CSCE 452/752 Fall 2024

5. Other wheeled systems

TEXAS A&M UNIVERSITY

AARRG

Introduction

We've already talked about differential drive wheeled systems.

Today we'll talk briefly about **other wheeled systems**.

Three objectives.

1. Explain the assumptions behind the existence of an ICC.
2. Determine where the ICC might be.
3. Apply these ideas to various wheel configurations, including common patterns.

Multiple wheels

If the robot has multiple wheels, how does the robot move?

Two assumptions:

- Each wheel rolls forward or backward. No lateral movement.
- Wheels don't move relative to each other. The robot body is rigid.

Instantaneous center of curvature

To satisfy both of these constraints, there must be a single point, called the

instantaneous center of curvature (ICC)

around which each wheel moves in a circular motion.

Key idea

Each wheel rotates around the ICC with the **same angular velocity**.

Finding the ICC

- Draw lines **perpendicular** the rolling direction of each wheel.
- Identify points where these lines intersect.

Three cases

- If the perpendicular lines intersect at a single point, that point is the ICC.
- If the perpendicular lines overlap, the ICC can lie anywhere along that line.
- If the perpendicular lines do not share any common intersection point, the robot cannot move.

Bicycle drive: Steered wheels

Bicycle drive has a steered wheel in the front and a non-steered wheel in the back.

The steered wheel gives some direct control over where the ICC is.

Tricycle drive

Tricycle drive has a steered wheel in the front and two non-steered wheels in the back.

Synchronous drive

A **synchronous drive** robot has three steerable drive wheels.

- All the wheels always point in the same direction.
- All the wheels always drive at the same speed.

Ackerman steering

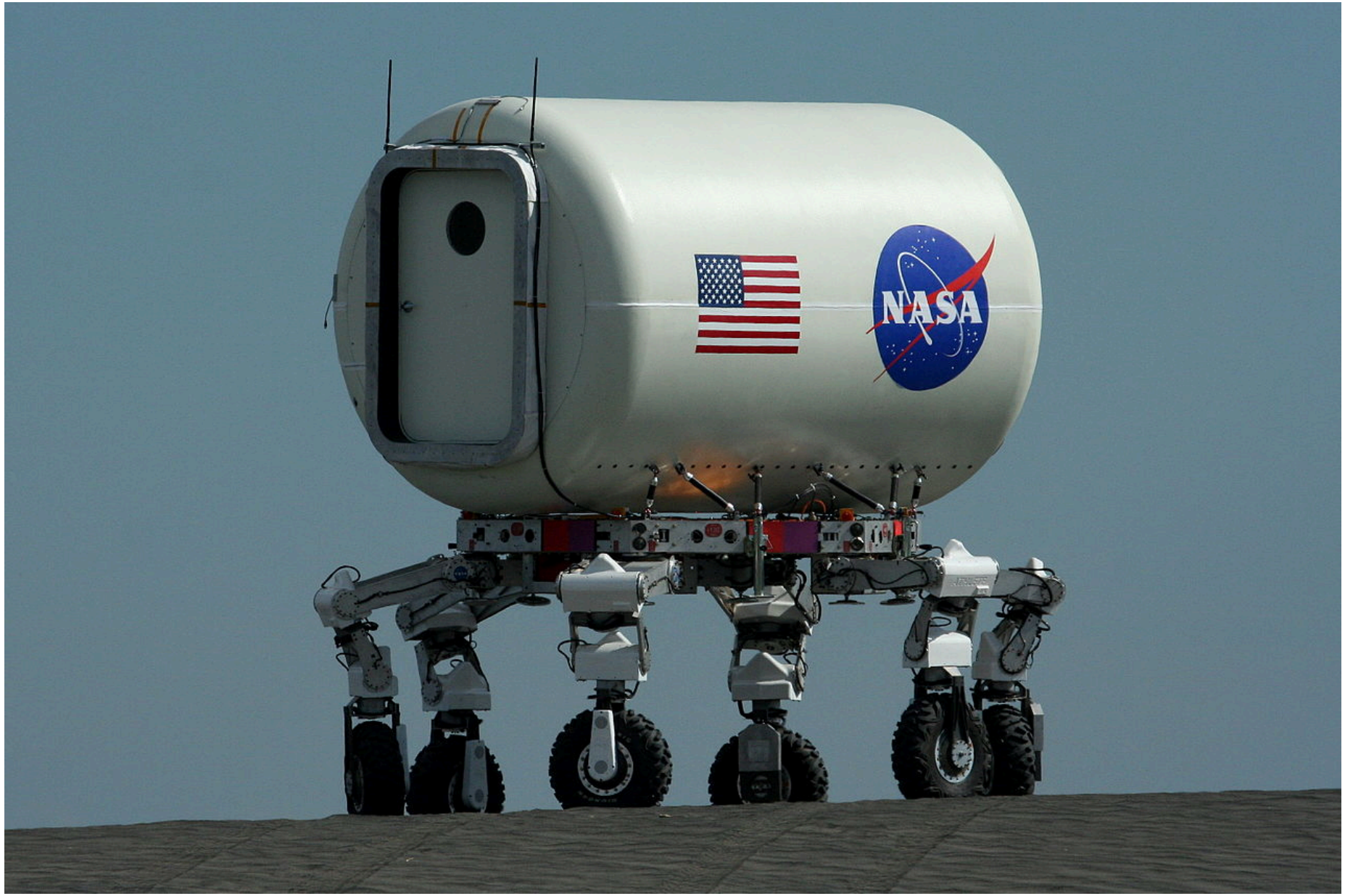
On traditional cars, the two steered wheels do *not* steer by the same amount. (Why?)

