MASTER THESIS PROPOSAL

Istituto di Tecnologie Industriali e Automazione
Consiglio Nazionale delle Ricerche

TITLE

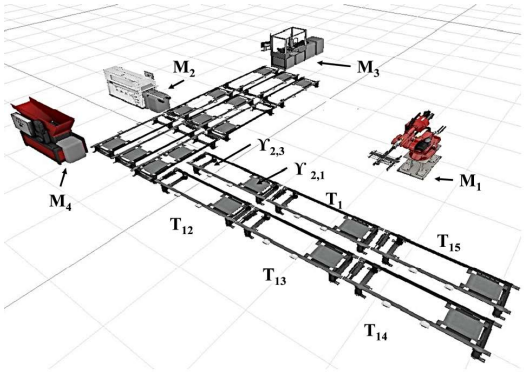
New matheuristic decomposition approaches for a Demanufacturing plant

CANDIDATE CHARACTERISTICS

The thesis is for a master student (*tesi di laurea magistrale*).
The ideal candidate is a Master student of either Mathematical Engineering (with an Optimization Curriculum) or Automation, Information and Electronic Engineering.

STATE OF THE ART

Model Predictive Control (MPC) is an advanced optimization technique for the on-line control of dynamic systems, which is widely used in the process industry for its ability to cope with constraints and multiple objectives.
In manufacturing, MPC has been already applied to a number of different problems, e.g., supply chain optimization and control.
However, the diffusion of MPC in manufacturing has been partially hampered by the intrinsic discrete-event nature of the plants, usually characterized by integer, or even Boolean, control variables, so that large combinatorial optimization problems must be solved quickly for an effective on-line control.
Specifically for the demanufacturing plant located in ITIA-CNR (see Figures), the acceptable time delay between two following control actions to be sent to the system is about 2-3 seconds.
On the other hand, the Integer Programming (IP) formulation cannot be solved within this time and proper decompositions are required to get a solution within the time.



WORK PROPOSAL

Different methods can be used to reformulate/decompose the IP optimization problem.
According to the demanufacturing line, the spatial decomposition is not convenient because a possible constraint violation could lead to unrealistic pallet movements. On the contrary, the temporal decomposition would allow partitioning the prediction horizon in sub-horizons so to solve smaller IP optimization problems.
One of the widely adopted approaches consists on relaxing some constraints by means of the *Lagrangean dualization*. However, this approach seems unappropriated to deal with discrete lines.
Thus, the goal of the thesis are to find out the most proper solution and to develop a new efficient version of the on-line control of the CNR-ITIA demanufacturing plant. Indeed, starting from an evaluation of the *Lagrangean dualization* in this case, the work will consider alternative decompositions that are suitable for discrete lines.

DURATION

The expected duration of the thesis is about 6-8 months.

PARTNERSHIP

This is a joint Thesis Project in collaboration with:

- **Politecnico di Milano, DEIB, Milan, Italy;**
- **Consiglio Nazionale delle Ricerche (CNR), Istituto di Tecnologie Industriali e Automazione (ITIA), Milan, Italy.**
- **Consiglio Nazionale delle Ricerche (CNR), Istituto di Matematica Applicata e Tecnologie Informatiche (IMATI), Milan, Italy.**

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