Autonomous and Mobile Robotics

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Wheeled Mobile Robots

Mechanics of Mobile Robots

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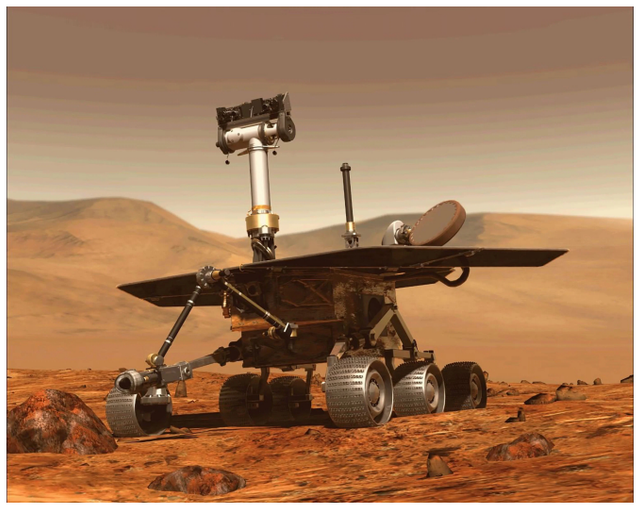
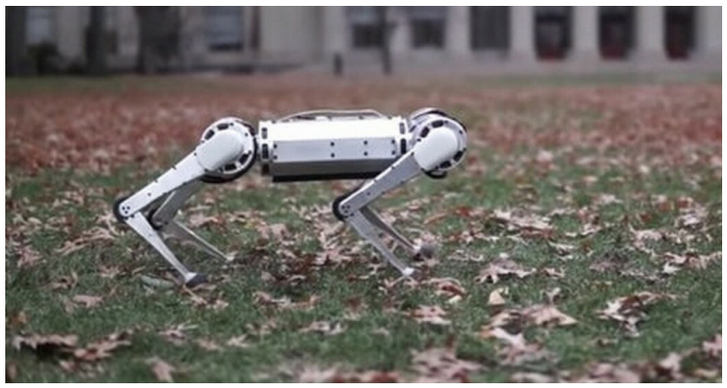
outline of this lecture

- ground locomotion
- balance
- wheels
- kinematic structures

ground locomotion

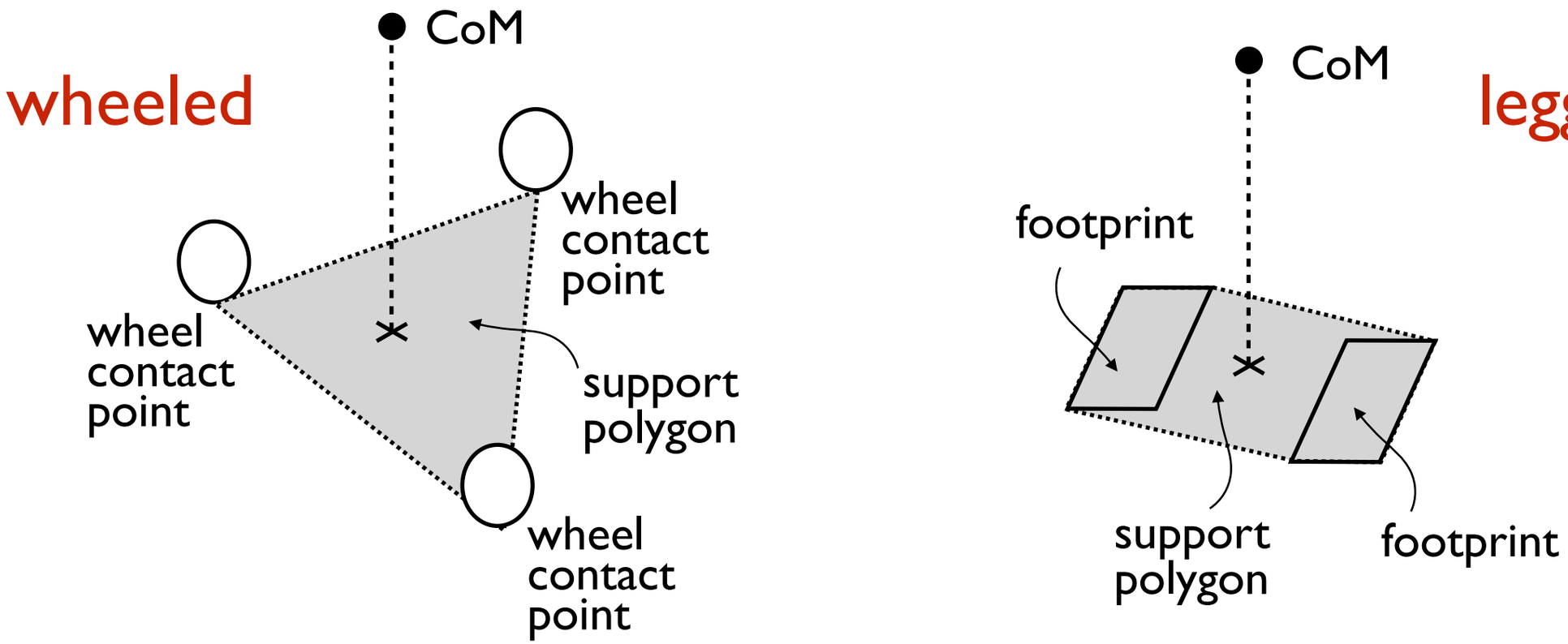
- requires contact via
  - wheels: wheeled mobile robots (WMRs), typically consisting of a rigid body (base or chassis) + wheels
  - feet: legged robots, typically consisting of several rigid bodies, articulated through joints
- some mobile robots can achieve locomotion on the ground without wheels or feet: e.g., snake robots





