

# **Robotic Arm Simulator and RRT Motion Planning**

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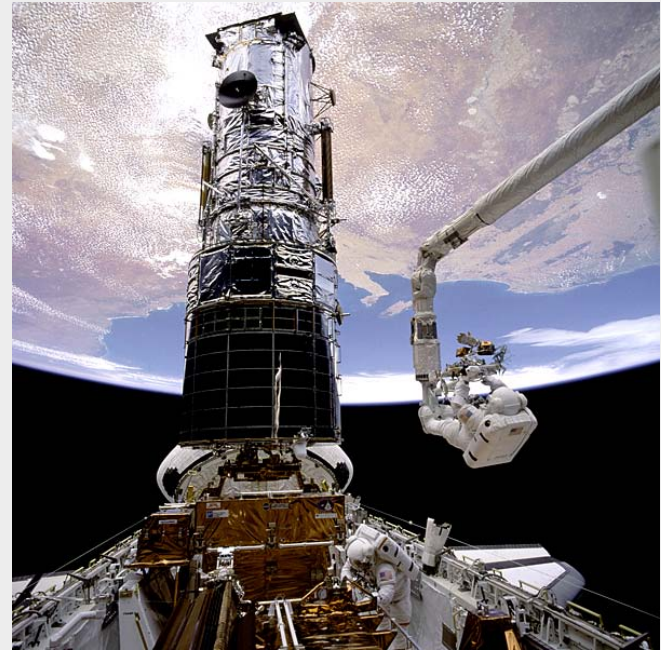
**University of California, Santa Barbara  
Department of Mechanical Engineering**



# Autonomous Robotic Arms



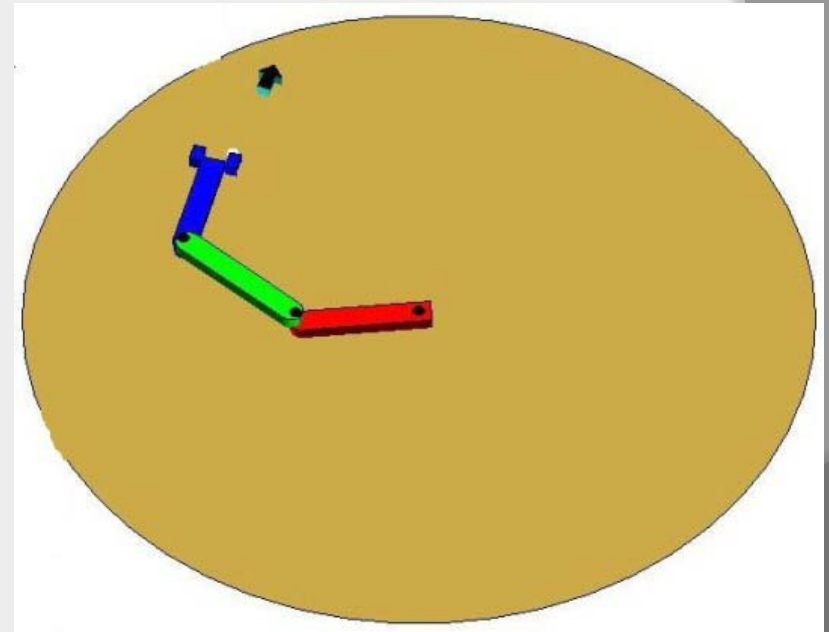
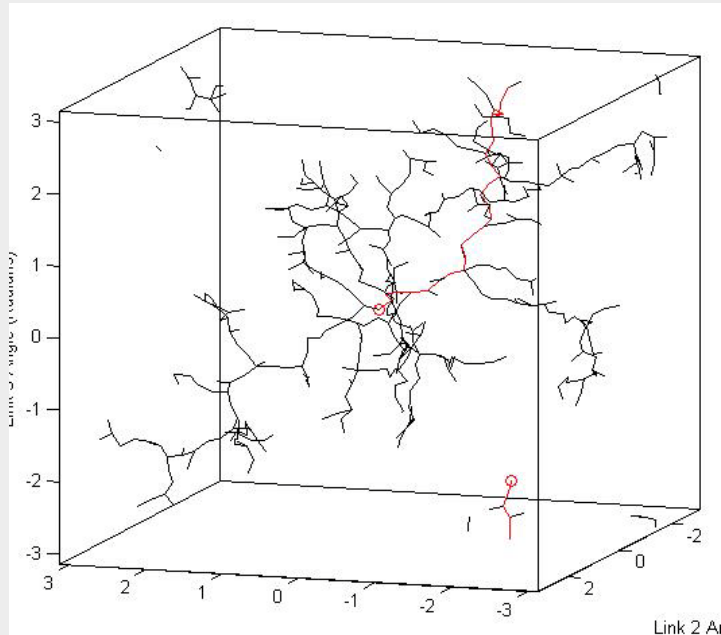
**Manufacturing  
Assembly Lines**



