Ensuring Safe Obstacle Avoidance in a Shared-Control System

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Outline

The Bremen Autonomous Wheelchair

- Experimental Platform in Spatial Cognition Research
- Development of Safe Embedded Systems
- Real World Application to Support Handicapped Persons

Sonar Sensors in Mobile Robots

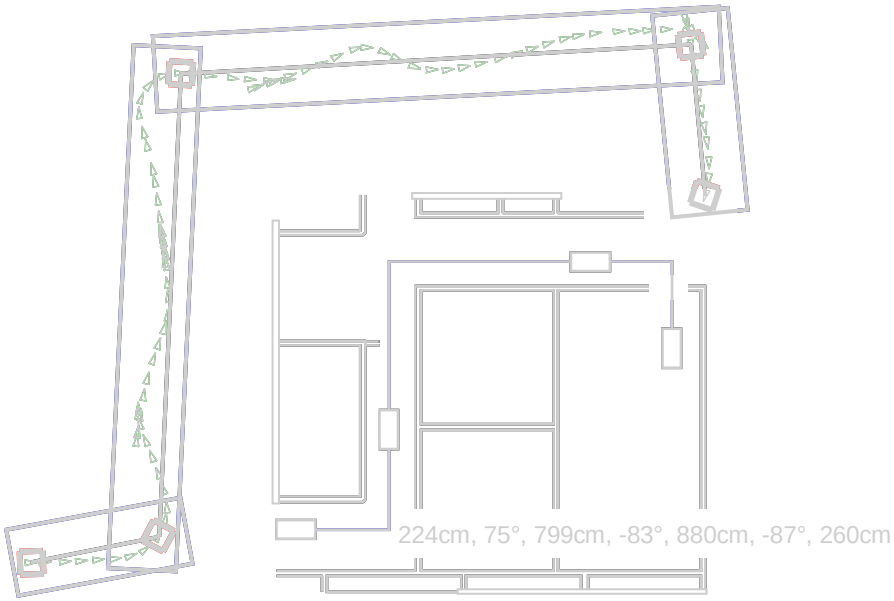
- Pros and Cons of Sonar Sensors
- Standard Firing Strategies Fail
- A New Dynamic Firing Strategy

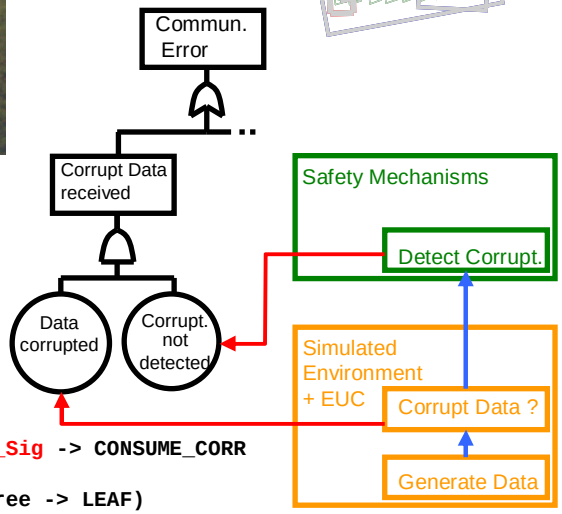
Safe Obstacle Avoidance in a Shared-Control System

- The Wheelchair's System Architecture
- Various Control Modes
- Avoiding Obstacles and Steering Back to the Original Orientation

Future Work

The Bremen Autonomous Wheelchair






```
LEAF = Start_FaultTree -> (Corruption_Sig -> CONSUME_CORR
                           []
                           End_FaultTree -> LEAF)
```