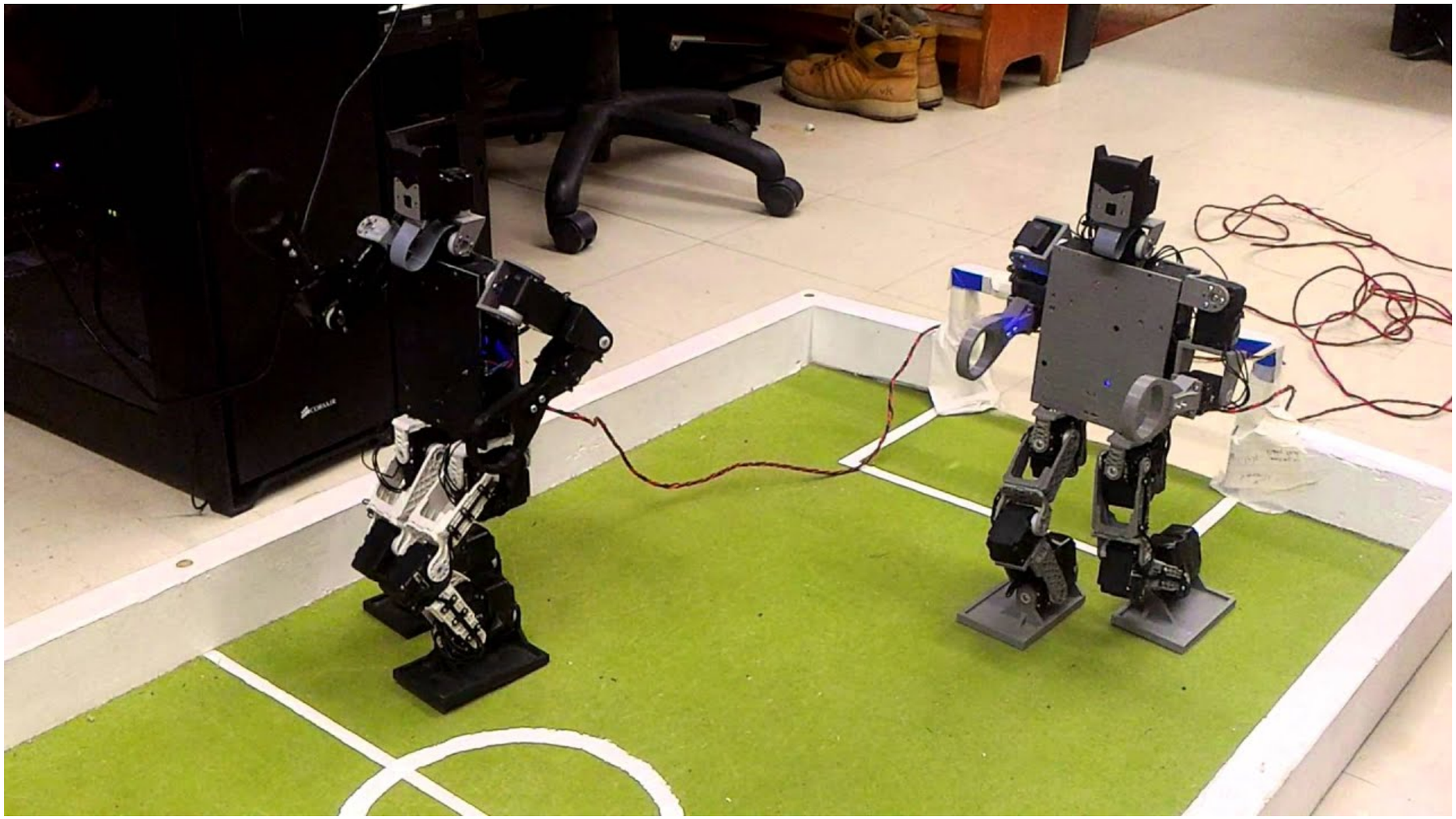
balance (not falling)