**Space Shuttle**

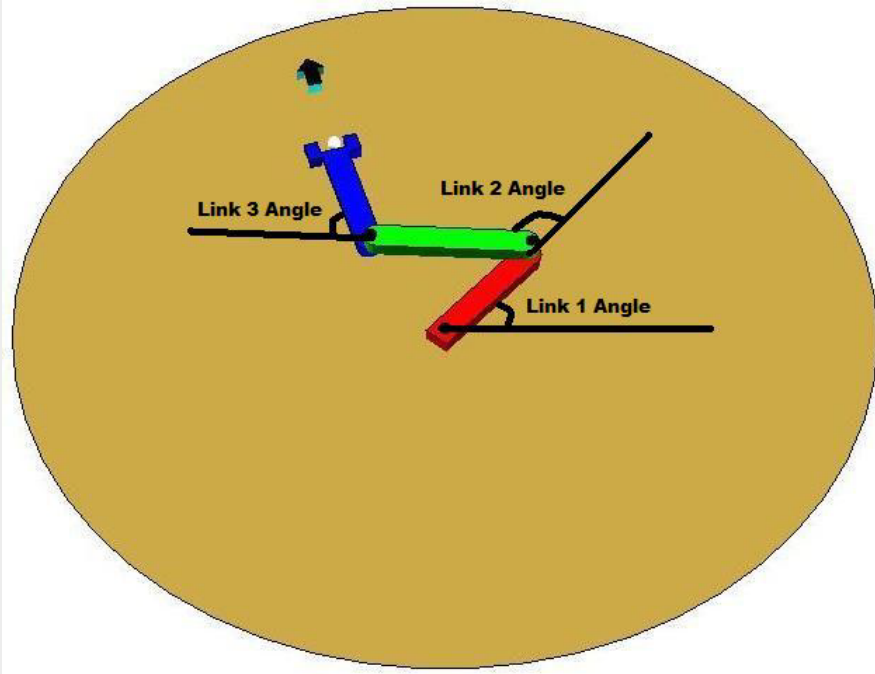
# Project Goals

## Rapidly-exploring Random Tree Motion Planning



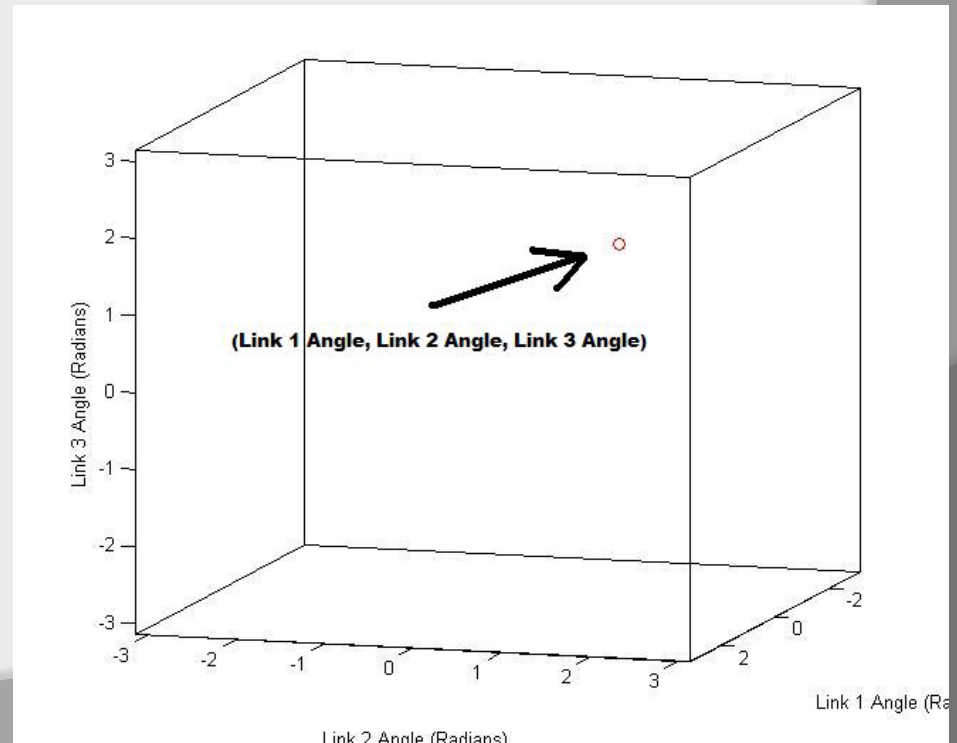
**3-Link Manipulator  
Robotic Arm**

# Workspace vs. Configuration Space

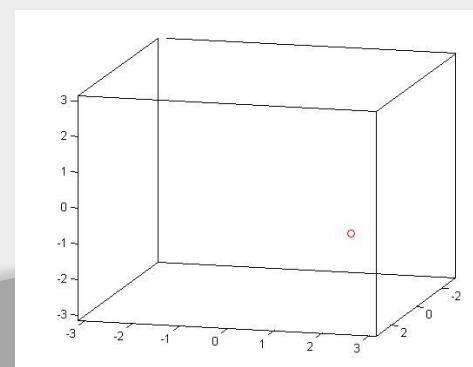