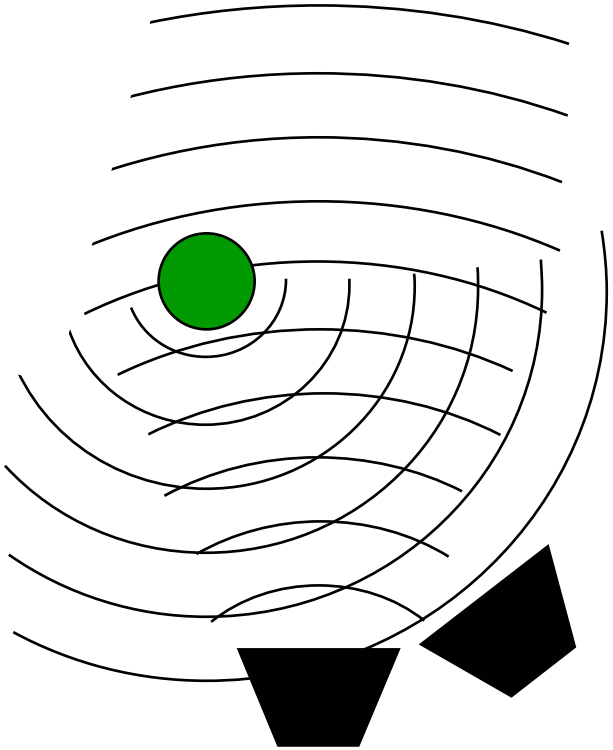
Sonar Sensors in Mobile Robots

Pros

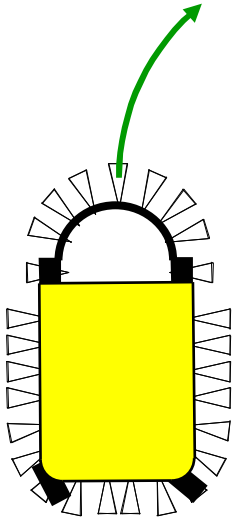
- Small
- Cheap
- Good Range Resolution

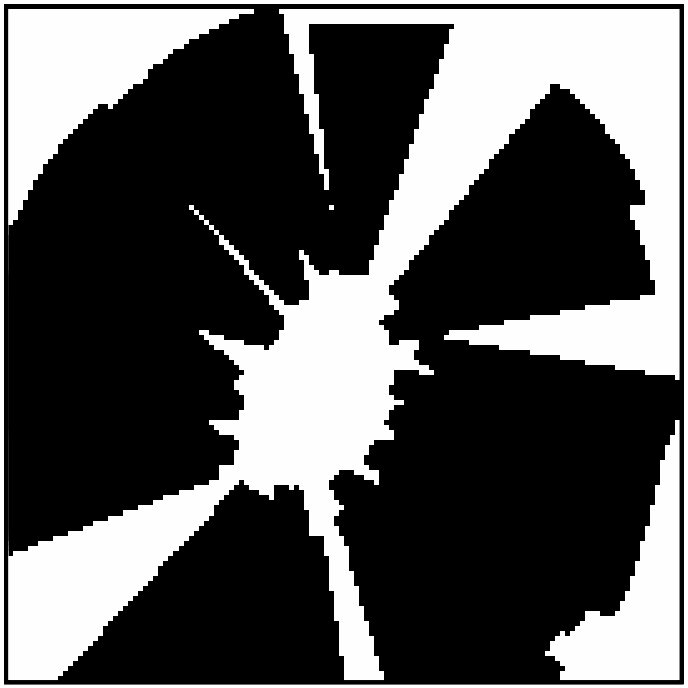
Cons

- Low Angular Resolution
- Specular Reflections
- Cross-Talks



“Static” Sonar Measurements





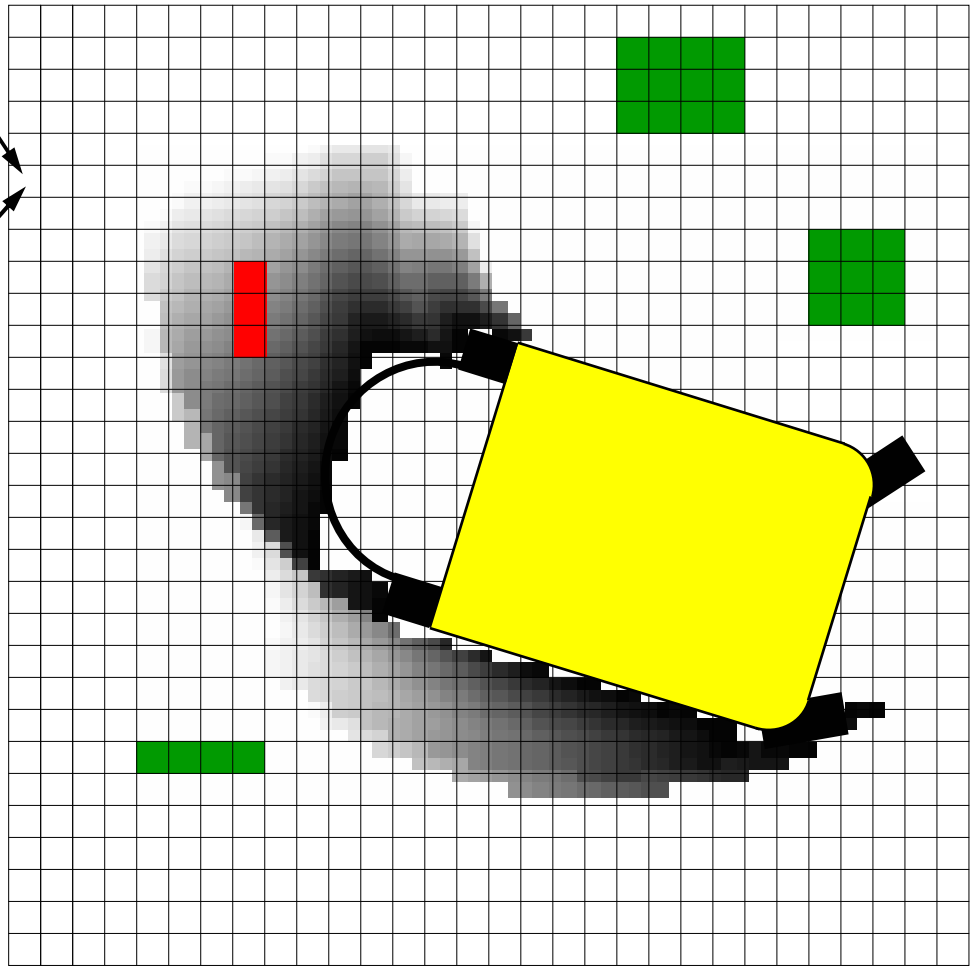
Measurements on Demand
Provide Uniform Spatial Coverage

