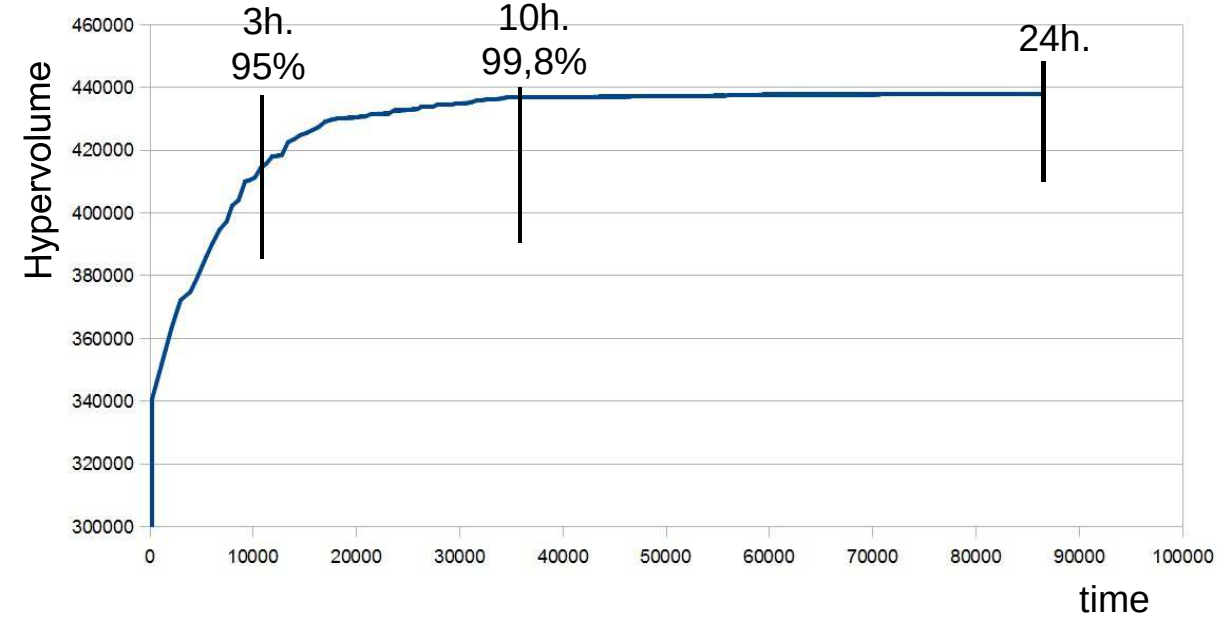


- Measure
  - Hyper volume : [Zitzler 1998]
  - Computation time



- 3 experiments on a large model
  - Large problem : 30 decision variables
  - Zoom possibility to speed up optimization process
  - 3 different zoom tested on the large model