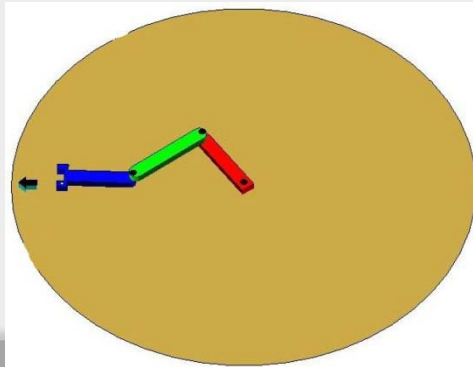
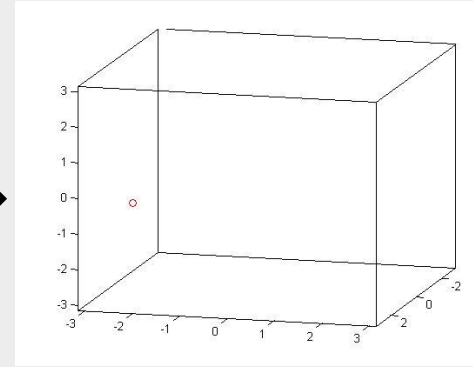
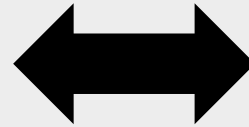
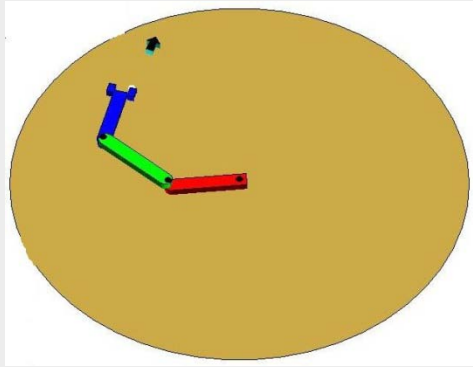
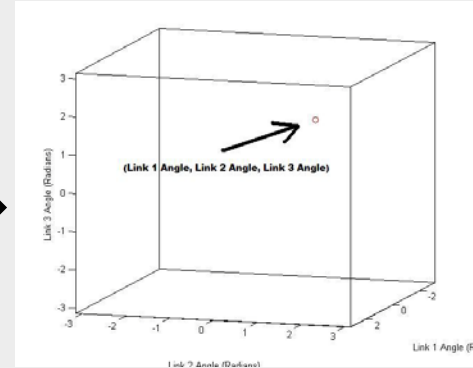
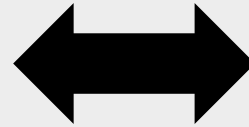
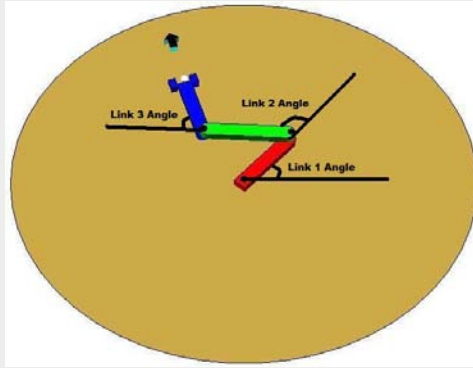