Age of Measurement

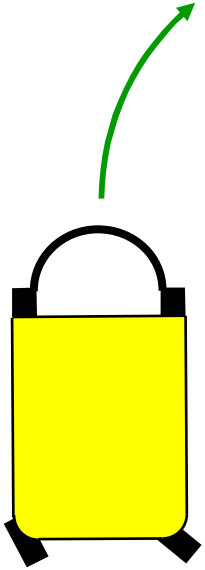
Occupancy of Cell

- Never Measured
- Empty
- Obstacle Supposed
- Obstacle Confirmed

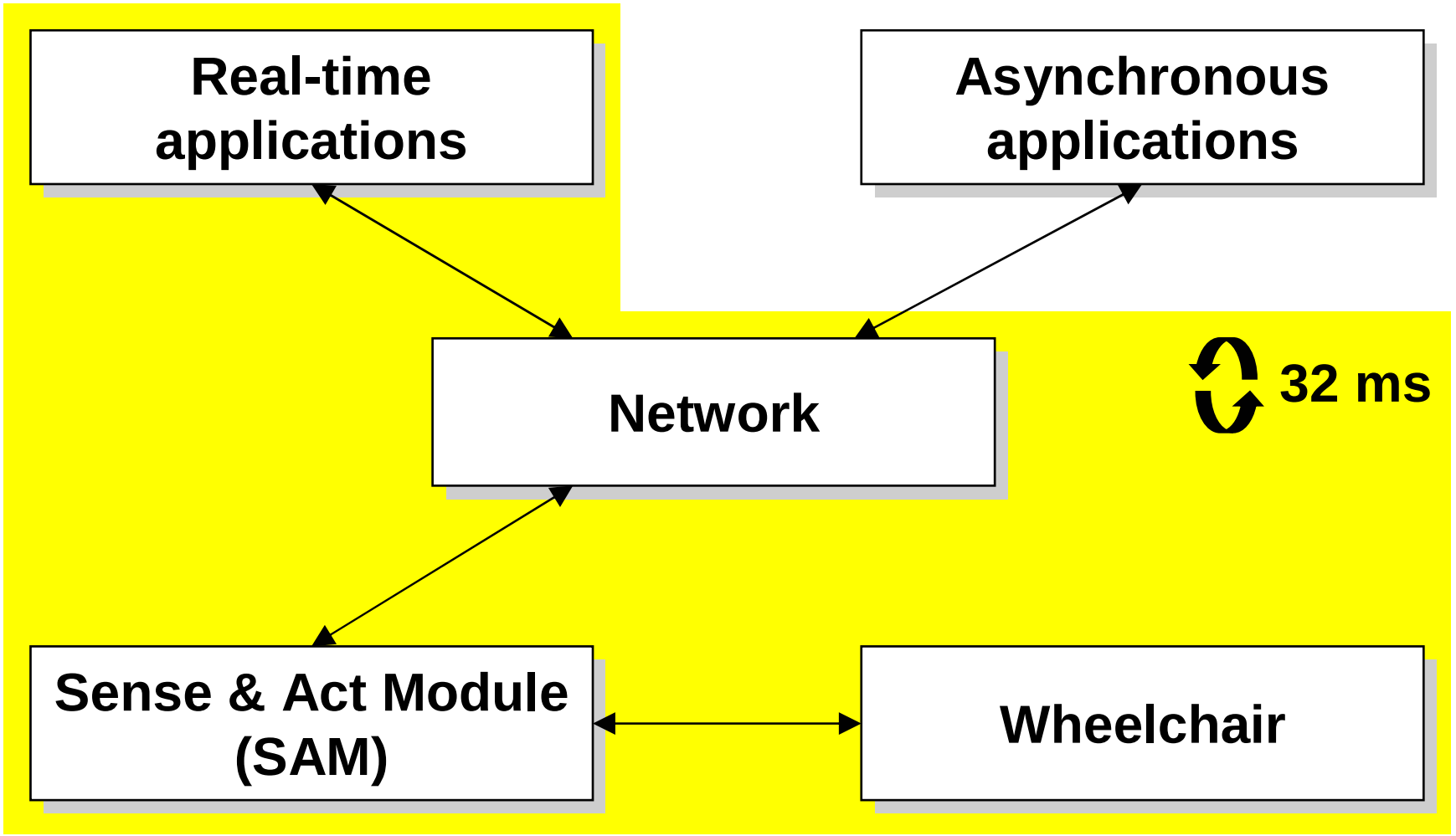
Danger of Collision!



