Localization Using Landmarks

Chapter 8

Revisiting the Localization via Landmarks

- recall that on Day 22 we used an extended Kalman filter to estimate the position and orientation of mobile robot moving in the plane
  - we assumed that the robot could measure the distance to beacons (landmarks) with known locations in the world
- today we revisit the localization problem via landmarks and look at some classical solutions to the problem

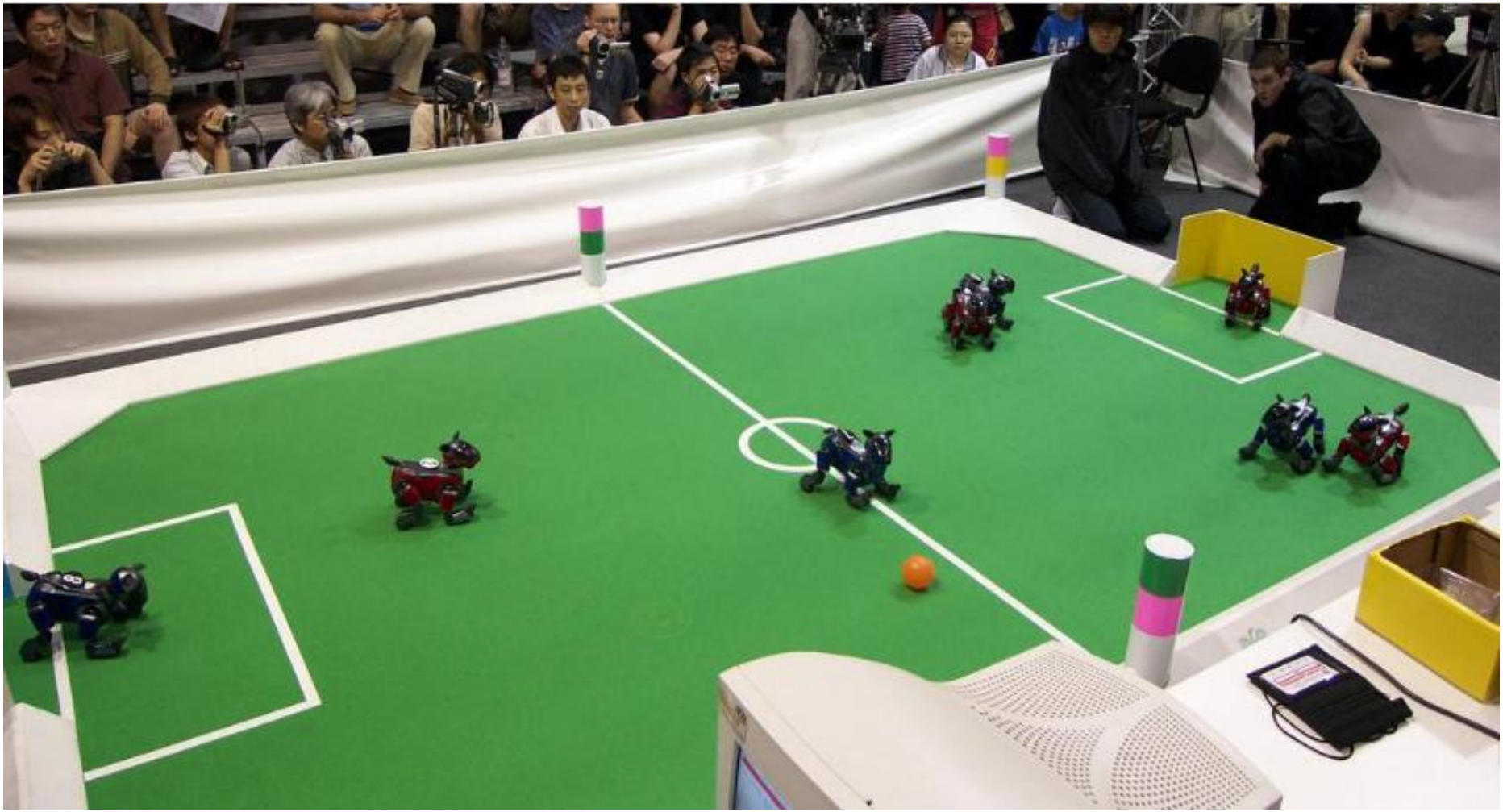
Landmarks

- a landmark is literally a prominent geographic feature of the landscape that marks a known location
- in common usage, landmarks now include any fixed easily recognizable objects
  - e.g., buildings, street intersections, monuments
- for mobile robots, a landmark is any fixed object that can be sensed

