Improving Process Planning for Largescale Industrial Applications

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Where We’re Going

- **Limitation of Descartes Light**
  - Constrains size of workpieces
  - Slower Process

- **SwRI ROS-I Team’s Enhancements**
  - Structural Changes
  - New algorithms
  - Ongoing work

- **Unlocking New Capabilities**
Key Terms

• **Motion Planning**: change target positions into robot motions
  - Graph Searching
  - Joint Space Sampling

• **Process Planning**: Motion Planning for robot tool paths
  - Descartes Light is ROS Industrial’s Process Planner
What Limits Motion Planning?

- **Constrained by Memory**
  - Edges grow exponentially
  - All edges must exist

- **Effects of Limitations**
  - Smaller toolpaths
  - Slower process
  - More sensitive toolpaths
  - Separate external axis planning

*Memory limitations are inherent to fully connected graphs*
Enhancements for Descartes Light

- **Employ Boost Graph Library**
  - Systematic development
  - Leverage existing search systems
  - Built in benchmarking

- **Dynamic Graph Construction**
  - Inspired by spatial search
  - Only allocate explored edges
  - Consumes 90% less memory
Search Methods...

- Modified Dijkstra’s Algorithm
  - Depth First Searching
  - Limit graph span

- Modified Rapidly exploring Random Trees
  - Used in free-space planning
  - Stop conditions
    - Time
    - Cost
  - Will converge to optimal solution
  - Expandable
Next Steps

• **Open Motion Planning Library Interface**
  • Leverage more algorithms
  • Basis for benchmarking
  • Empowering further growth

• **Sampling and Evaluating**
  • Configuration aware graph searching
  • Process Consistent position sampling

**OMPL**
The Open Motion Planning Library

*What capabilities do these enhancements enable?*
Applications of Descartes Light 2.0

• **Mobile Robots**
  • Create Dynamic Factory Footprints
  • Flexible tasking
  • Plan large toolpaths with mobile base
  • Operate on large curved geometry

• **Linear Rails**
  • Longer Processes
  • Guarantee Planning Time
  • Consistent Robot Configuration
  • Bias gantry movement
  • Modular planning functions
Conclusion

• **Motivations**
  • Limiting memory limits largescale robotics

• **Enhancements**
  • Rebase onto Boost Graph Library
  • Custom search algorithms
  • Interface with Open Motion Planning Library

• **Horizons**
  • Mobile robots
  • Gantry systems