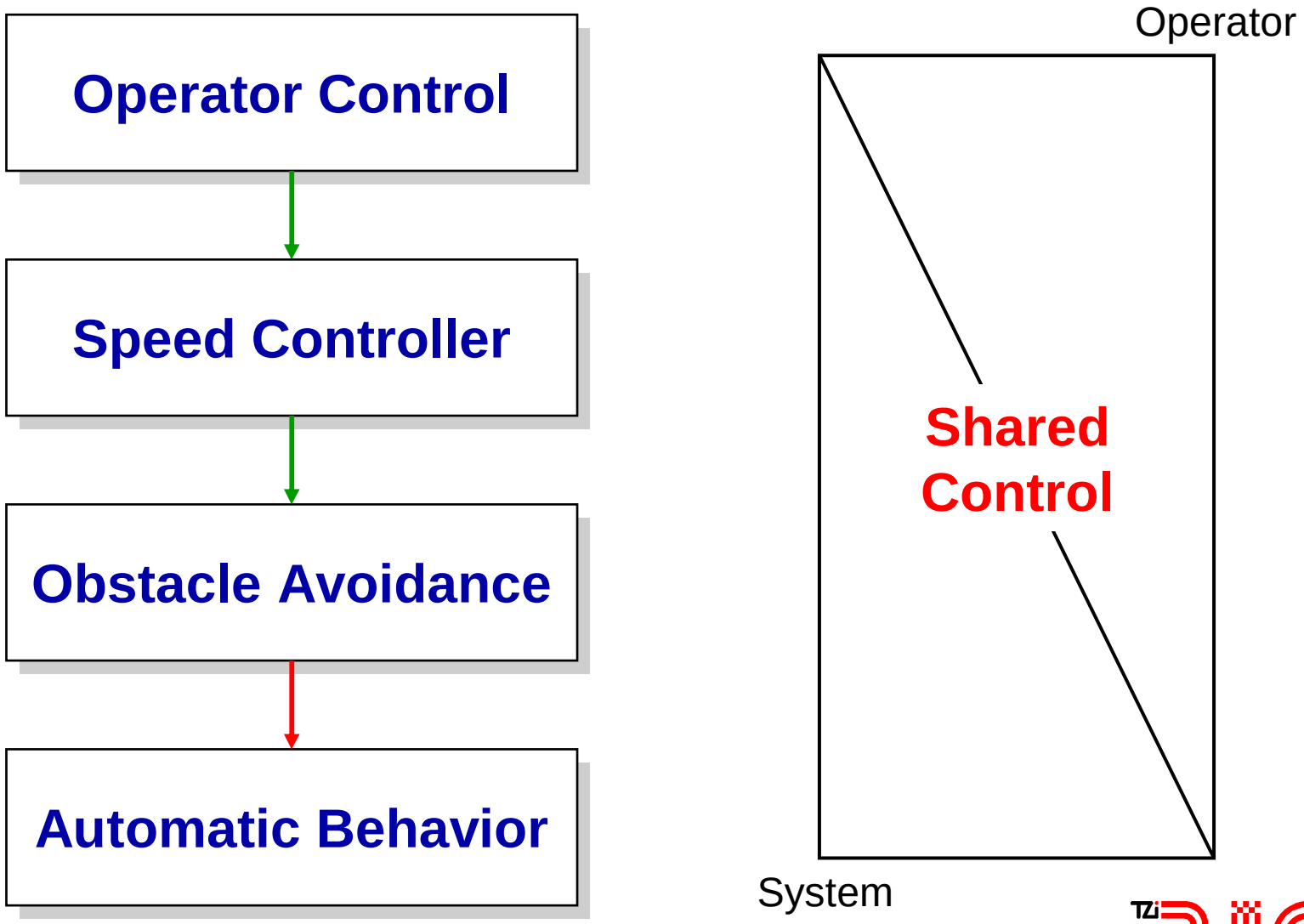
Results



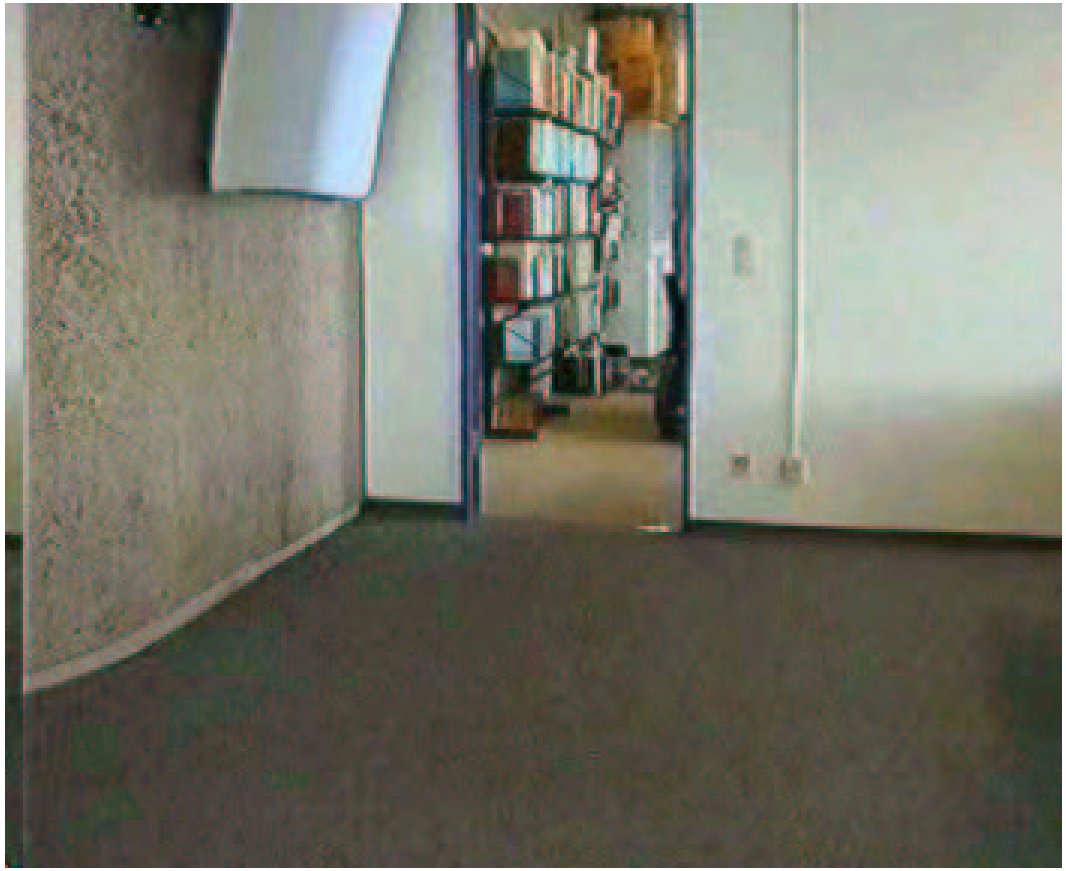
