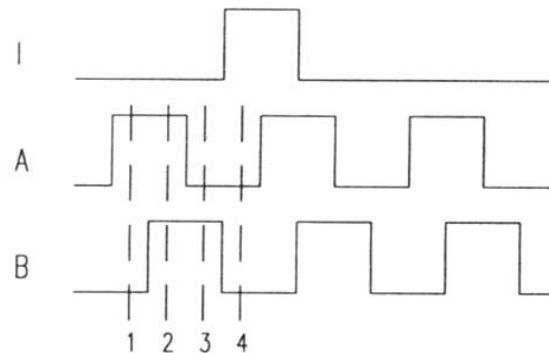
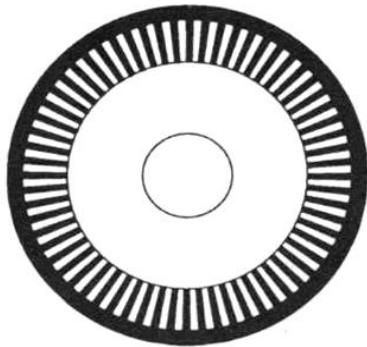


# HW3 (Due Next Tuesday 12AM)

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**Problem 1:** If there are 100 lines in the grating, what is the smallest detectable change in motor-shaft angle?

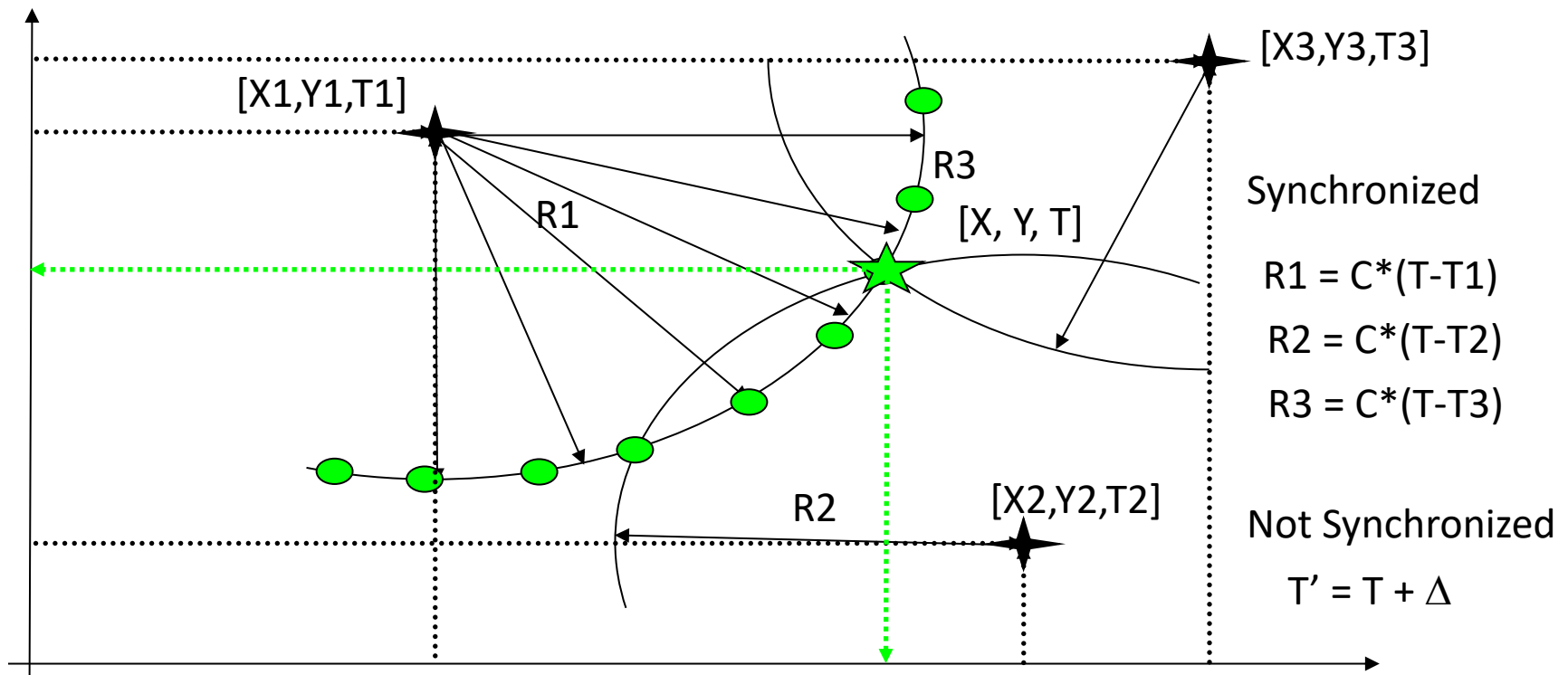
**Problem 2:** Explain how to determine the rotation directions if the following encoders are used. List two concerns while choosing an encoder.



State	Ch A	Ch B
S <sub>1</sub>	High	Low
S <sub>2</sub>	High	High
S <sub>3</sub>	Low	High
S <sub>4</sub>	Low	Low

# HW3 (Due Next Tuesday 12AM)

**Problem 3:** Simulate the process of localization with GPS signals. When sender-receiver clocks are either synchronized or not synchronized, how many satellites are needed to achieve 3D accurate positions, respectively? (HINT: use MATLAB fsolve to estimate the target location).

