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.

Contribution

Multi-layer environment model

Planning process

Interaction and control sharing

Proposition

Environnement modeling
Path planning
Interaction means

Semantic map
Topological map
Geometrical map
Environment model
Human operator

- 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

Environment modeling

Interaction means

Path planning

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.

Results

Path planning 3D environment

Guidance following planned trajectory
Operator control planned trajectory

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