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Bat-Inspired Robot Navigation

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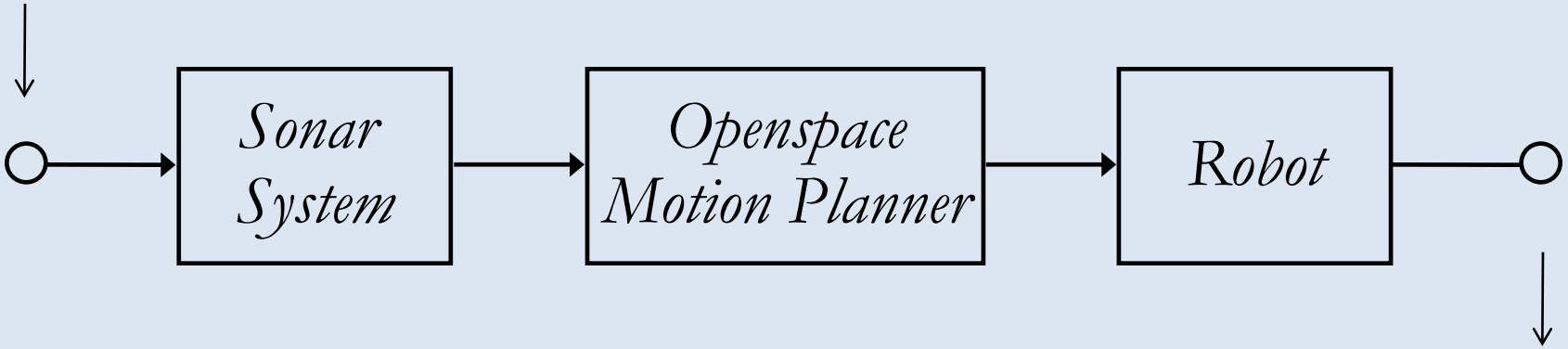
A Navigation Problem

- Scenario: navigating a forest at night
  - Difficult for humans
  - Easy for bats
  - Why?
- Objective: build a navigation system inspired by bat echolocation

Image available at: http://picasaweb.google.com/lh/photo/CUVA1rKZBoKvE3tbR6xn3g

System Overview

Start:
Obstacles in unconstrained environment



End:
Robot avoids obstacles

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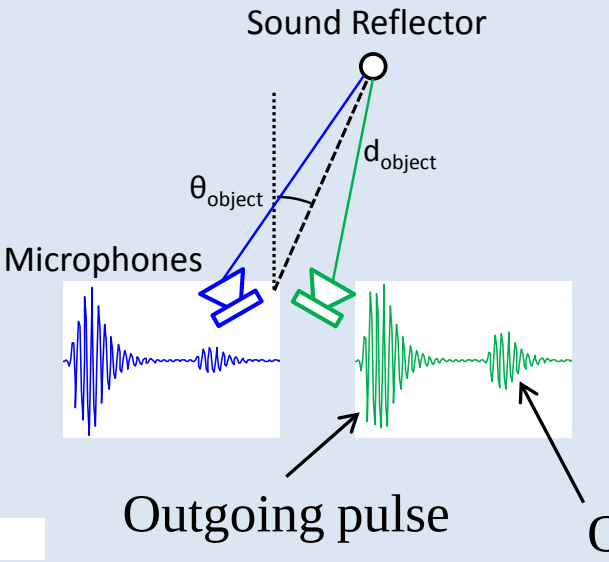
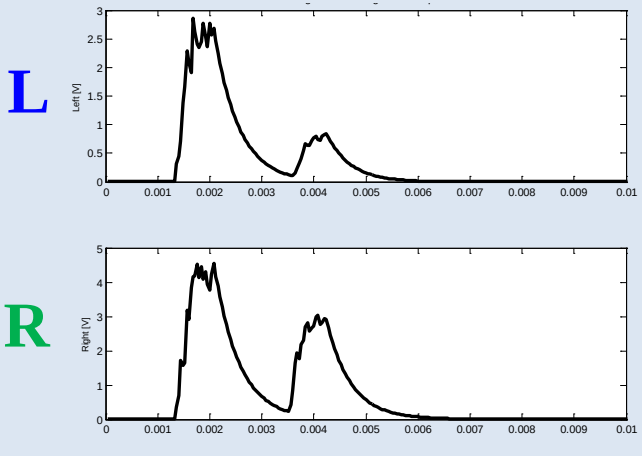
Sonar System