Alternatives to wheels

Both wheels and legs?

NASA Athlete

Both wheels and legs?



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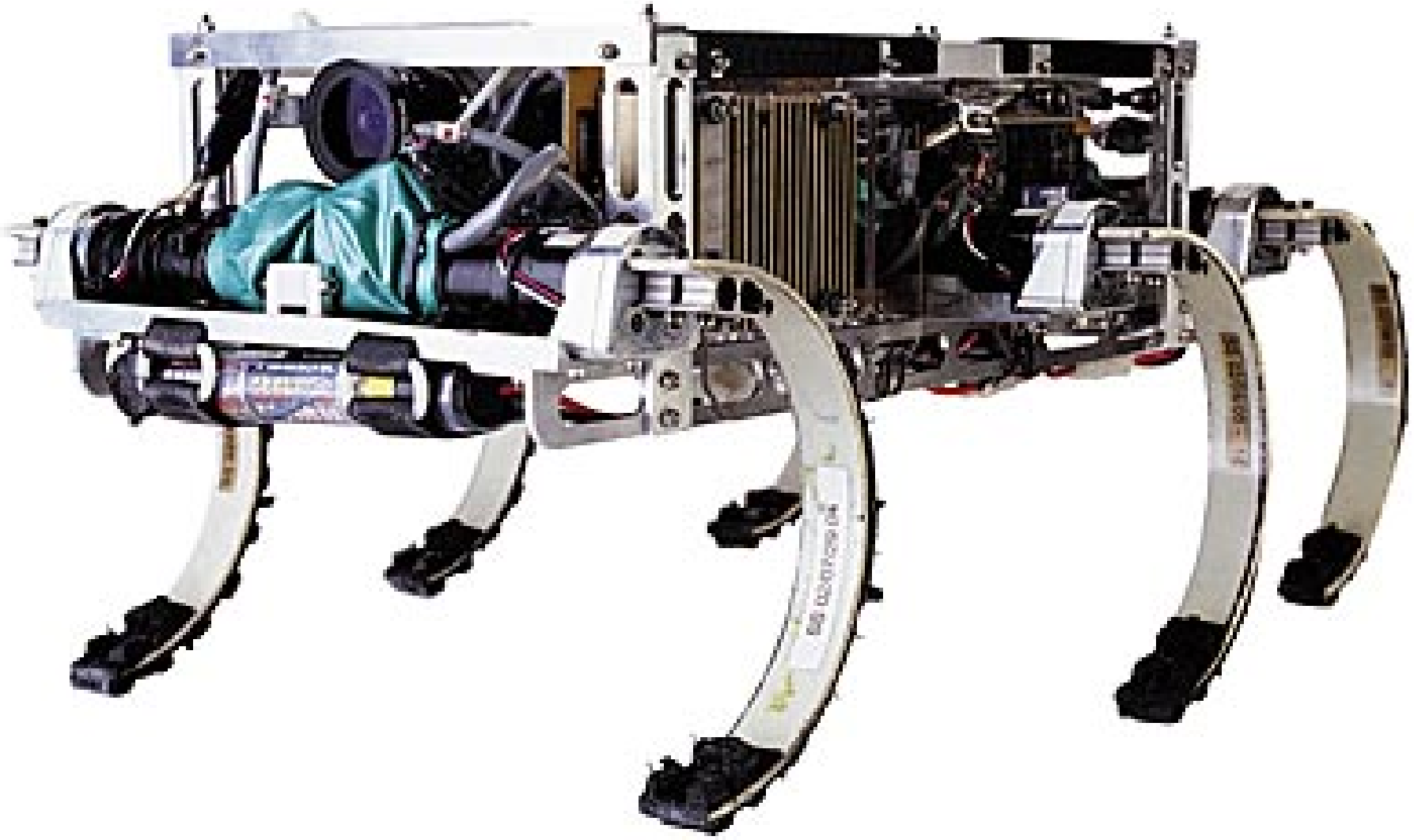
Middle ground between wheels and legs?



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Hybrid terrestrial/aquatic locomotion?