- statical balance is achieved when the projection of the robot Center of Mass (CoM) falls inside the support polygon; in the case of WMRs, one needs 3 wheels!



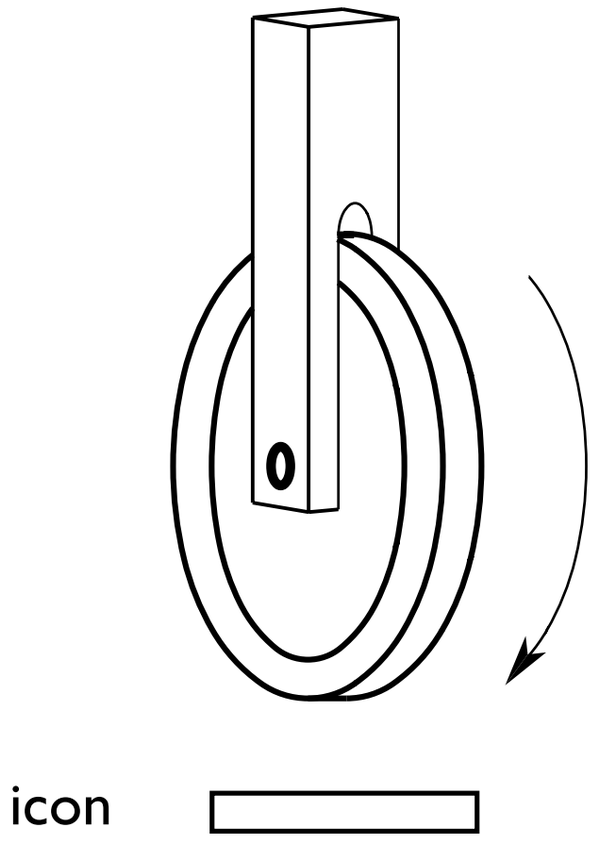
- dynamical balance is a different type of balance in which the CoM is replaced by the Zero Moment Point (ZMP)

balance (not falling)



dynamic walking vs static walking

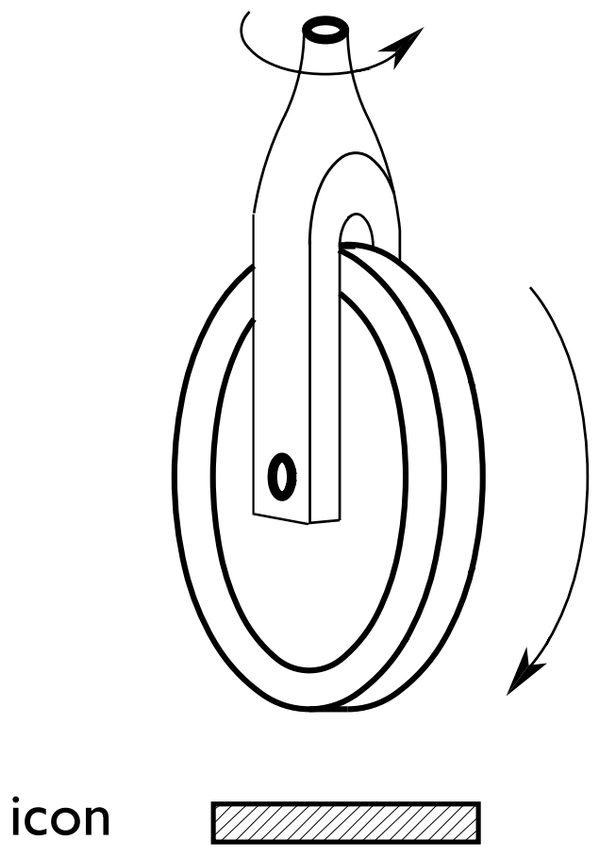
wheels: 3 basic types



fixed wheel

- fixed orientation w.r.t. the chassis
- may be active (used for driving) or passive (used for balance)