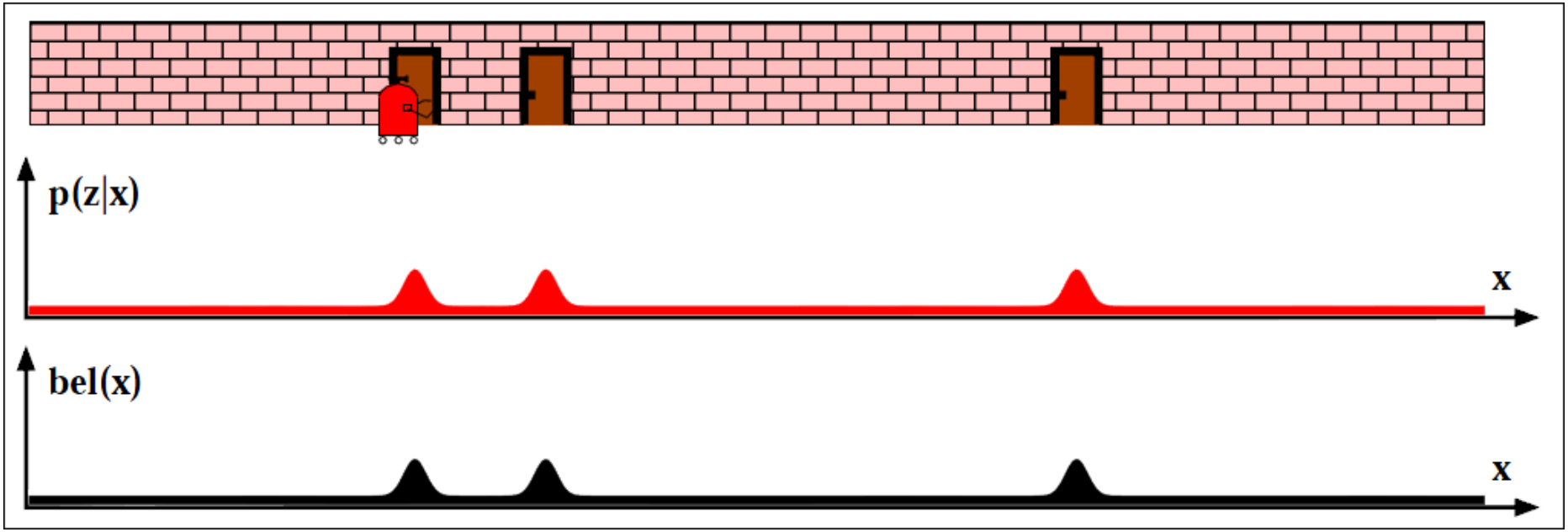
Landmarks for Mobile Robots

- visual
  - artificial or natural
- retro-reflective
- beacons
  - LORAN (Long Range Navigation): terrestrial radio; now being phased out
  - GPS: satellite radio
- acoustic
- scent?

