PR2 navigation with wheeled object(s)

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Introduction

• How can we improve on the hackathon results?
• What are the main criteria for a good planner?
• Starts to get interesting when we add cart params
Considerations for good planning
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• **Soundness**
Considerations for good planning

- **Soundness**
- **Completeness**
Considerations for good planning

• Soundness
• Completeness

• “optimality” (??)
Considerations for good planning

- **Soundness**
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• “optimality” (??)
Considerations for good planning

- **Soundness**
- **Completeness**

<- It’s tough to get both ->

- “optimality” (??)
The Task
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- Amounts to solving the following core problems:
  - Perceiving the state of the cart
  - Articulating the cart with both arms
  - Checking the cart and robot for collisions
  - Combining everything in a new local planner
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- And solving these would be nice too:
  - Visualization (publish cart models, footprints, etc.)
  - Robot+Cart teleop
  - Utils for setting up runs (pose saver and teleop)
Quick overview of the NavStack
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• Plugin-based architecture that alternates between two modes
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  - Global planning: Search a map for a path
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  • Local planning: Issue robot commands to follow path
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I focused mainly on this
The Cart Hackathon Approach
The Cart Hackathon Approach

Is it Sound?

Is it Complete?
First improvement: Articulation
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- Added a method for articulating rigid bodies with both arms
First improvement: Articulation

- Added a method for articulating rigid bodies with both arms
- Created a local planner that picked cart poses from the global plan and sent along to the cart controller

Tuesday, September 6, 2011
Cart Pushing 0.1: havoc!

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Cart Pushing 0.1: havoc!

Is it Sound?... obviously not
More improvements
More improvements

• *Collision detection for the cart*
More improvements

• Collision detection for the cart
• Velocity control of cart (smoothness)
More improvements

- Collision detection for the cart
- Velocity control of cart (smoothness)
- Global plan pruning (no more spin-offs)
More improvements

- Collision detection for the cart
- Velocity control of cart (smoothness)
- Global plan pruning (no more spin-offs)
- Combined velocity filtering (better waypoint tracking)
Is it Sound?
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Sort of... more like “safe”
Is it Sound?
Sort of... more like “safe”

Is it Complete?
Is it Sound?
Sort of... more like “safe”

Is it Complete?
No!? ...so what did we get?
Conclusions

• We can push holonomic (hackathon) carts through buildings with fairly high confidence

• Traded a little soundness for completeness
  • Solution: cart global planner

• What about other carts, chairs, etc?
  • cart_local_planner is a base class for deriving pushing-type controllers
The problem with other carts
The problem with other carts

• *Same idea, but different constraints are different...*
Related Work

- **pr2_pose_saver**
  - $\text{savepose hackathon\_cart\_ready}$
  - $\text{setpose hackathon\_cart\_ready.pps}$

- **pr2_cockpit_teleop**

- **rxplot**
$ rxplot --mode=3d Pose2D/x:y:theta

$ rxplot --mode=2d Pose2D/x:y:theta
Thanks!

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