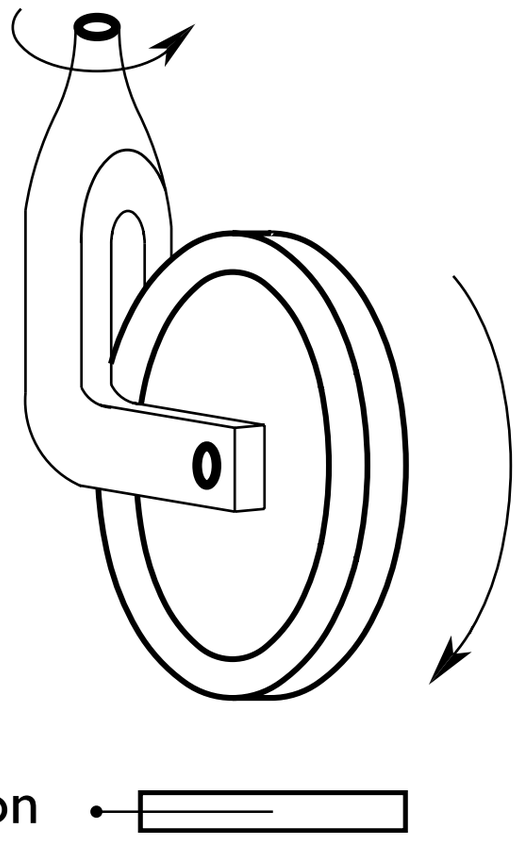
wheels: 3 basic types



orientable (steerable) wheel

- variable orientation w.r.t. the chassis
- typically active (used for steering)

