

The Robot Doctor

Episode 104: Robot Localization

Common Core Standards:

- Circle Equation:
 - Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
 - Intersection Points of two Circle Equations
- Roots of quadratic equations

Review:

Robots need to find their position on a map relative to landmarks

- 1. Identify at least 3 landmarks whose position is known on the map
- 2. Determine range to the landmark
- 3. Calculate the intersection point of the range circles

To find the intersection of 3 circles:

- 1. Use the equation for a circle: $(x-a)^2 + (y-b)^2 = r^2$ for landmarks located at (a,b) and at a range of r
- 2. Find the radical line by subtracting the two circle equations
- 3. Substitute back into one of the circle equations to get a quadratic formula in terms of one variable
- 4. Solve the quadratic equation to find the two value for that single variable
- Substitute back into the radical line equation to get the two values for the other variable
- 6. Substitute these two points into the third circle equation to determine which point the robot is at



Challenge Questions

1. The tree is at (2, 13) and the range is 5 meters. The bush is at (13, 11) and the range is 10 meters. Finally, the pond is at (5,22) and the range is 5 meters – what is the robot's position?

2. Now imagine the robot only sees two landmarks, a pile of rocks and an umbrella. The rocks are at the position (10,0) and the umbrella is at the position (20,0). The distance to the rocks is 5 meters, and the distance to the umbrella is also 5 meters. Can you still determine the position of the robot, even though there are only two landmarks?