**Configuration Space**

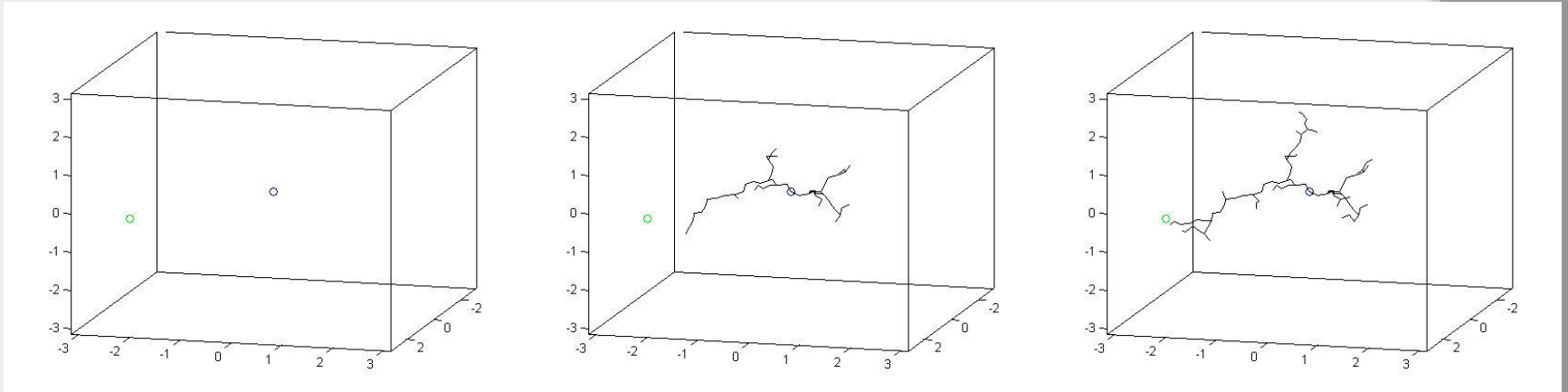
**Workspace**



# Workspace vs. Configuration Space



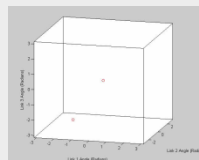
