Motion Planning RRTs	handout: slides asst3 posted

Motion Planning	
RRTs	

#### Motion Planning

- Problems
- Motion Planning
- Geometric
- Dynamics
- Break

RRTs

# **Motion Planning**

Wheeler Ruml (UNH)

Lecture 5, CS 730 – 3 / 14

#### **Planning Problems**

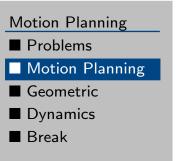
Mation	Dlanning
IVIOLION	Planning

- Problems
- Motion Planning
- Geometric
- Dynamics
- Break

RRTs

Observability: complete, partial, hidden State: discrete, continuous Actions: deterministic, stochastic, discrete, continuous Nature: static, deterministic, stochastic Interaction: one decision, sequential Time: static/off-line, on-line, discrete, continuous Percepts: discrete, continuous, uncertain Others: solo, cooperative, competitive

#### **Motion Planning Problems**



RRTs

- geometry
- kinematics
- dynamics
- hybrid state
- steering: closed form, controller, random (raw simulator)

### **Geometric 'Path Planning'**

Motion Planning

- Problems
- Motion Planning
- Geometric
- Dynamics
- Break

RRTs

grid pathfinding: basic discretizationvisibility graphs: clever discretization

single- vs multiple-query

PRM: discretization by sampling

non-point robots: eg, 7-DOF arms workspace, freespace

### **Dynamics**

Motion Planning	
Problems	
Motion Planning	
■ Geometric	
Dynamics	
Break	

RRTs

what if you don't have infinite acceleration?

- configuration space vs state space
- Heuristic search: lattice, grid
  - RRT (next)

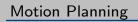




Break

RRTs

asst3 projects



#### RRTs

- RRT
- RRT\*
- BIT\*
- Others
- EOLQs

## **RRT**s

Wheeler Ruml (UNH)

Lecture 5, CS 730 – 9 / 14



Motion Planning		
RRTs		
RRT		
■ RRT*		
■ BIT*		
Others		
EOLQs		

initialize the tree with the initial state until the tree reaches the goal: sample a random state find the nearest state in the tree extend from that state toward the sample

(Lavalle video) goal bias smoothing bidirectional probabilistically complete

Lecture 5, CS 730 - 10 / 14



Motion Planning		
RRTs		
■ RRT		
■ RRT*		
■ BIT*		

Others
EOLQs

for all states near new state if path to new through near is better rewire using that path for all states near new state if path to near through new is better rewire using that path

(Karaman video) asymptotically optimal



Motion	Planning
RRTs	
RRT	

■ RRT\*

- BIT\*
- Others

EOLQs

until tired

sample (additional) random states consider nearby states to be successors run A\* over the implied graph

uses both a vertex open list and edge open list to minimize edge evaluation

prune any states with  $f \ge incumbent$ PC and AO and heuristically guided!

### Others

Motion	Planning
RRTs	

- RRT
- RRT\*
- BIT\*
- Others
- EOLQs

- Potential fields
  - Skeletonization
  - Trajectory optimization

## **EOLQs**

Motion	Planning
RRTs	
RRT	

■ RRT\*

■ BIT\*

Others

EOLQs

Please write down the most pressing question you have about the course material covered so far and put it in the box on your way out. *Thanks!*