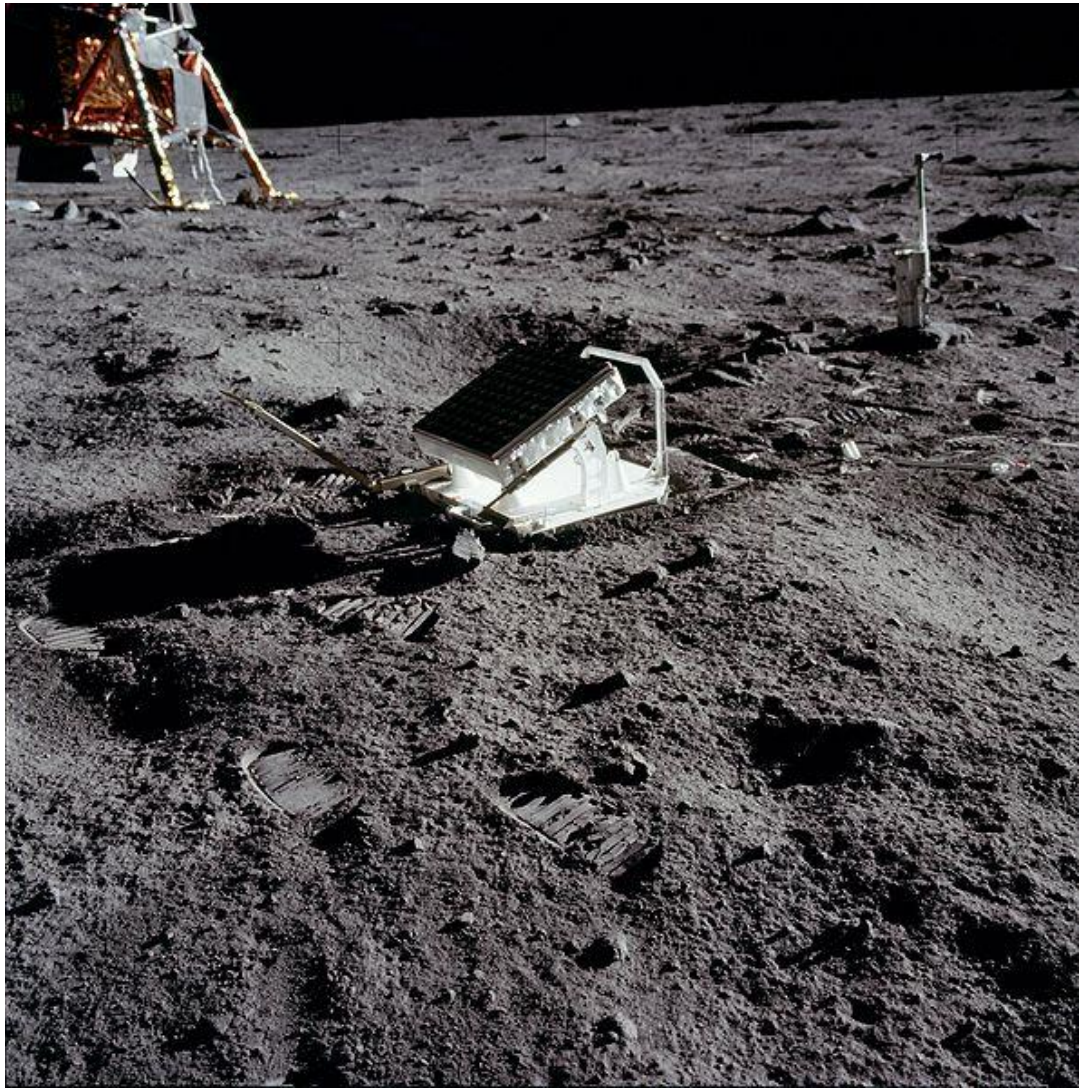
Landmarks: RoboSoccer



Landmarks: Corridor Environments

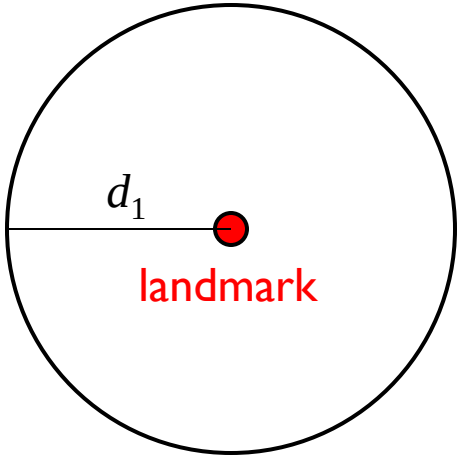


Landmarks: Retroreflector



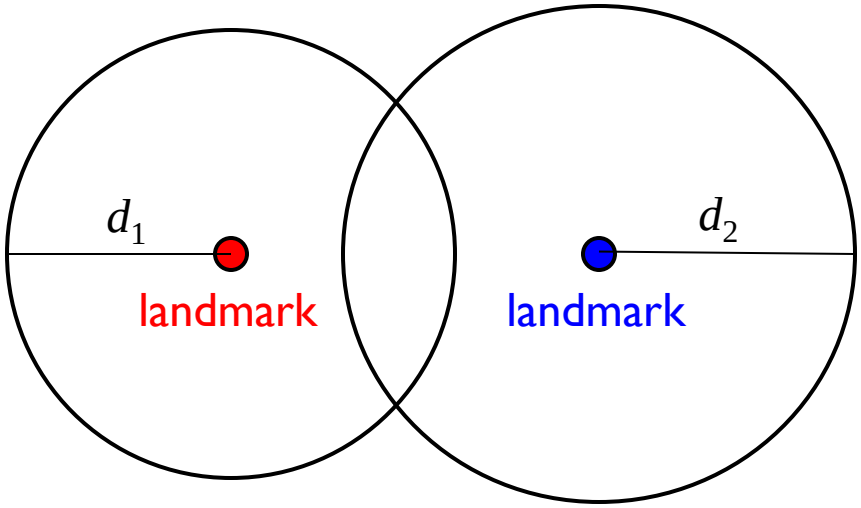
Trilateration

- uses distance measurements to two or more landmarks
- suppose a robot measures the distance d_1 to a landmark
