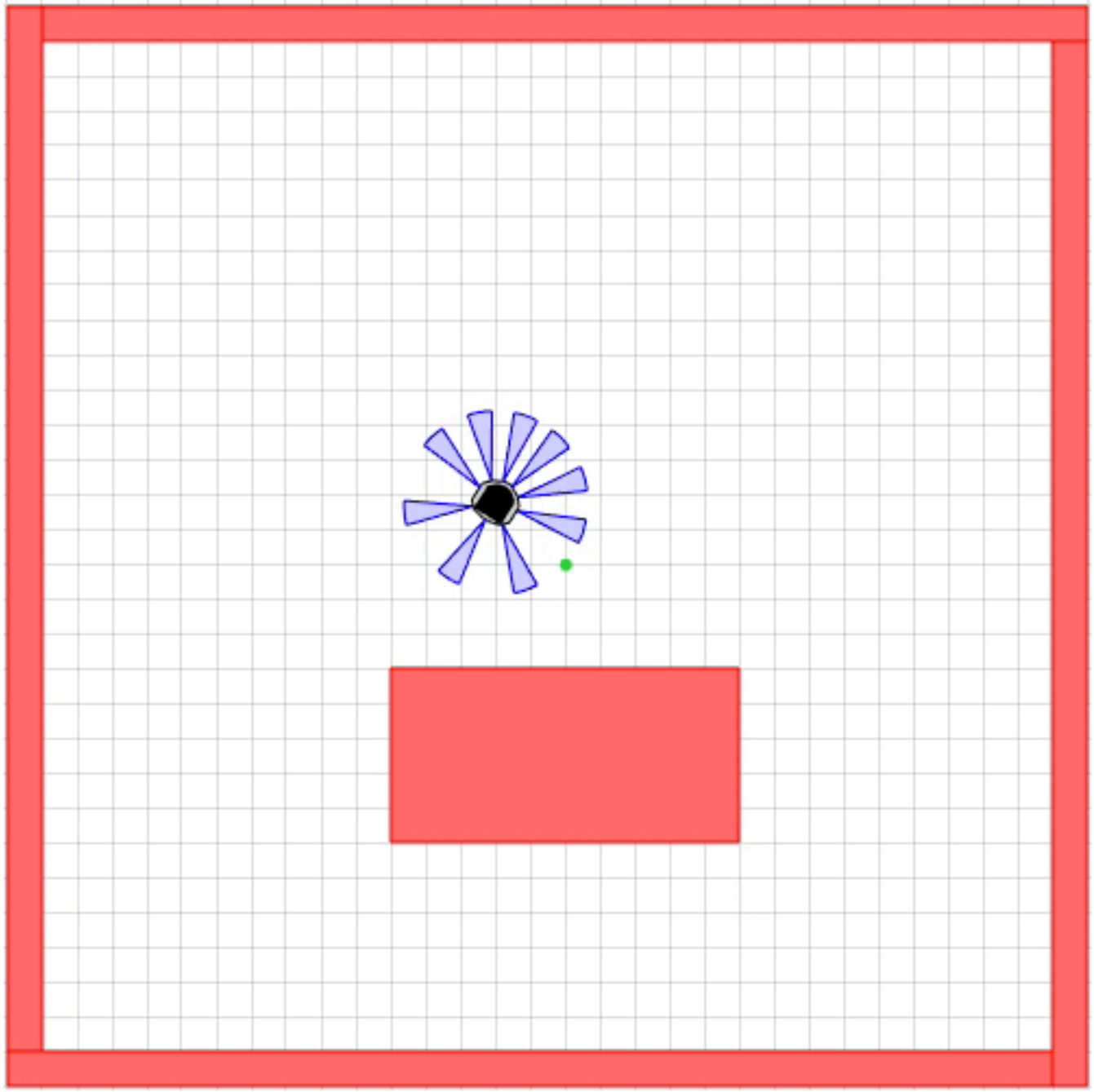
電気情報工学基礎演習B

Simulation of Controlling Mobile Robot
Lecture 4

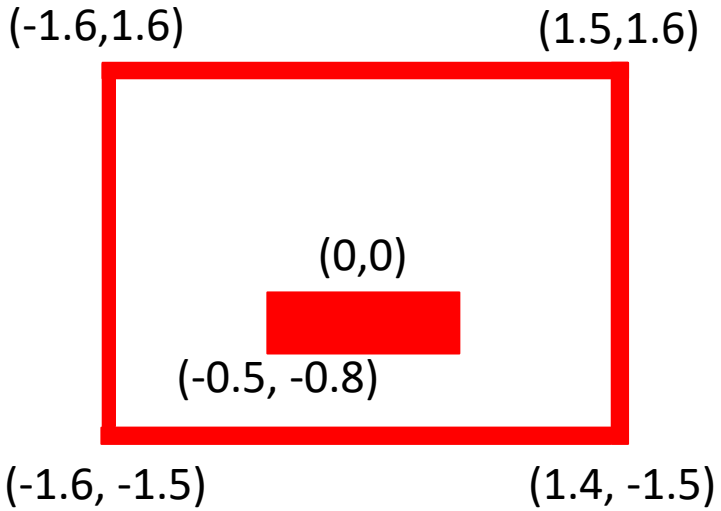
Instructor:　蔡　凱
TA:　笠原　萌人



Week 4

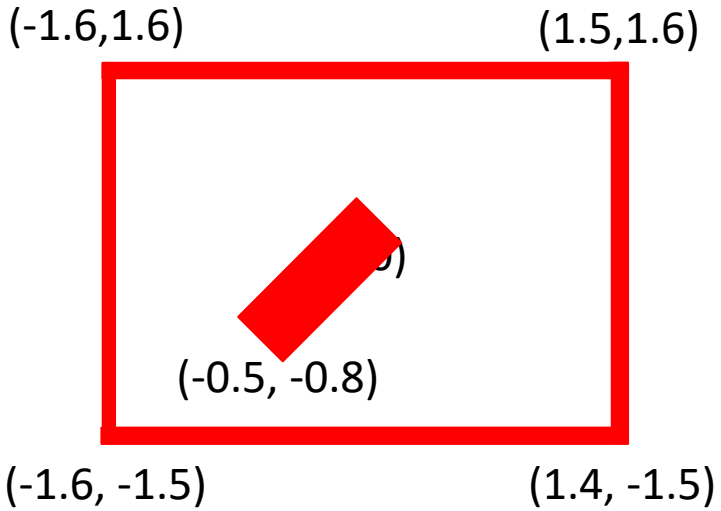
- AvoidObstacles control

Obstacles



- settings.xml:
  - <obstacle>
    <pose x=”-0.5" y=”-0.8" theta="0" />
    <geometry>
    <point x=“0" y="0" />
    <point x=”1" y=”0" />
    <point x=”1" y=”0.5" />
    <point x=“0" y=“0.5" />
    </geometry>
    </obstacle>