wheels: 3 basic types

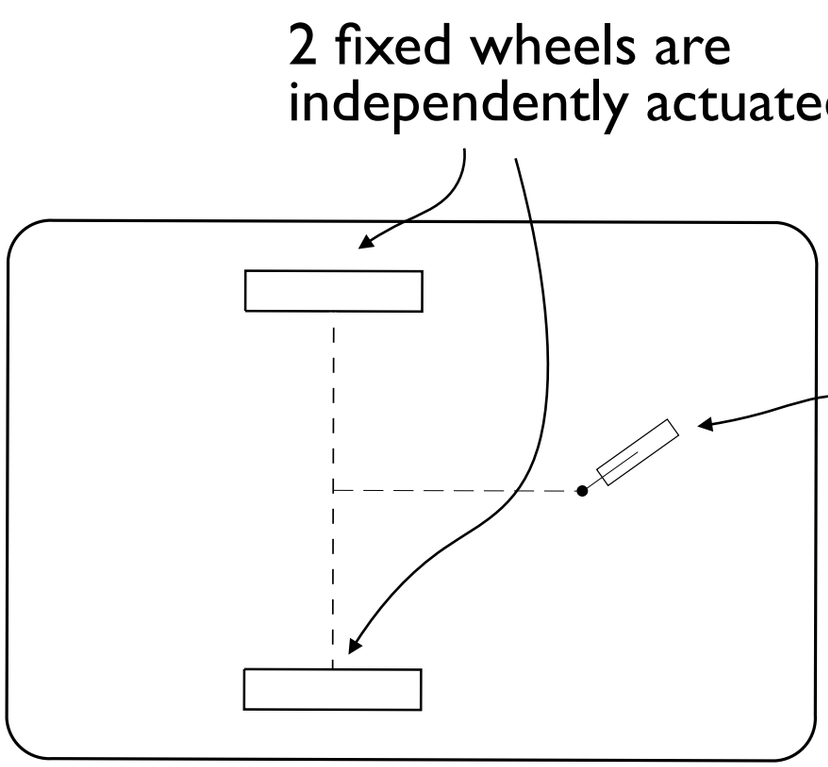


icon

caster wheel

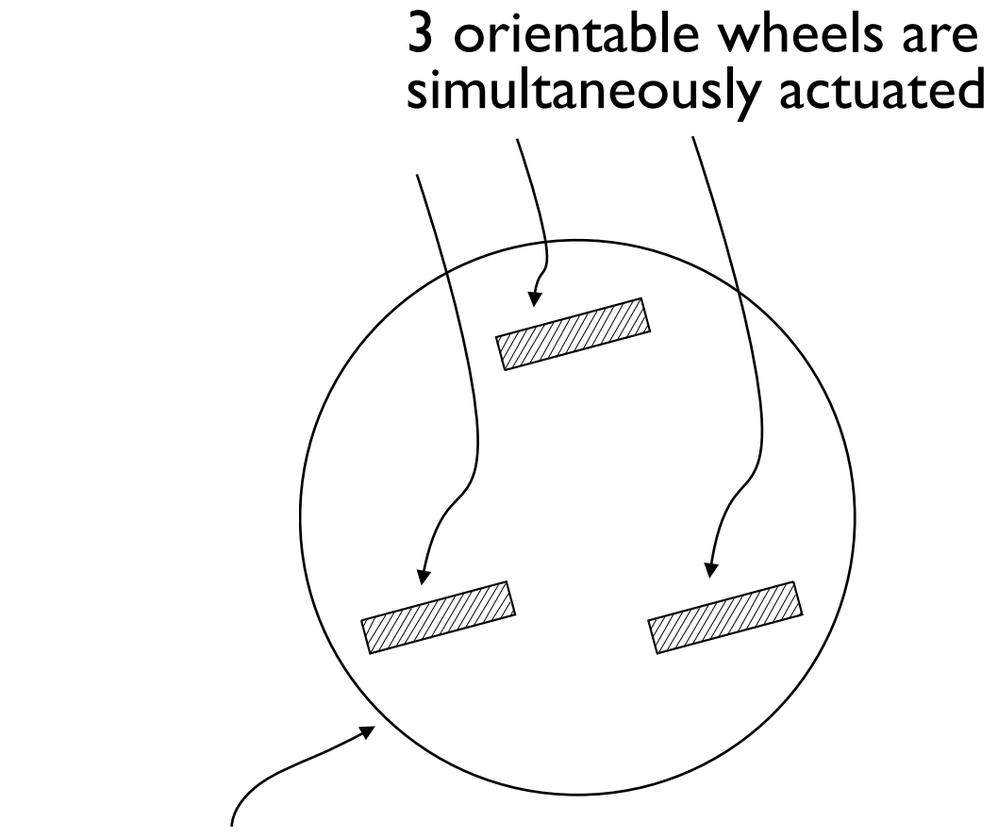
- variable orientation w.r.t. the chassis
- automatically aligns with the direction of motion
- typically passive (used for balance)

