

A multi-layer approach of interactive path planning for assisted manipulation in Virtual Reality

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Context

Industrial motivation

While designing products with the Product Lifecycle management (PLM) approach, the tasks involving manipulations by a human operator can be simulated in Virtual Reality (VR) applications. One of the main issues for most of such tasks is to find path for systems components to move.

Path finding tools

Off-line simulation

Path planners from robotic research field.
Computation time for highly integrated systems.

On-line simulation

Manipulation in VR assembly applications.
Environment hard to handle for human operator.

Assisted VR assembly

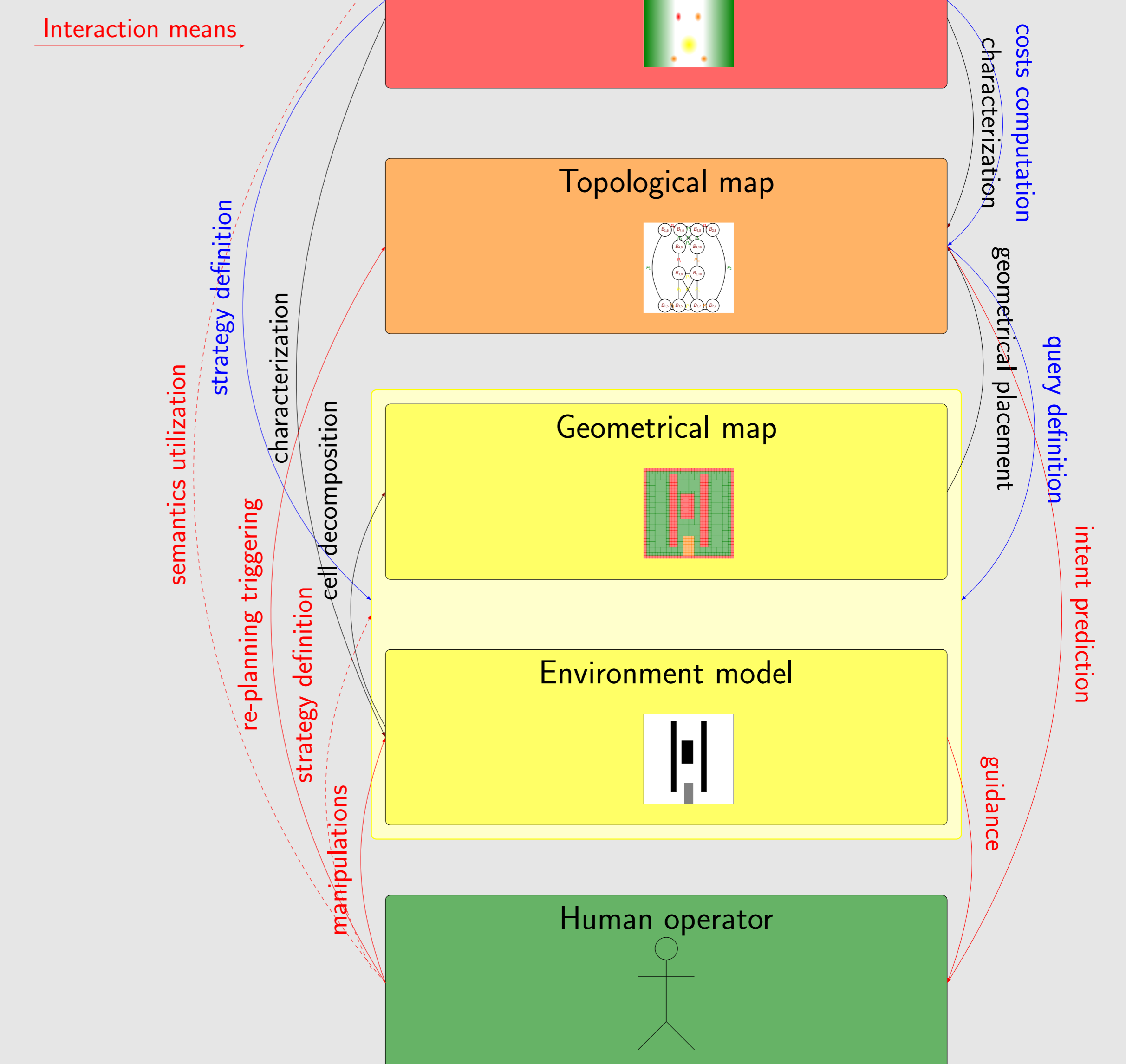
Use an automatically planned trajectory to guide human operator immersed in VR application.