Safe Wheelchair – System Architecture



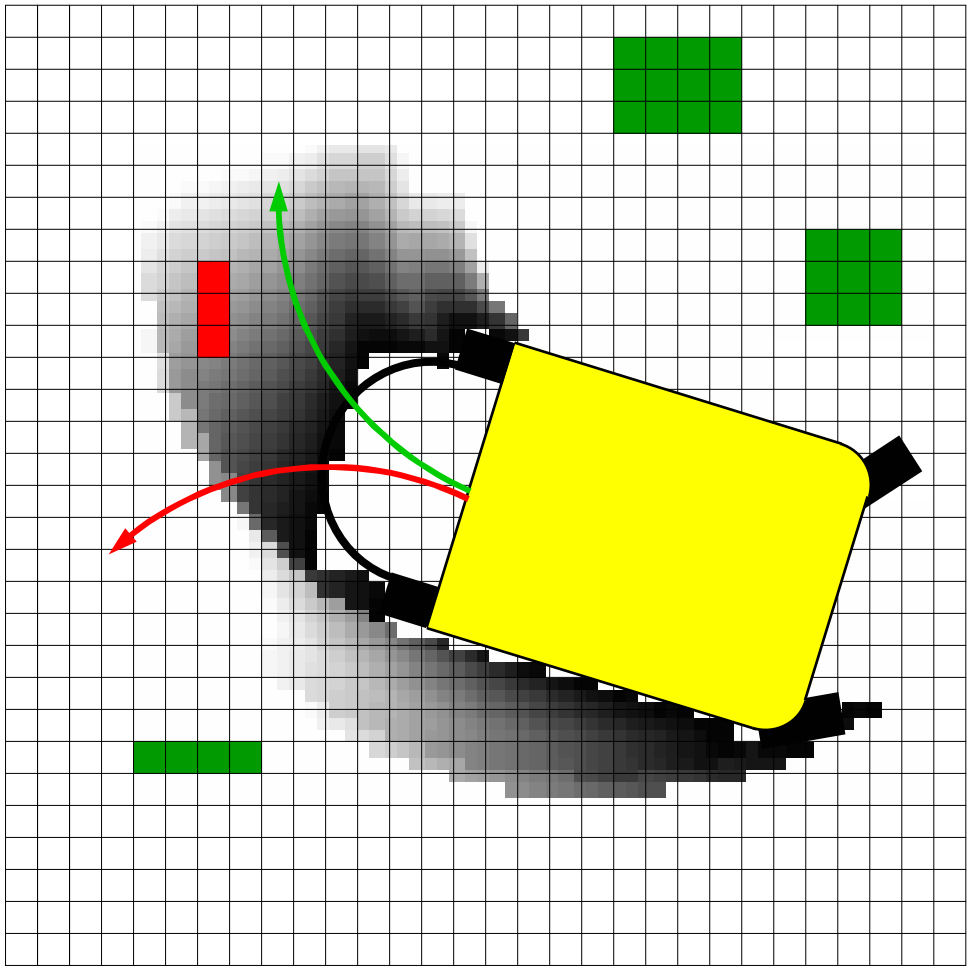
Various Modes of the Wheelchair