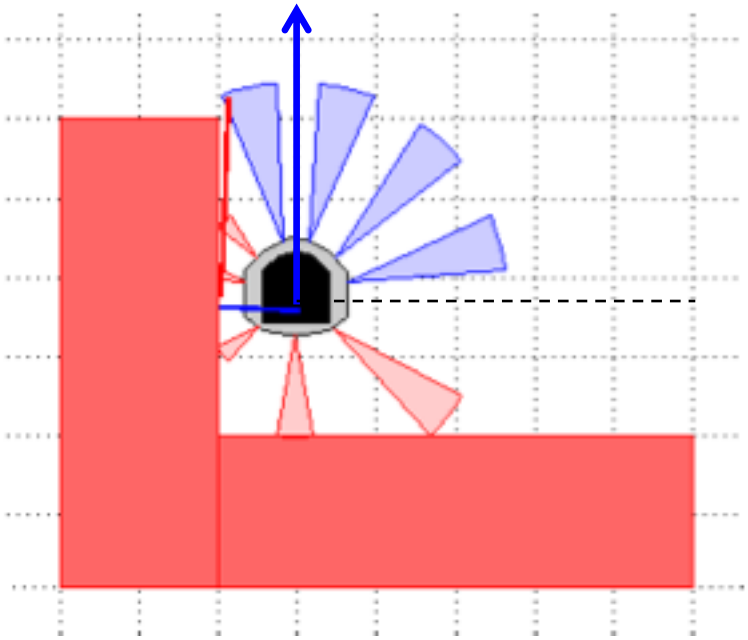
Obstacles



- settings.xml:
  - <obstacle>
    <pose x=”-0.5" y=”-0.8" theta="0.79" />
    <geometry>
    <point x=“0" y="0" />
    <point x=”1" y=”0" />
    <point x=”1" y=”0.5" />
    <point x=“0" y=“0.5" />
    </geometry>
    </obstacle>

Avoid Obstacle

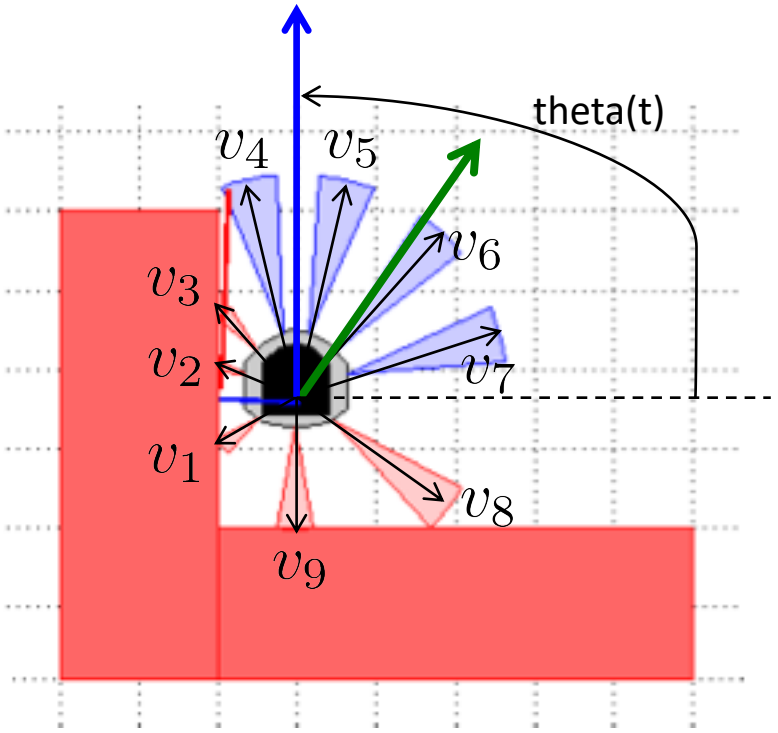
- Objective: steer the robot away from nearby obstacles



Assume robot is moving at linear velocity v=constant.

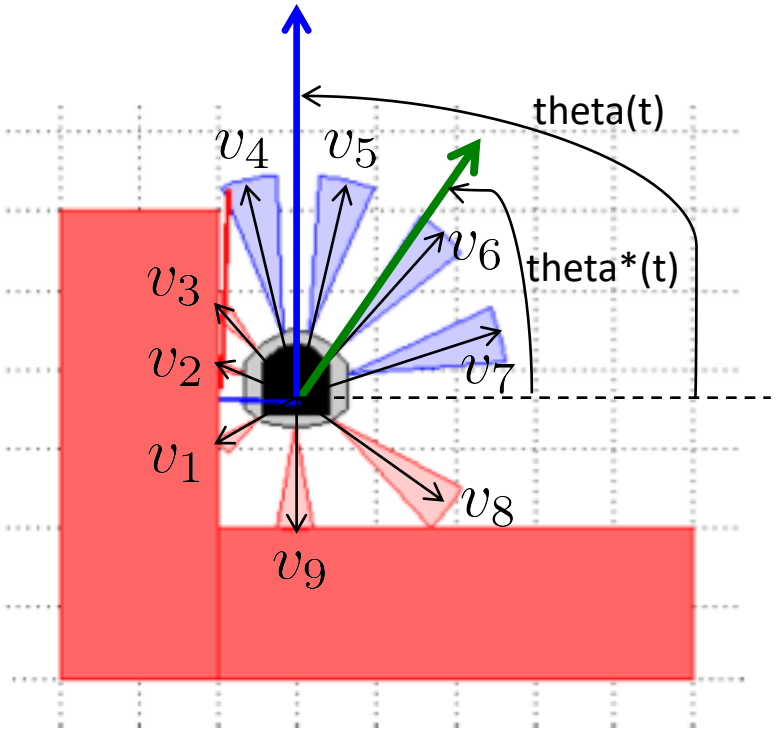
We only control robot's angular velocity w: $\frac{d\theta}{dt} = u(t)$, control input