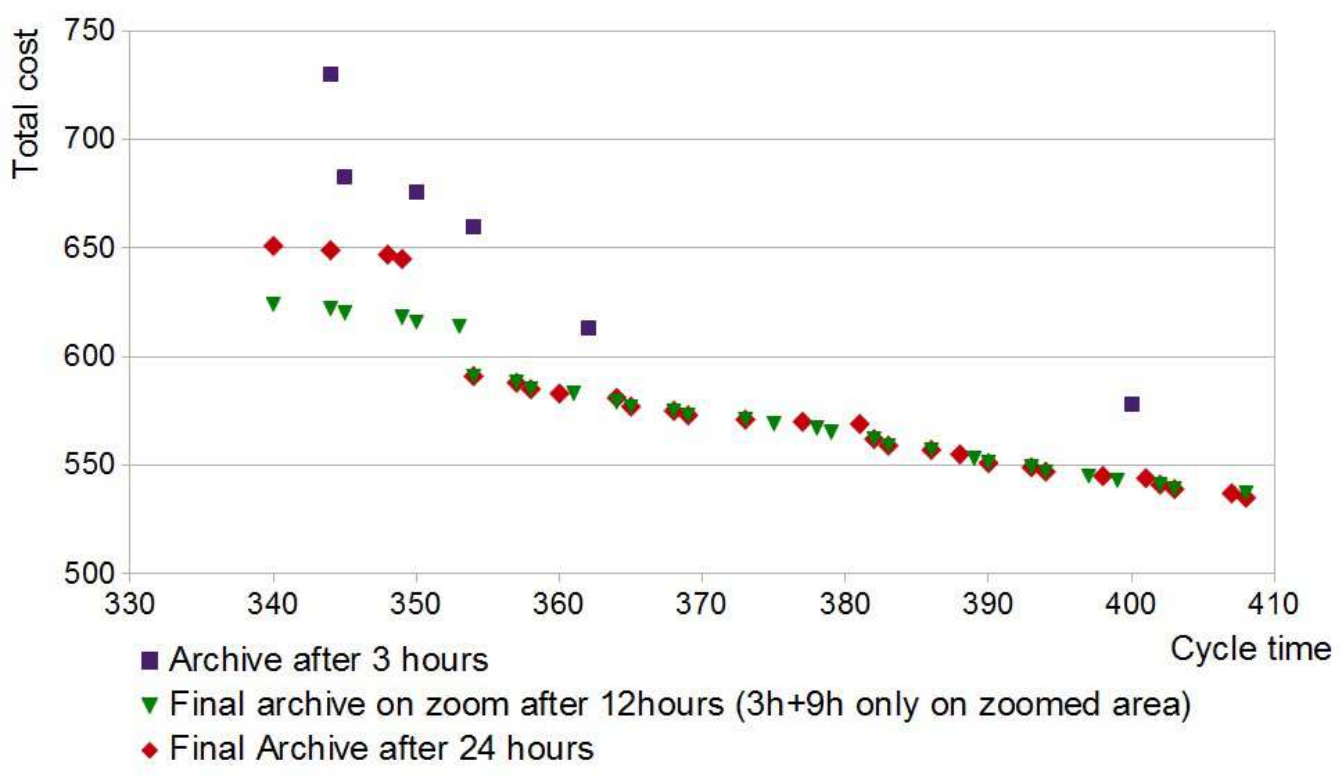
Results: large problem



- Large problem solution space around 10^{16}
  - 95% of final score in 3 hours
  - 99.8% of final score in 10 hours
- Operational interest

  - For large problem : proposed EA approach is competitive
  - A good approximation is founded relatively quickly

Results: optimizing with a zoom

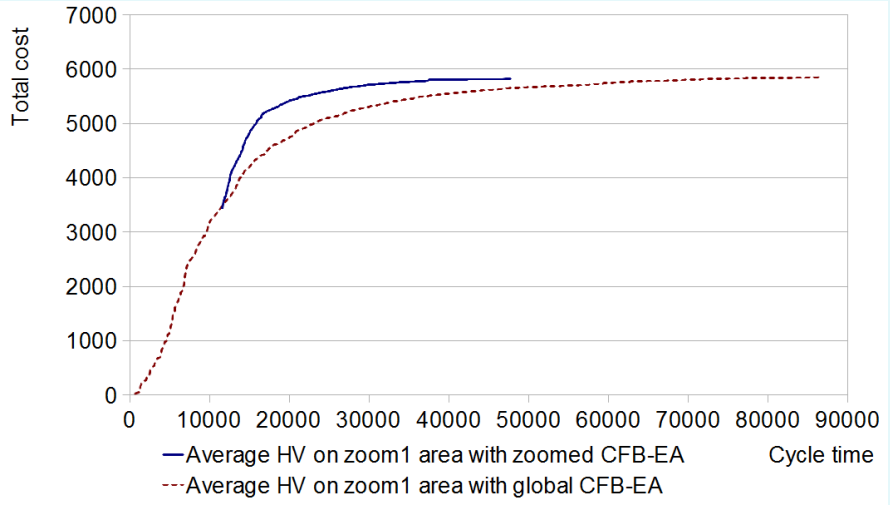


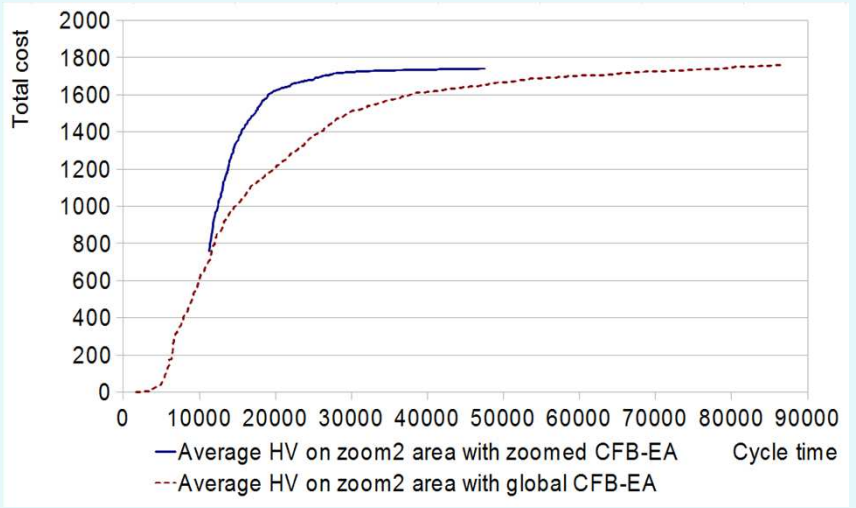
- Idea is : break optimization in 2 steps
  - compute quickly a low quality Pareto
  - select the area that interest the customer
  - compute a second Pareto on the restricted area.
- Results