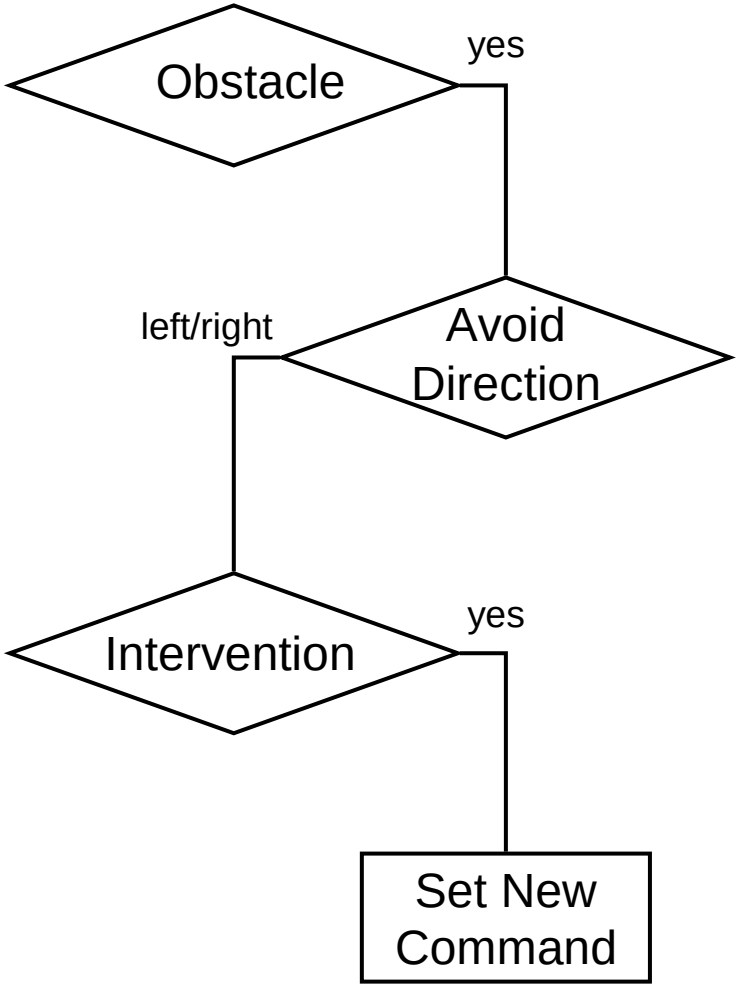
A “Multi-Mode” Scenario: The Driving Assistant