AvoidObstacles Controller



$$v^*(t) = v_1(t) + \cdots + v_9(t)$$

AvoidObstacles Controller



$$v^*(t) = \text{weight}_1 v_1(t) + \cdots + \text{weight}_9 v_9(t)$$

$$\theta^*(t) = \tan^{-1}\left(\frac{v_y^*(t)}{v_x^*(t)}\right)$$

Use P-controller $u(t) = K_p(\theta^*(t) - \theta(t))$ to achieve $\theta(t) \to \theta^*(t)$

Code

- +simiam/+controller/+khepera3/K3Supervisor.m
  - function obj=K3Supervisor()

```
% Input your code below %
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%Specified (constant) speed
obj.v = 0; (change this to see what happens)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Code

- +simiam/+controller/AvoidObstacles.m
  - function obj = AvoidObstacles()

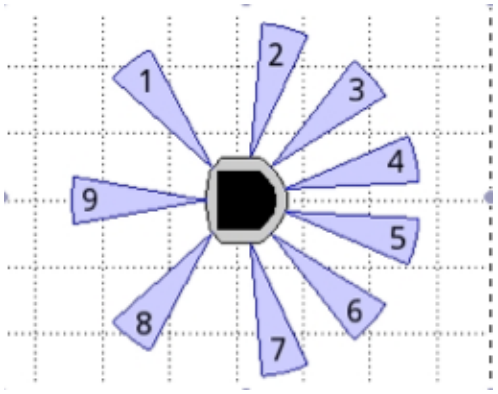
```
% Input your code below %
%%%%%%%%%%%%%%%%
% Propositional control gain %
obj.Kp = 0; (change this to see what happens)
%%%%%%%%%%%%%%%%
```

Code

- +simiam/+controller/AvoidObstacles.m
  - function outputs = execute(...)

```
% Input your code below %
%%%%%%%%%%%%%%%%%%%%%%
% Weights for the nine sensors %
sensor_gains = [1 1 1 1 1 1 1 1 1];
(change this to see what happens)
%%%%%%%%%%%%%%%%%%%%%%

%Distances sensed by the nine sensors:
ir_distances = robot.get_ir_distances()
```



Exercises

- Use package: simiam_lecture4.zip
- Change robot's initial pose and obstacle pose in settings.xml
- Set robot's linear speed in K3Supervisor.m
- Adjust control gain parameter in AvoidObstacles.m
- Adjust sensor weights in AvoidObstacles.m

Task

- Set robot's pose (0,1,1.57) and the following two obstacles in settings.xml

```
% Obstacle 1
    <pose x="-0.5" y="-0.8" theta="0.79" />
    <geometry>
      <point x="0" y="0" />
      <point x="1" y="0" />
      <point x="1" y="0.5" />
      <point x="0" y="0.5" />
    </geometry>
% Obstacle 2
    <pose x="-1" y="0.26" theta="0.0" />
    <geometry>
      <point x="0" y="0" />
      <point x="2" y="0" />
      <point x="2" y="0.5" />
      <point x="0" y="0.5" />
    </geometry>
```

- Find suitable linear speed, control gain parameter, and sensor gains that the robot can run without collision for 1 minute