Intelligent Servosystems Laboratory

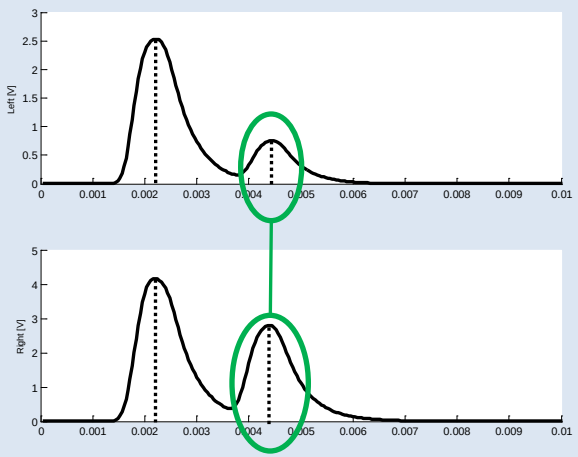
1. Listen for echoes
2. Process signal envelope
3. Detect peaks
4. Infer object location based on peak time and amplitude differences



Sonar Envelope



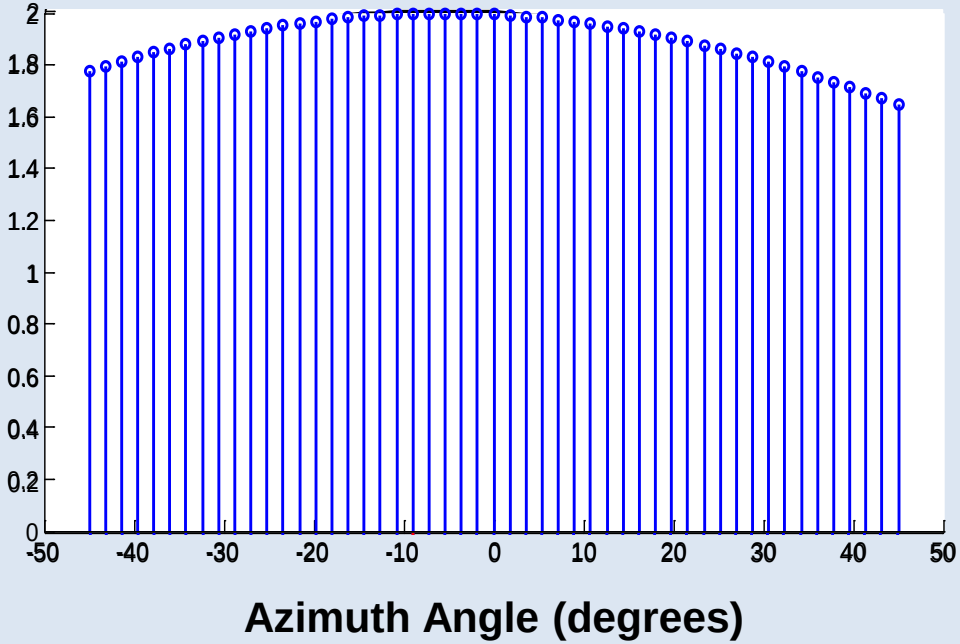
Filtered Envelope & Peaks



Object detected!

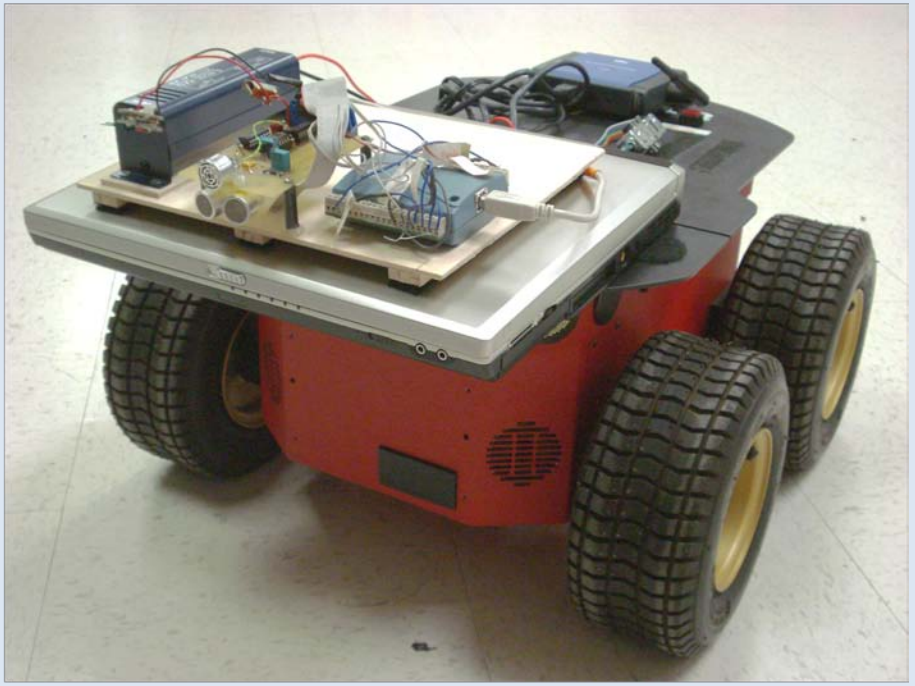
Openspace

- Motion-planning algorithm
- Each direction evaluated for desirability
  - Goal steering
  - Suppression from obstacles
- Winner-take-all (WTA) selection