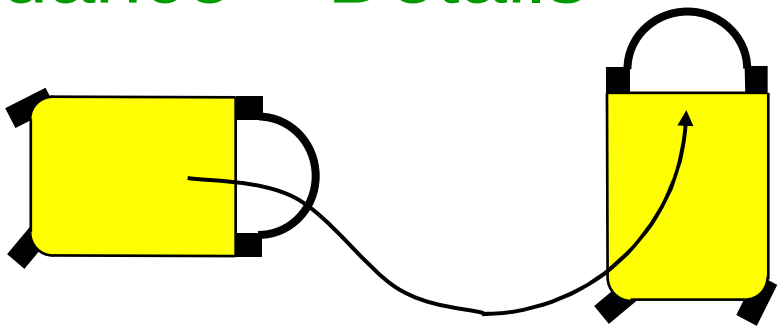


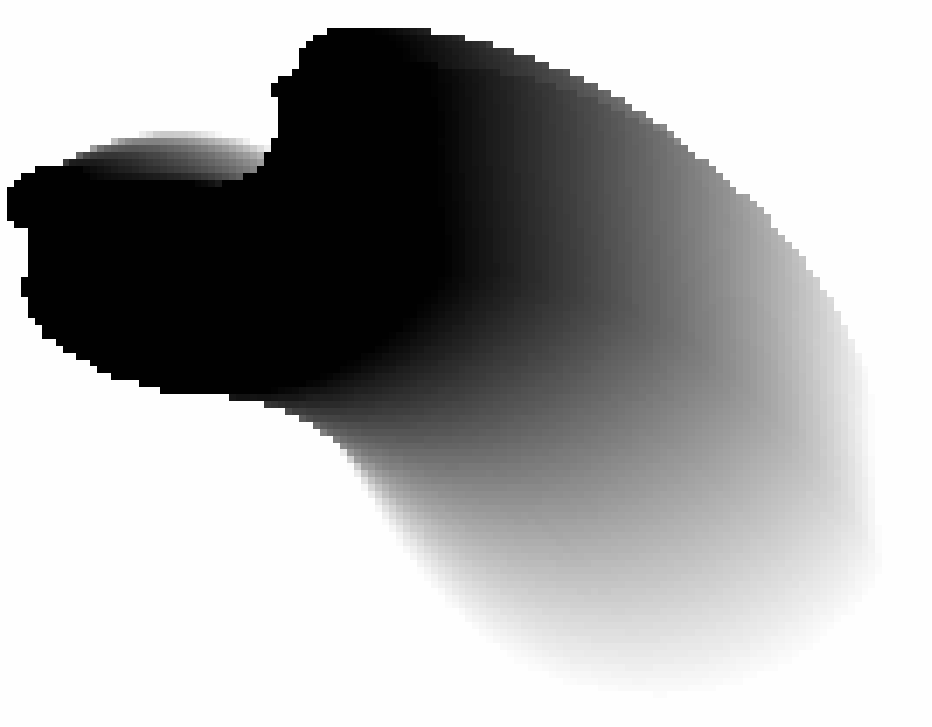
Obstacle Avoidance – Basic Idea



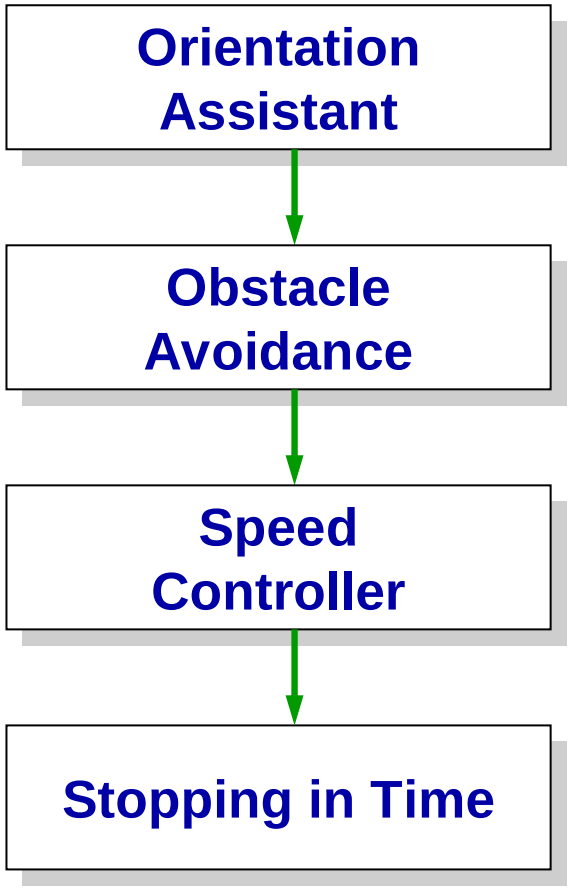
Obstacle Avoidance – Details



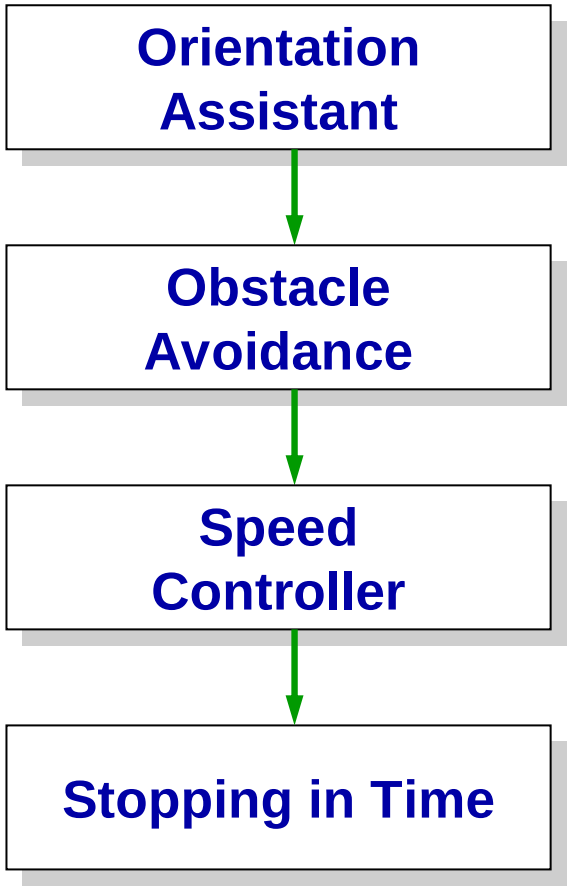


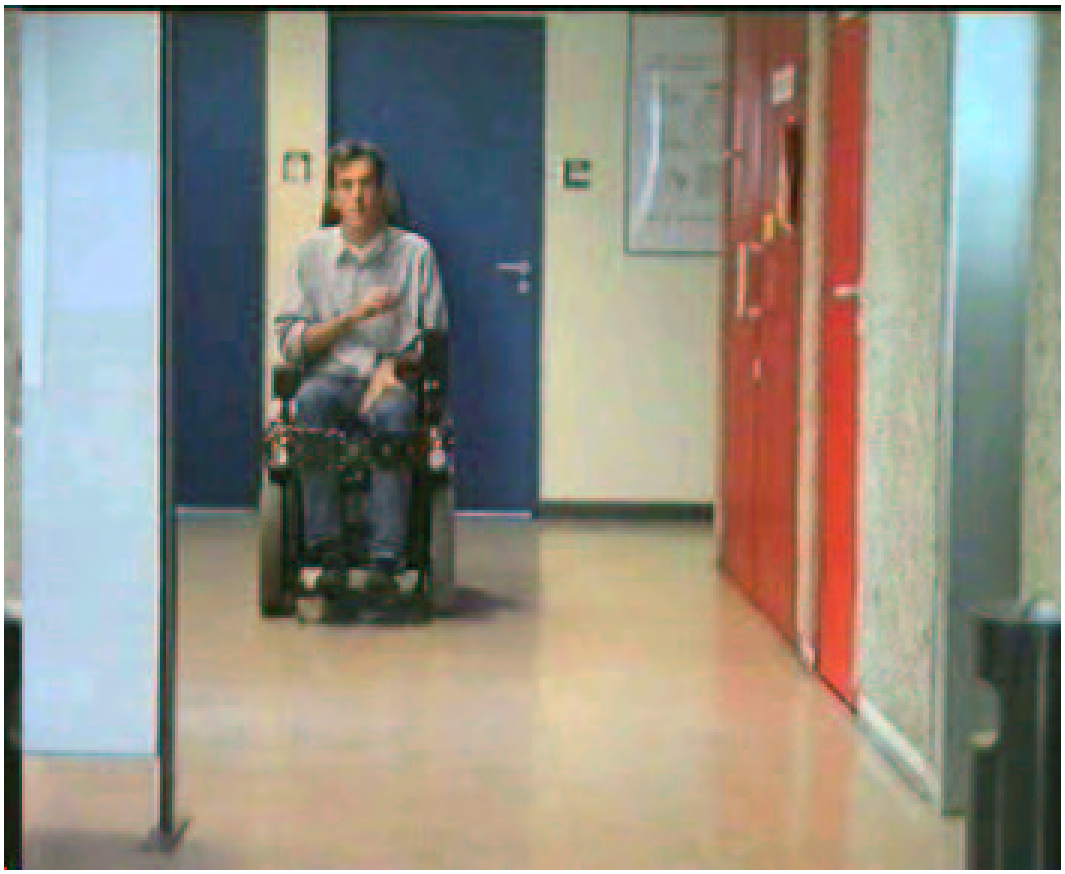


Orientation Assistant



Orientation Assistant





Future Work

Obstacle Avoidance

- Intensity of Intervention Depending on Sensor Resolution

Driving Assistant

- Integration of Additional Skills
  - *Docking to a Table*
  - *Shunting*
- Extension of the Man-Machine-Interface
  - *Speech Recognition*
  - *Shared-Control*

Orientation Assistant

- Steering Back to the Original Path