kinematic structures



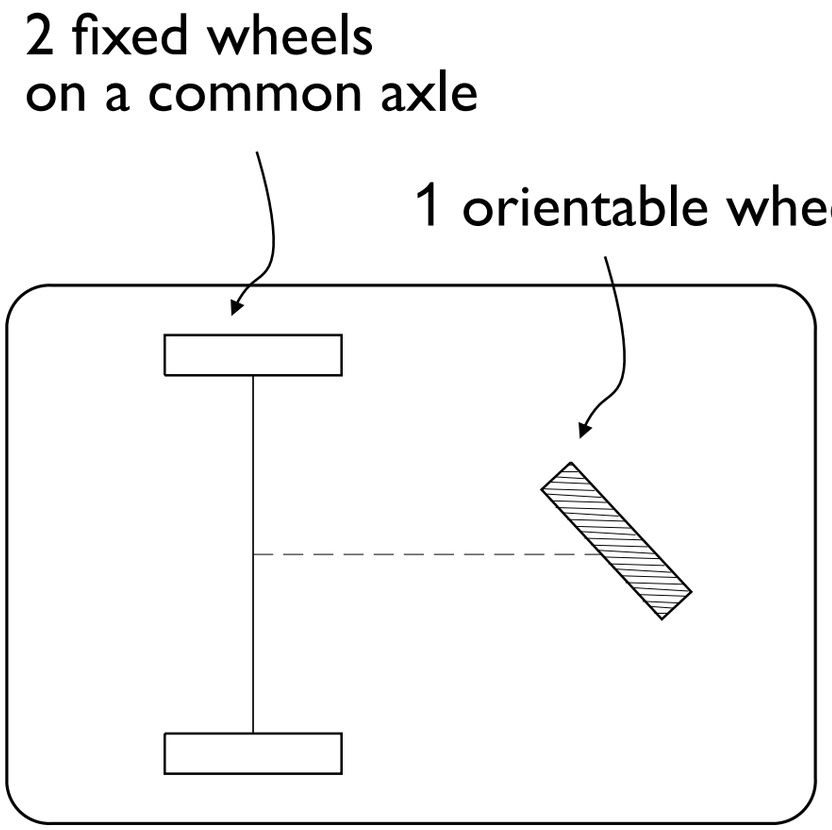
differential-drive mobile robot

kinematic structures

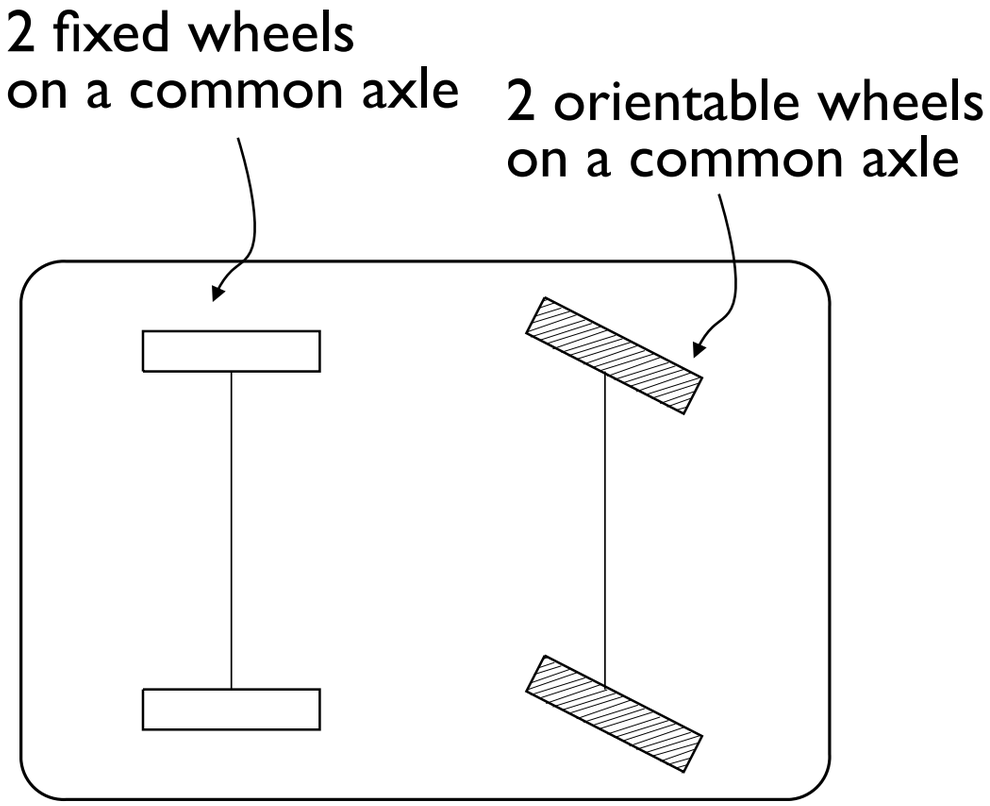


synchro-drive mobile robot