  - the robot can be anywhere on a circle of radius d_1 around the landmark



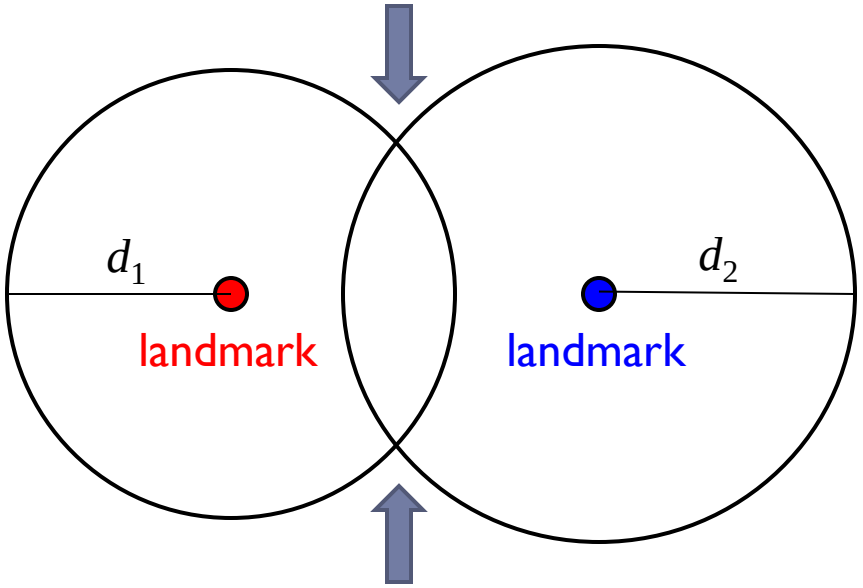
Trilateration

- without moving, suppose the robot measures the distance d_2 to a second landmark
  - the robot can be anywhere on a circle of radius d_2 around the second landmark



