CSE435 – Robotics

Lecture 2 Notes

📘 Educational Importance

Mobile robots are widely used for teaching in:

- Computer Science
- Computer & Electrical Engineering
- Information Technology
- Mechanical Engineering

Advantages in education:

- **Tangible Learning:** Robots are real, physical systems — easier for students to understand than simulations.
- **Real-World Complexity:** Real robots have sensor noise, actuator limits, and mechanical inaccuracies, forcing students to solve realistic engineering problems.
- **Engagement:** Programming a moving robot is fun, motivating, and often enhanced through competitions between student teams.

🤖 Types of Mobile Robots

All members of the **EyeBot family** use the **EyeCon embedded controller**.

Categories:

- Wheeled Robots
- Tracked Robots
- Legged Robots
- Flying Robots
- Underwater Robots

🚗 Wheeled Robots

The simplest form of mobile robots.

Main components:

- One or more **driving wheels**
- Optional **passive or caster wheels**
- Possibly **steering wheels**
- Most designs use **two motors** (for driving and/or steering)

🔸 Single Drive/Steer Wheel

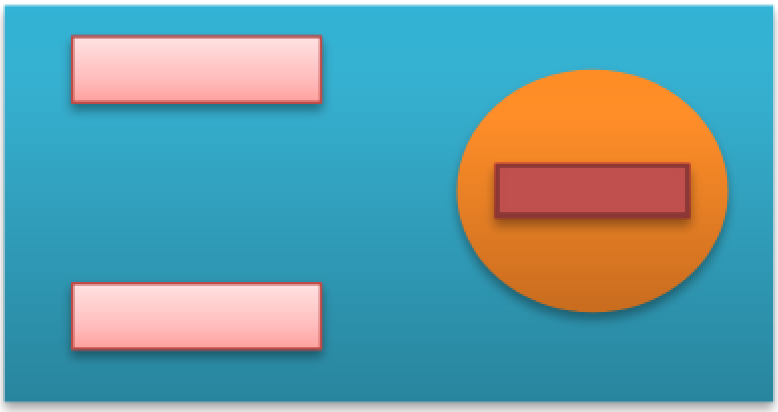

Figure 1: Single Drive/Steer Wheel

- One wheel controlled by **two motors**:
    - One for **driving**
    - One for **steering**
- **Advantages:** Driving and steering are completely independent.
- **Disadvantages:** Cannot turn on the spot because the driven wheel is off-center.

Differential Drive

Figure 2: Differential Drive

- Two **independently driven** center wheels.
- Allows motion in straight lines, curves, or turning on the spot.
- Steering is achieved by **differential speed control** between the two wheels.

Ackermann Steering

Figure 3: Ackermann Steering

- Standard **car-like steering system**.
- **Rear wheels:** Driven by a single motor.
- **Front wheels:** Steered together by one motor via a linkage mechanism.

🔸 **Omni-Directional (Mecanum Drive)**

Figure 4: Omni-Directional (Mecanum) Drive

- Four **independently driven** wheels with special rollers.
- Can move in any direction (sideways, diagonal, rotate on the spot).
- **Requires a flat surface** for smooth operation.

🚜 Tracked Robots

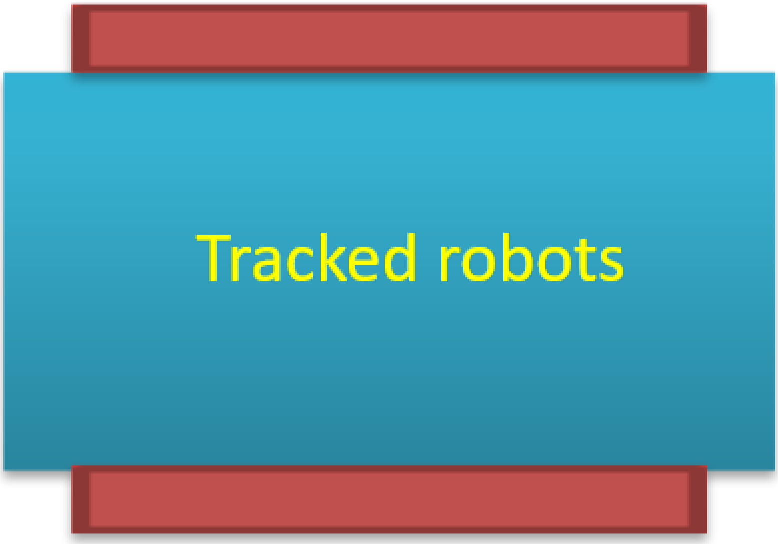

Figure 5: Tracked Robot

- Use **two parallel tracks** for motion.
- Can handle **rough or uneven terrain** effectively.
- Less precise in navigation compared to wheeled robots.
- Typically require **two motors** — one for each track.

🦿 Legged Robots

- Move efficiently over **complex terrain or stairs**.
- **More legs → easier balance.**
- Example: A six-legged robot always keeps three legs on the ground for stability.
- Require **multiple motors per leg** (2 or more DOFs).
- **Biped robots** need active balance control (since only two contact points).

- Generally more complex, heavy, and costly.

🔁 Sensor–Actuator–Controller Interaction

- Inspired by **Braitenberg Vehicles (1984)** — showing how simple sensor-motor connections can create complex behaviors.

Two main configurations:

1. **Parallel Connection:**
    - Left sensor → Left motor
    - Right sensor → Right motor
    - Robot moves toward light but may overshoot or miss the target.
2. **Crossed Connection:**
    - Left sensor → Right motor
    - Right sensor → Left motor
    - Robot steers **toward** the light — smoother tracking behavior.

💡 *Demonstrates how simple reactive control can produce intelligent-looking motion.*