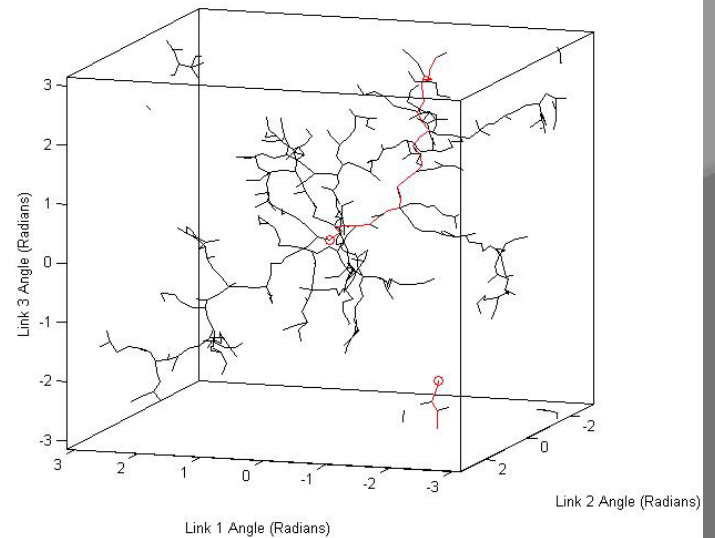
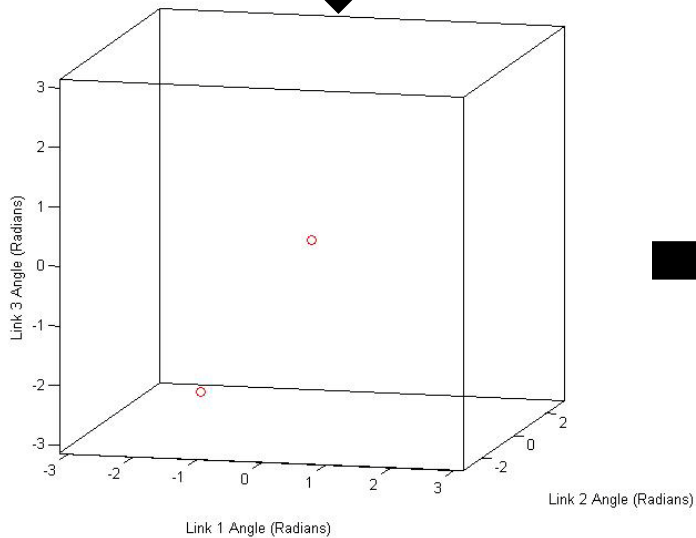
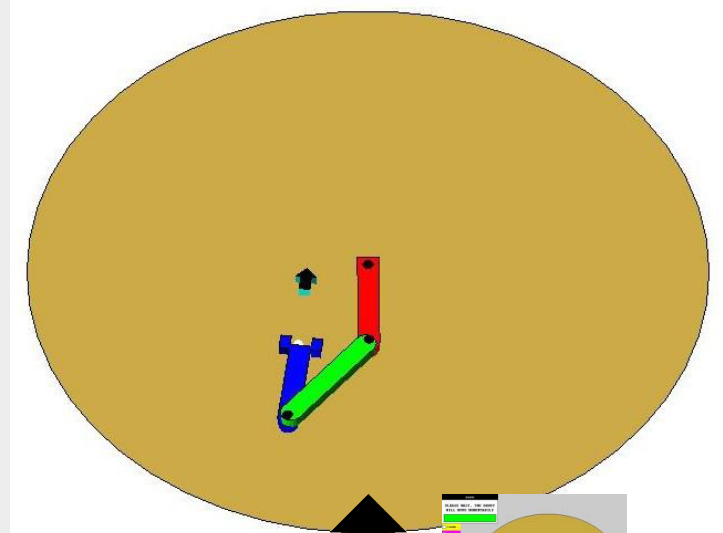
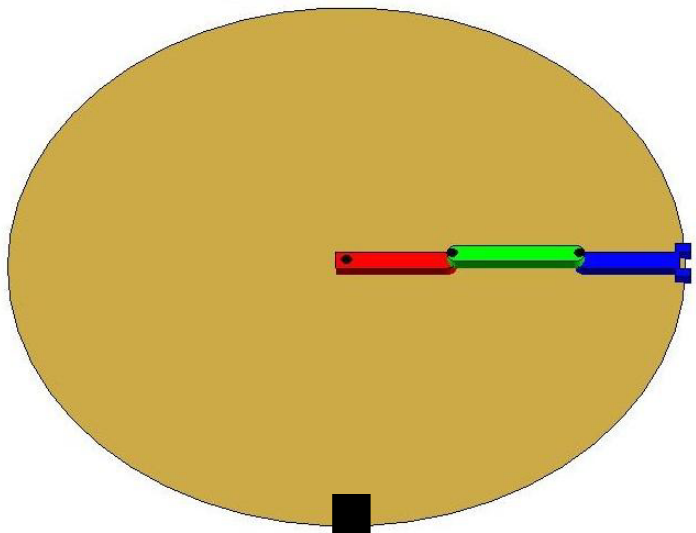
# RRT Algorithm