Trilateration

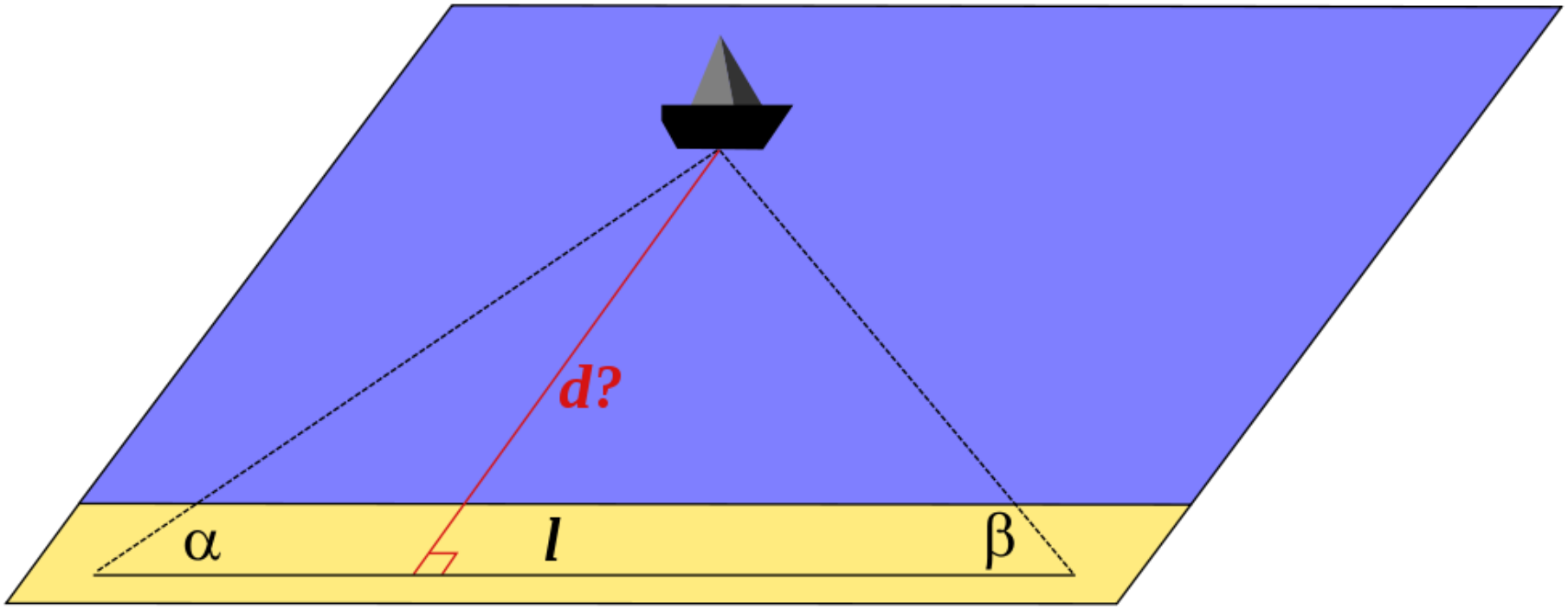
- the robot must be located at one of the two intersection points of the circles
  - tie can be broken if other information is known



Triangulation

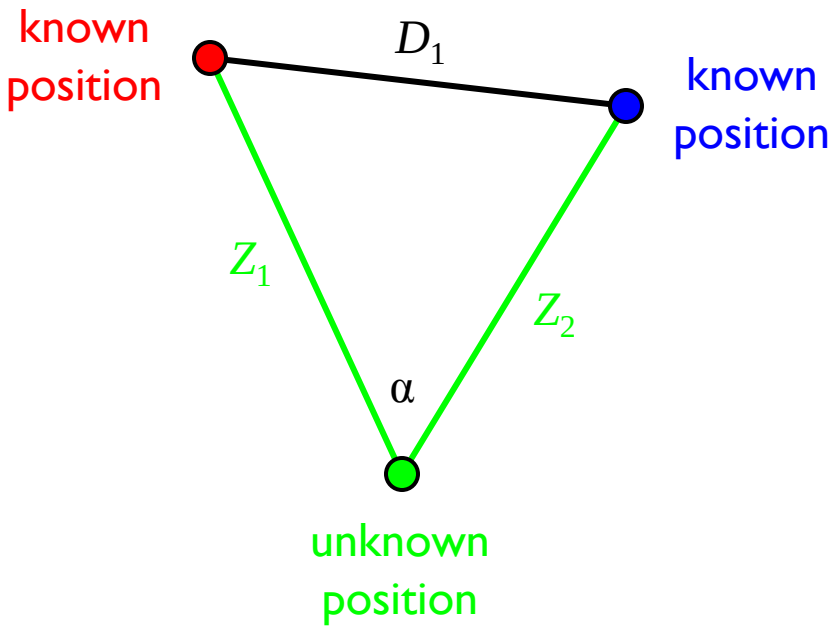
- triangulation uses angular information to infer position
  - http://longhamscouts.org.uk/content/view/52/38/

Triangulation



Triangulation

- in robotics the problem often appears as something like:
  - suppose the robot has a (calibrated) camera that detects two landmarks (with known location)
    - then we can determine the angular separation, or relative bearing, α between the two landmarks



Triangulation

- the unknown position must lie somewhere on a circle arc
  - Euclid proved that any point on the shown circular arc forms an inscribed triangle with angle α
    - we need at least one more beacon to estimate the robot's location