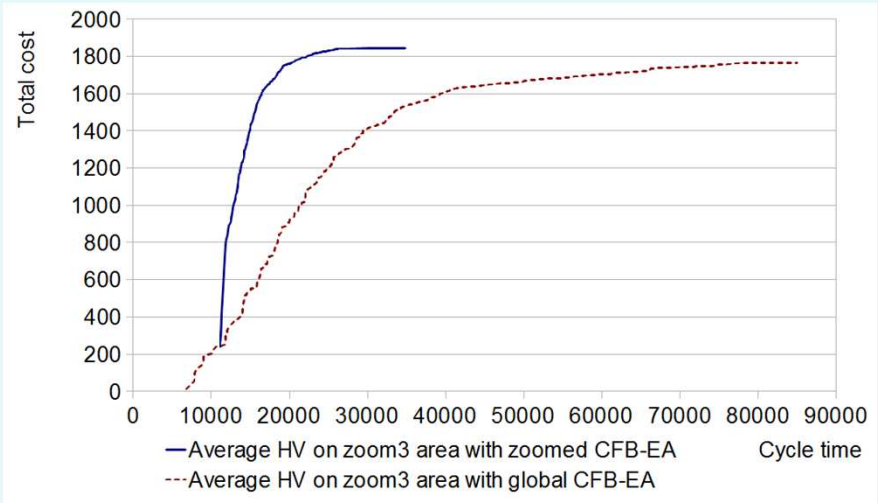
  2 optimization steps of 3+ 9 hours

  almost equivalent to a single optimization of 24 hours

Results: optimizing with a zoom







- Results
  - obtaining a similar performance with respect to single-shot one
  - in around half of computing time

Conclusions

- Product configuration and production planning can be considered and optimized simultaneously
- Proposed specific EA algorithm works well and can deal with rather large model
- Zoom possibility seems interesting to get results quicker or to consider larger models
- Hybridation with local optimization algorithms

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Thanks for your attention….

Questions ???

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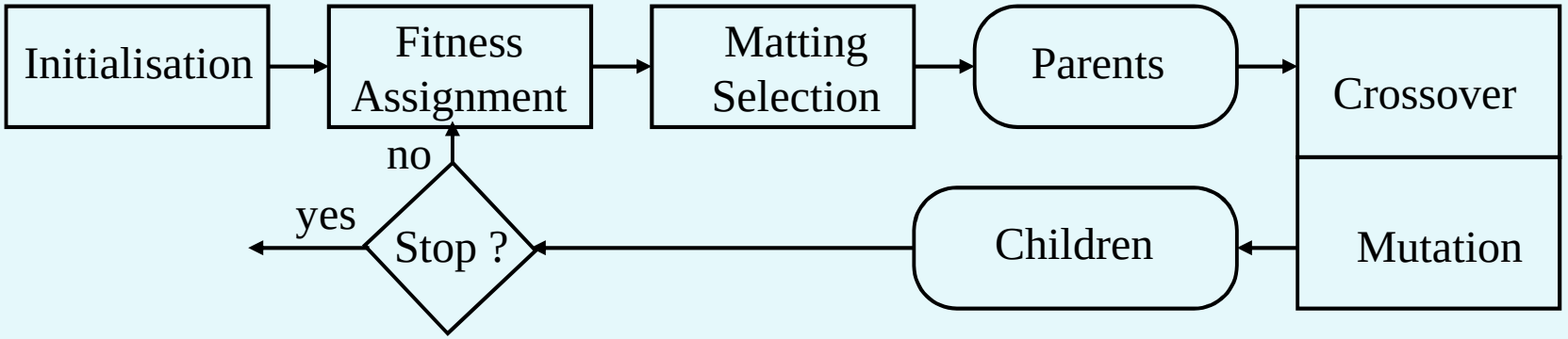
Results: optimizing with a zoom

		Single-shot CFBEA	Two-task CFBEA	gap in %
Zoom1	Average Final HV	5849	5823	-0.4
	Average HV RSD	3.8%	5.1%	
	Total time	86400(24h)	47996 (≈13h)	-44.6
	Total time RSD	0	15%	
	Max HV	6043	6057	0.2
Zoom2	Average Final HV	1758	1740	-1.
	Average HV RSD	2.1%	2.3%	
	Total time	86400(24h)	48501 (≈13.5h)	-44
	Total time RSD	0	16%	
	Max HV	1795	1776	-1
Zoom3	Average Final HV	1765	1844	4.4
	Average HV RSD	3.16%	0.07%	
	Total time	86400(24h)	38185 (≈10.5h)	-55.9
	Total time RSD	0	26%	
	Max HV	1831	1845	0,7

SPEA-2 [Zitzler et-al 2001]



SPEA-2 + Constraint filtering [Pitiot et-al 2008]

- Approach for constrained problems [C. Cuello Cuello]

  Penalty function, repair methods, specific operators…
- Proposition : Specific operators that prune search space, using CSP filtering, and provide consistent individuals