Proposition

Environment modeling

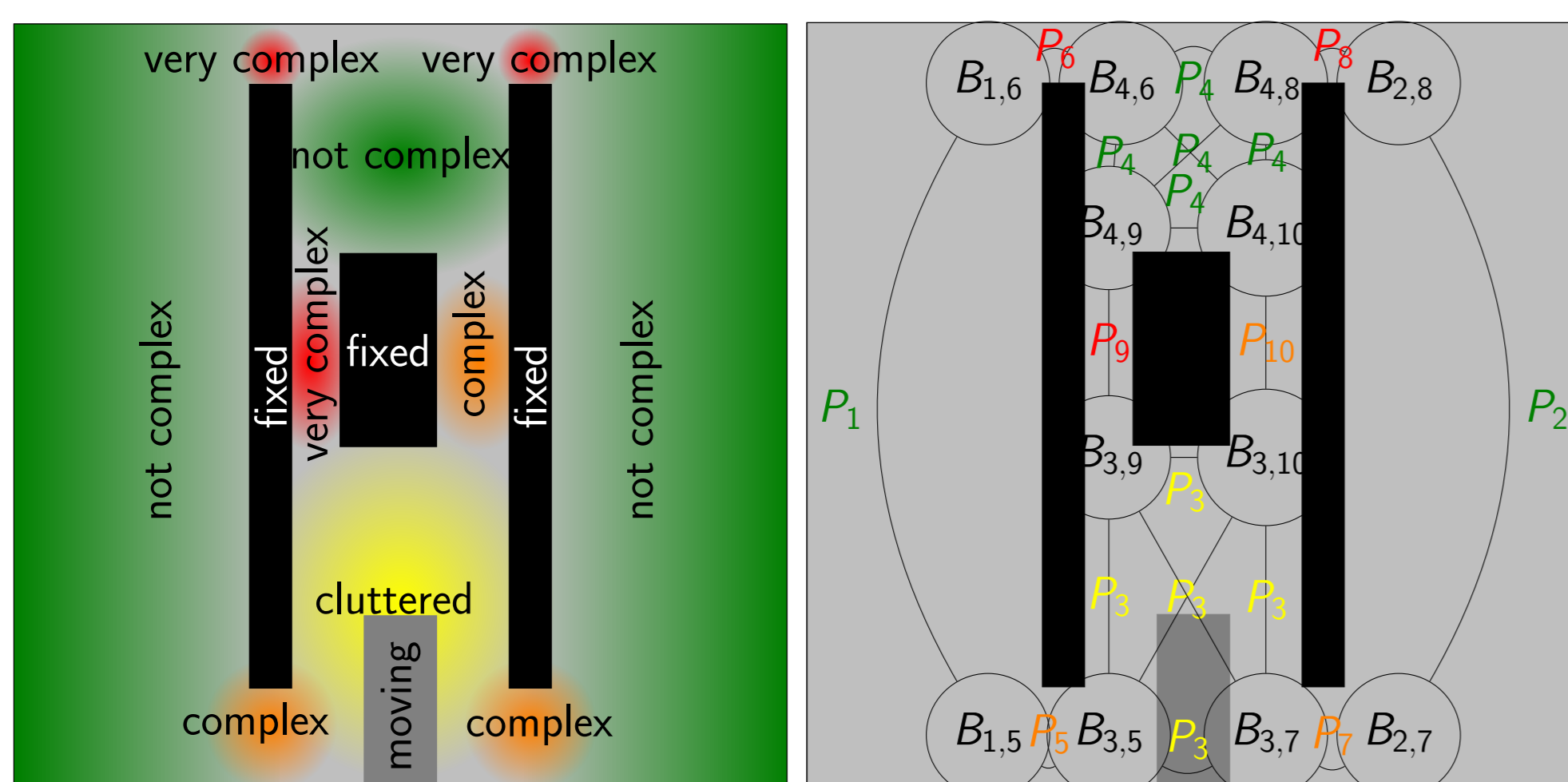
Path planning

Interaction means



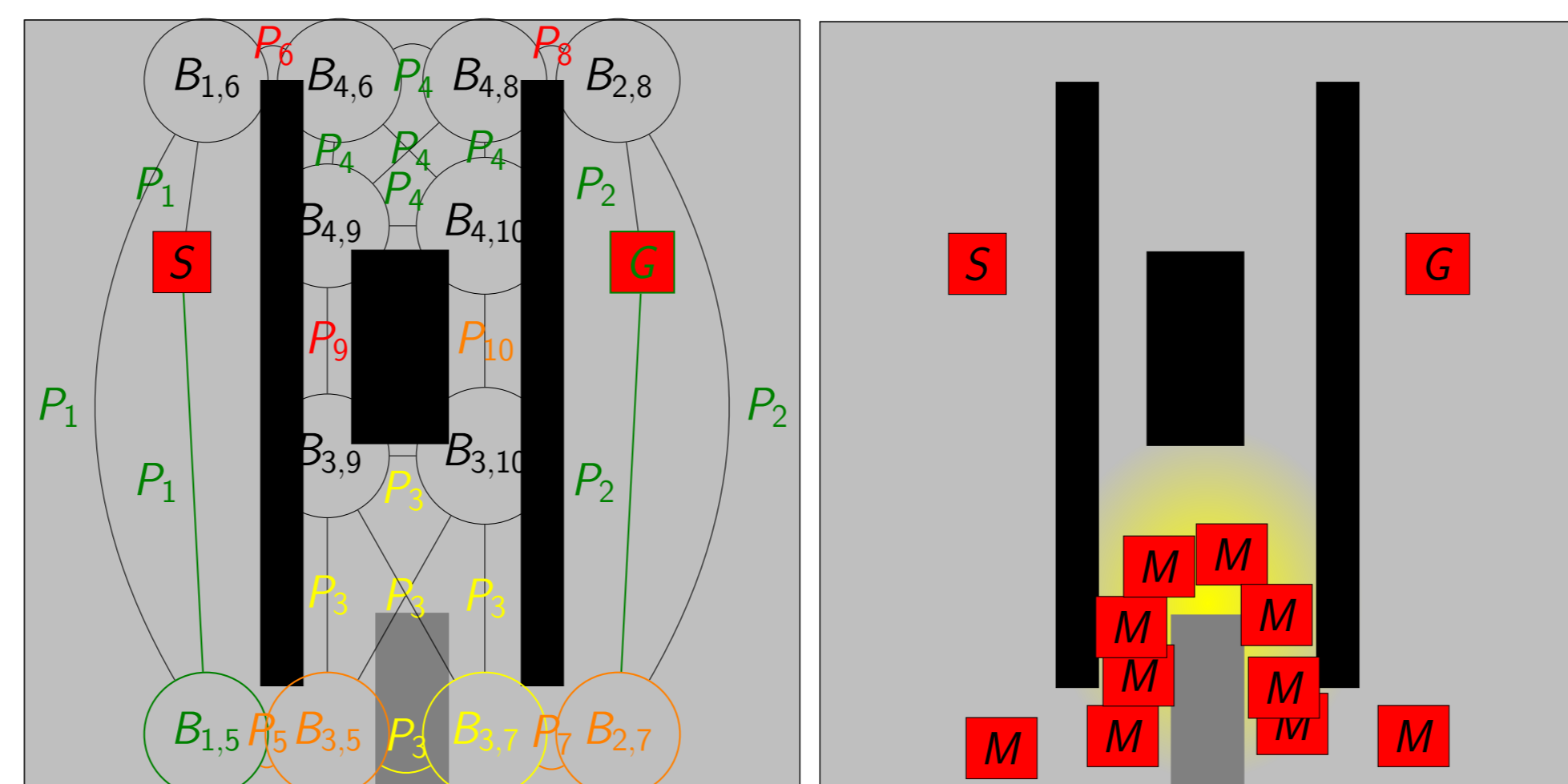
Contribution

Multi-layer environment model



- **Semantics** characterizes places and obstacles.
- **Topology** represents places, borders and their connectivity.
- **Geometry** describes obstacles and free space.