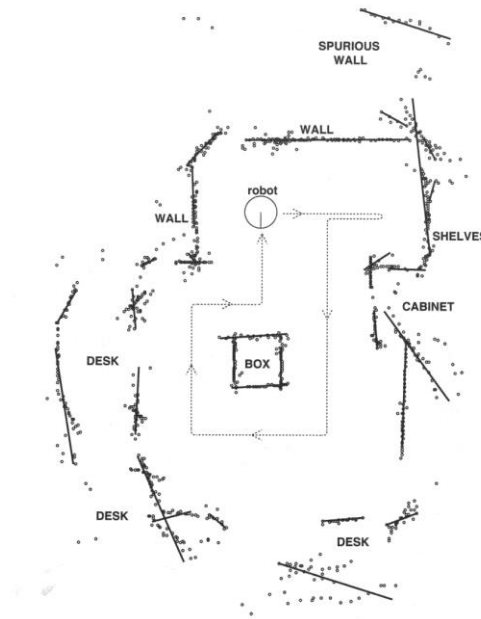
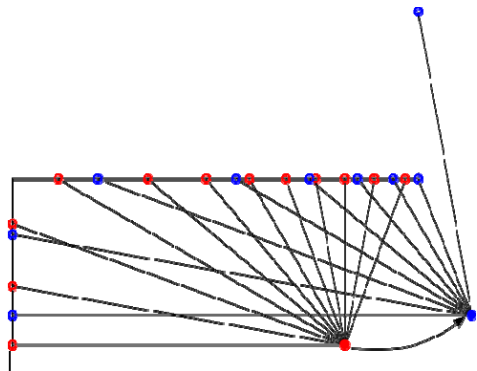


# HW3 (Due Next Tuesday 12AM)

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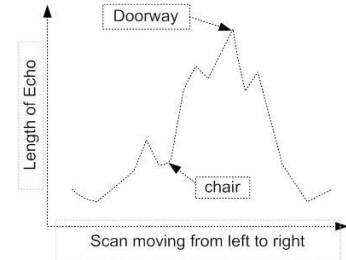
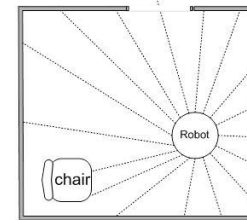
**Problem 4:** Simulate the process of mapping of a room by using a moving range sensor which knows its location accurately (randomly walking, or moving along a circle).

## Laser Sensors



## Ultrasonic Sensors

- Applications:
  - Distance Measurement
  - Mapping: Rotating proximity scans (maps the proximity of objects surrounding the robot)



Scanning at an angle of 15° apart can achieve best results

(Plot the geometry of a room and boxes first; select a motion trajectory of the robot; simulate the range sensor with a line (or a number of lines); compute the intersection points of range sensors and geometry of the room and boxes);

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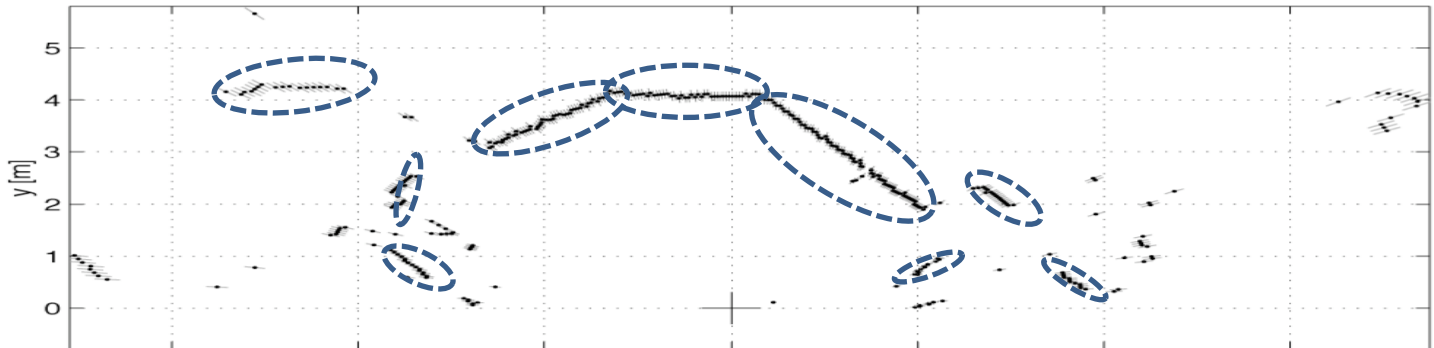
**Extra Credit on Next Page**

# HW3 (Due Next Tuesday 12AM)

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**Problem 5: ( Extra Credit for undergraduate students and required for graduate students)** Simulate the process of line segmentation estimation out of the intersection points (HINT: use the Gaussian mixture model clustering algorithm to form a number of Gaussian clusters; then each Gaussian cluster can use a linear segment to represent)

Raw  
range data  
and  
clusters



Line  
segments