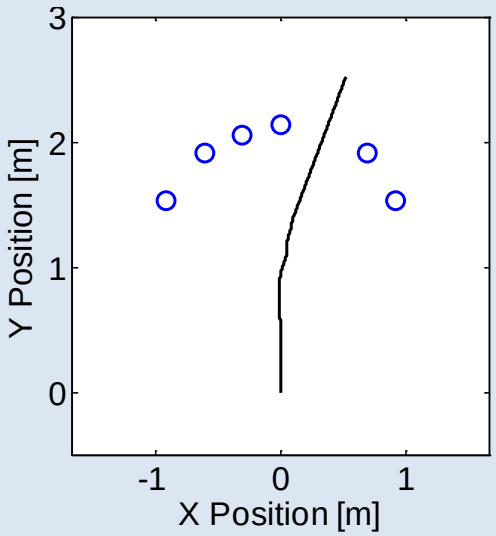
Robot

- Sonar System
  - Ultrasonic speaker
  - Left and right ultrasonic microphones
- Laptop runs MATLAB
  - Signal processing for obstacle detection
  - Motion planning with *Openspace*
- Pioneer 3 Robotic Platform

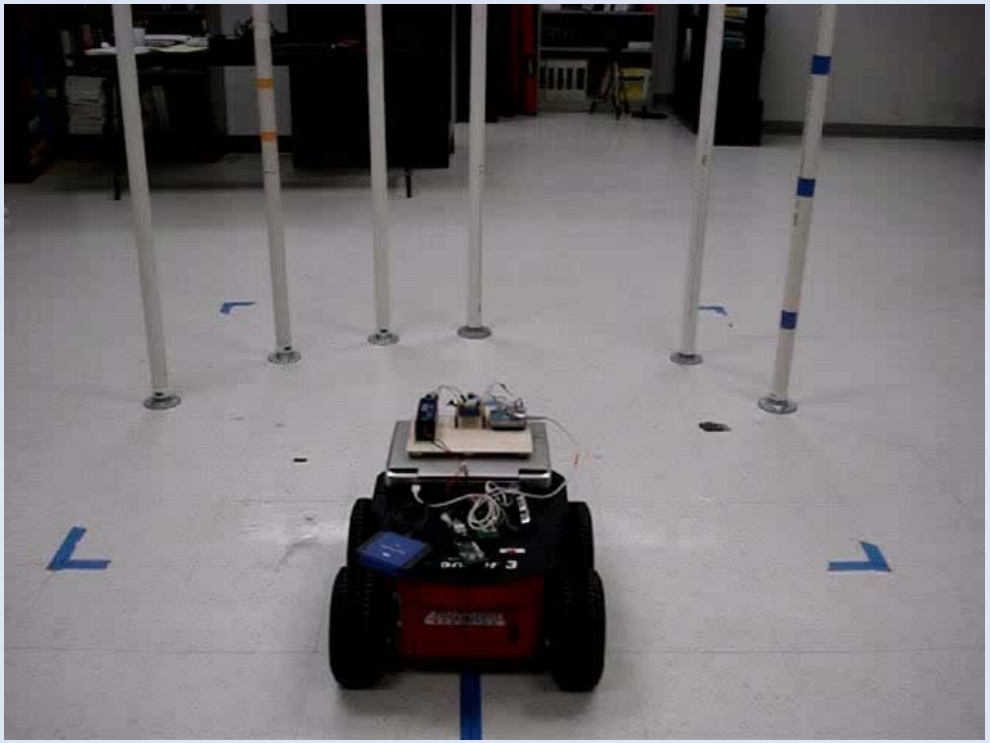


Performance

- Successful wander behavior
- Tested over various obstacle arrangements



Robot Trajectory



x2 speed

Conclusion

- Proficient obstacle avoidance
- Novel system integration
- Future work:
  - Indoor positioning system for goal-seeking behavior
  - Additional feedback

Acknowledgments

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