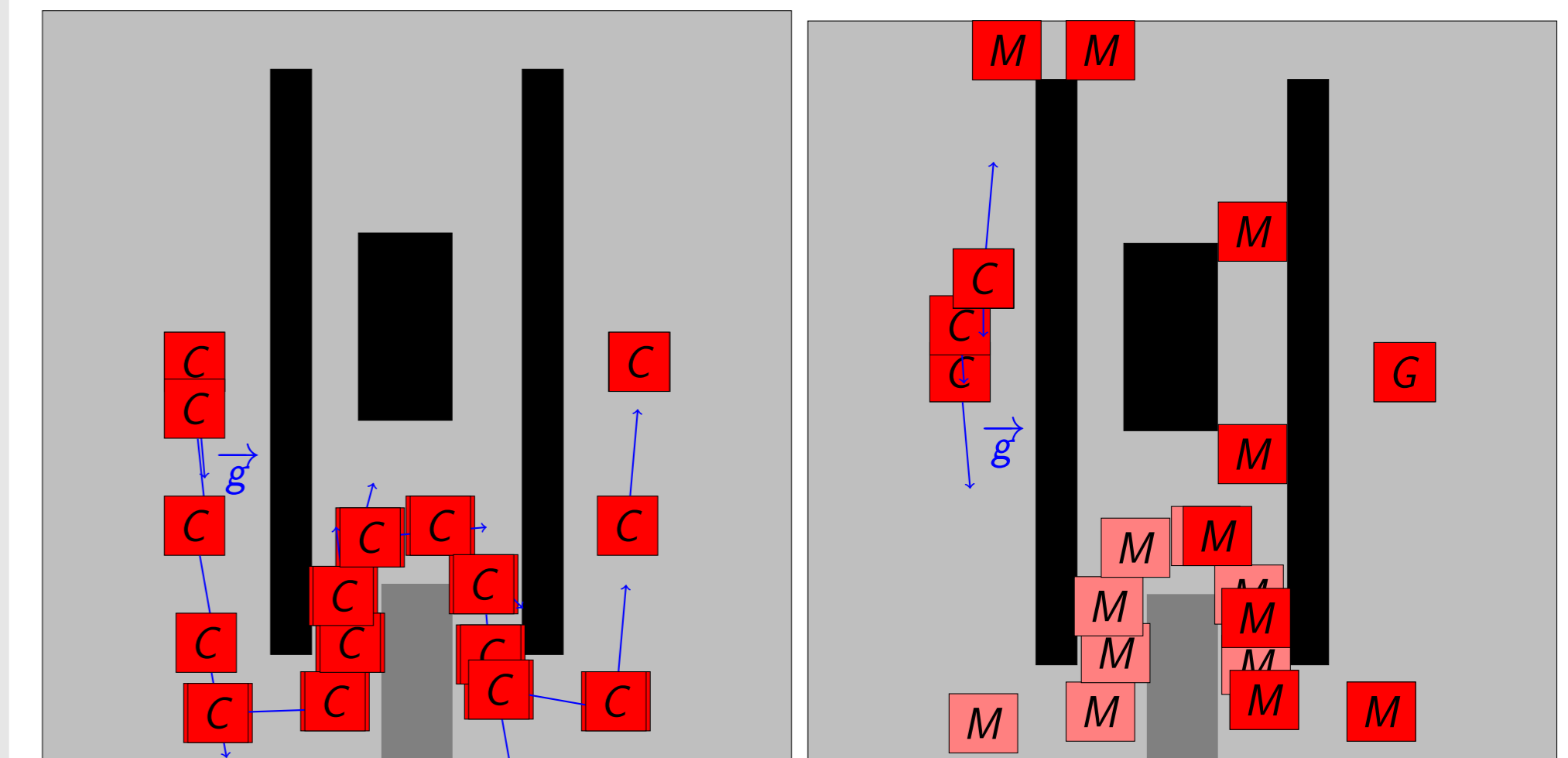
Planning process



A two phases path planning process involving both semantic information :

1. **Coarse planning** defines a path in the topology and split it in steps. Semantics controls the topology exploration.
2. **Fine planning** defines the geometrical path crossing each step. Semantics chose the planning technique.

