Sensing or Moving, Time and Energy

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Motivations & Goals

• Energy management
• Efficient behaviour
• Build a new robot
• Explore the trade-off: sensing or moving
Related Work

- Reduce consumption: DPM [Y. Mei, 2005]
- Efficient planning [T. Wang, 2008] [C. Ooi, 2007]
- Efficient recharging [Y. Litus, 2007] [J. Wawerla, 2008]
- Harvest biomass [I. Ieropoulos, 2003]
Building robot
Robot
Architecture

- Arduino: motor control, PID
- Robovero: sensors, UART
- Overo: algorithm, decision
- Computer: Start/Stop, display data
Problems

- Wifi
- ADC
- IMU
- UART
- Slow serial communication
- Power supply regulator
- Noisy power lines
Video of the robot

- Decoupling rotation and translation
- Reading sensors
Exploring the trade-off
Follow Wall

- Bouncing behaviour
- Fixed heading : offset
- Estimation of the wall
Wall estimation

$\theta_{\text{perp}}$
Simulation

- Stage
- Simplified map of the building
- No dynamics
- Exact position
- 100Hz
Reality

- Dynamics: inertia and slippage
- Gyroscope + commands → Position
- 45Hz
- Vibration → noisy distance
Experiments

Hypothesis:
• An angle of rebound minimizes the energy consumption / time

Experiments:
• vary the angle of rebound: [0°, 20°, 35°, 45°, 55°, 70°, 90°]
• arena: 4 inside corners, 1 outside corner
• 10 loops, same starting position
• record energy and time
Trajectory

20°

70°
Results Energy

- Not different
- Compensation
Result Time

- Large angles reduce time
- Small FOV $\rightarrow$ lot of motion
# Time management

<table>
<thead>
<tr>
<th>Component</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for components</td>
<td>1 month</td>
</tr>
<tr>
<td>Simulation</td>
<td>1.5 month</td>
</tr>
<tr>
<td>Design of brackets</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Assembly, connectors</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Software</td>
<td>1.5 month</td>
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<tr>
<td>Experiments</td>
<td>1 week</td>
</tr>
<tr>
<td>Reports, thesis</td>
<td>1 month</td>
</tr>
</tbody>
</table>

![Pie chart showing time allocation]

- Search for components: 15%
- Simulation: 15%
- Design of brackets: 23%
- Assembly, connectors: 8%
- Software: 12%
- Experiments: 4%
- Reports, thesis: 15%
Future work

• Improve the robot:
  - reduce mass

• Algorithm:
  - scanning behaviours
Achievements

- The robot is working
- Small FOV $\rightarrow$ lot of behaviour
Thanks for your attention