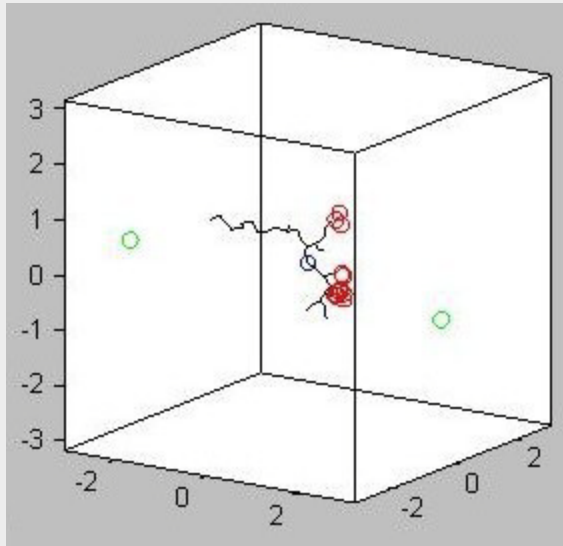
- 1. Select Random Point**
- 2. Find Point in Tree that is Closest to Random Point**
- 3. Create New Vertex in Direction of Random Point**



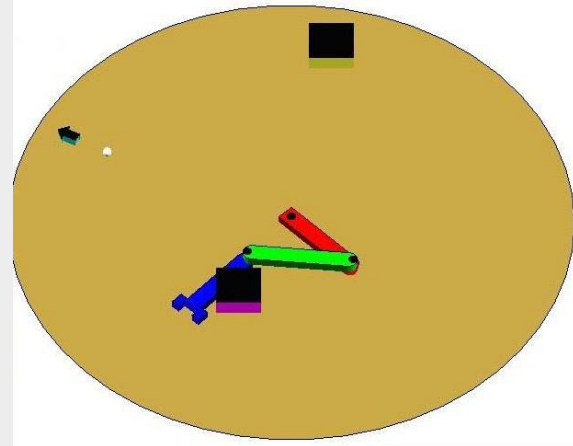
# Motion Planning



# Collision Detection

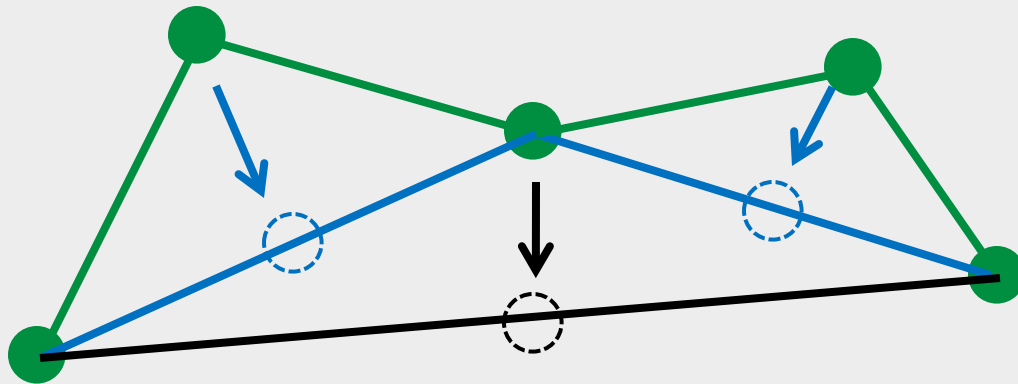


**Check each  
new point in  
configuration  
space for  
collision**

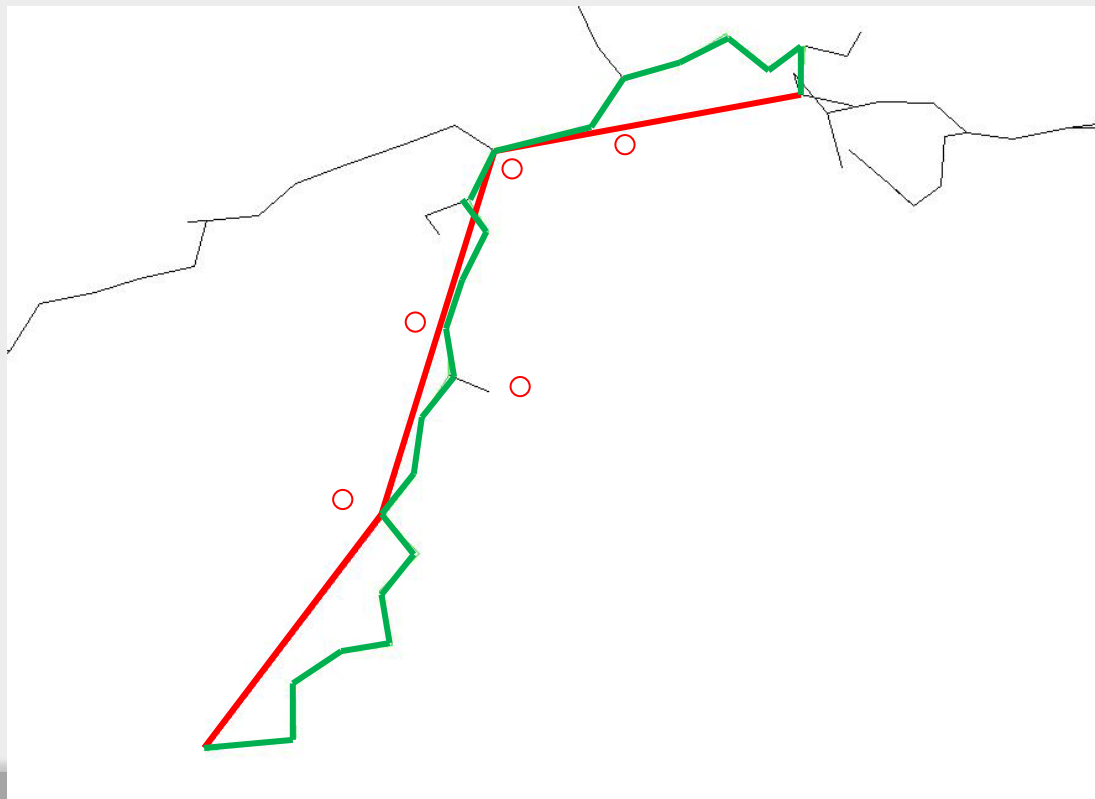




# Path Smoothing



- Average two points to find the midpoint
- Check for collision
- If no collision, remove point



# Summary

This simulator will function as a teaching tool, allowing students to better understand how the RRT algorithm works.

The image shows a software interface for a robot simulator. The central part is a 2D environment with a yellow floor and black obstacles. A robot arm is positioned in the center, with segments colored red, green, and blue. To the left is a control panel with various buttons and checkboxes. To the right is a panel titled 'RRT MOTION PLANNING' displaying statistics and a 3D visualization of the RRT tree.

**STATUS**

PLEASE WAIT, THE ROBOT WILL MOVE MOMENTARILY

Create ...

Create ...

Create ...

Set Ob...

Set Ob...

Set Ob...

Set Go...

Set Go...

Blank  Create ...

Run Error Check

Start

None  Tes...  Test...  Tes...

Reset Arm

**RRT MOTION PLANNING**

Number of Vertices: 1112, 65.42

Number of Edges Thrown Out: 259, 34.82

Computation Time: 2 seconds, 31.1804 seconds

Path Length: 11.2002 radians

Smoothed Path Length: 8.0092 radians

Draw RRT After Calculation...

# Acknowledgements

Joey Durham & Francesco Bullo



**UCSB**  
  
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SANTA BARBARA