Interaction and control sharing



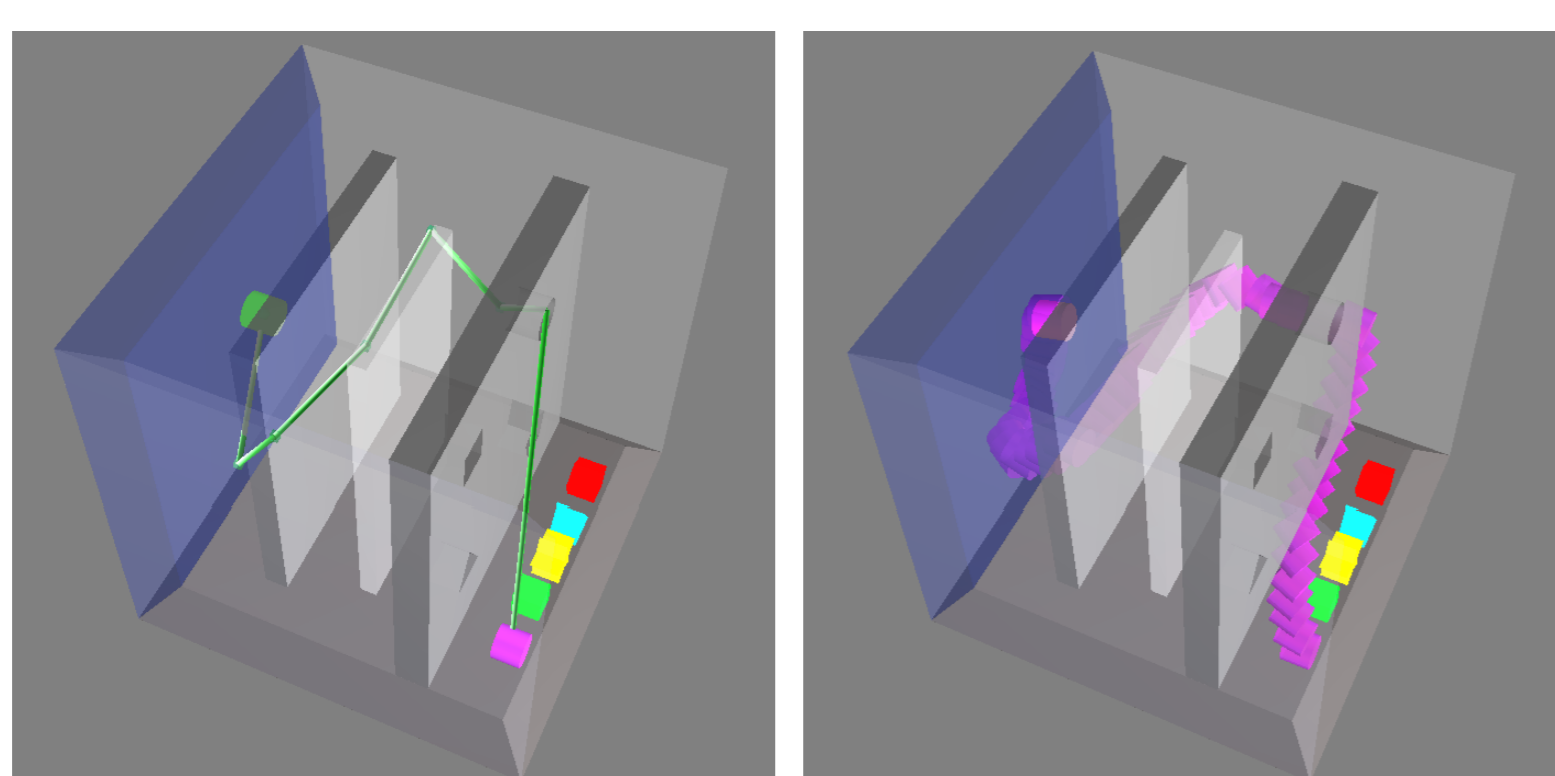
- Operator's actions are used to define **Semantics** utilization for cost functions and planning techniques
- Operator intent is predicted at **topological** level and used for path re-planning
- Authority is shared between automatic planner and human operator for **geometrical** manipulation

Results

Path planning 3D environment



Guidance following planned trajectory



Operator control planned trajectory