kinematic structures



tricycle

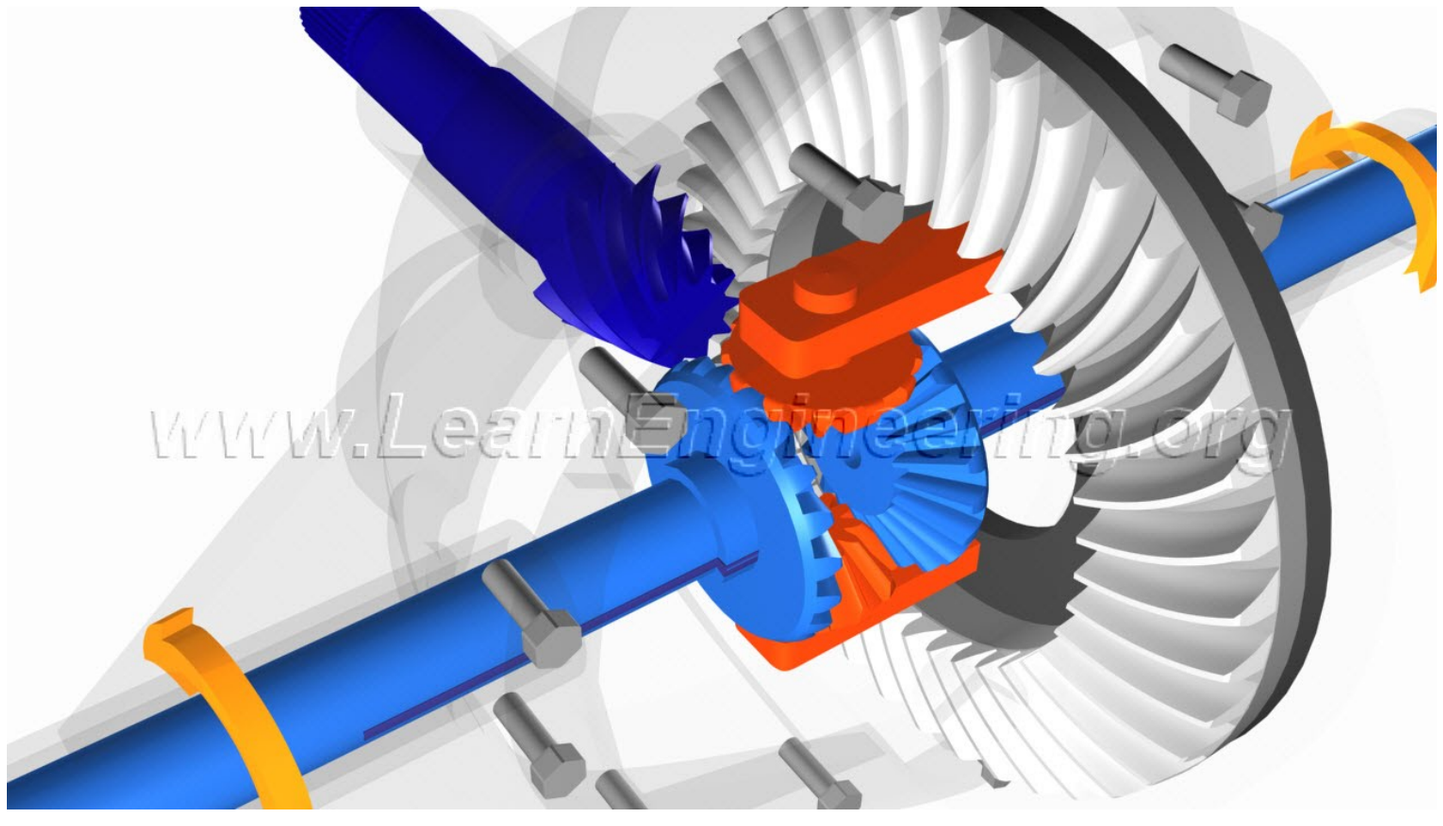


car-like

- both may be front-wheel drive or rear-wheel drive!

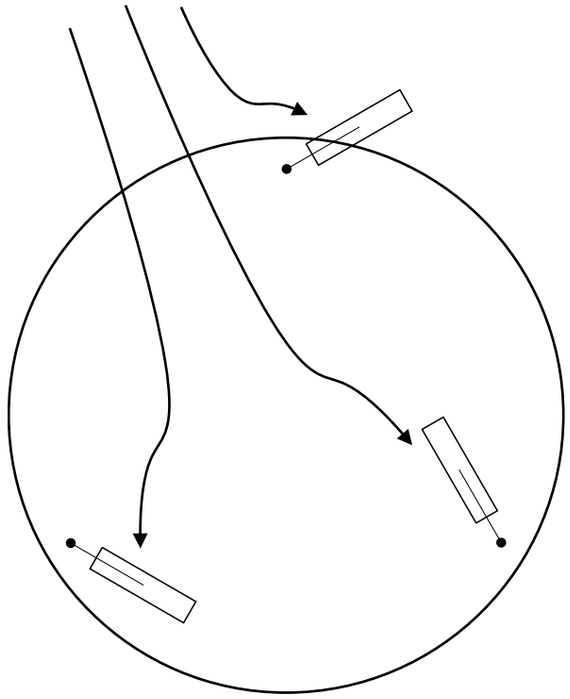
differential

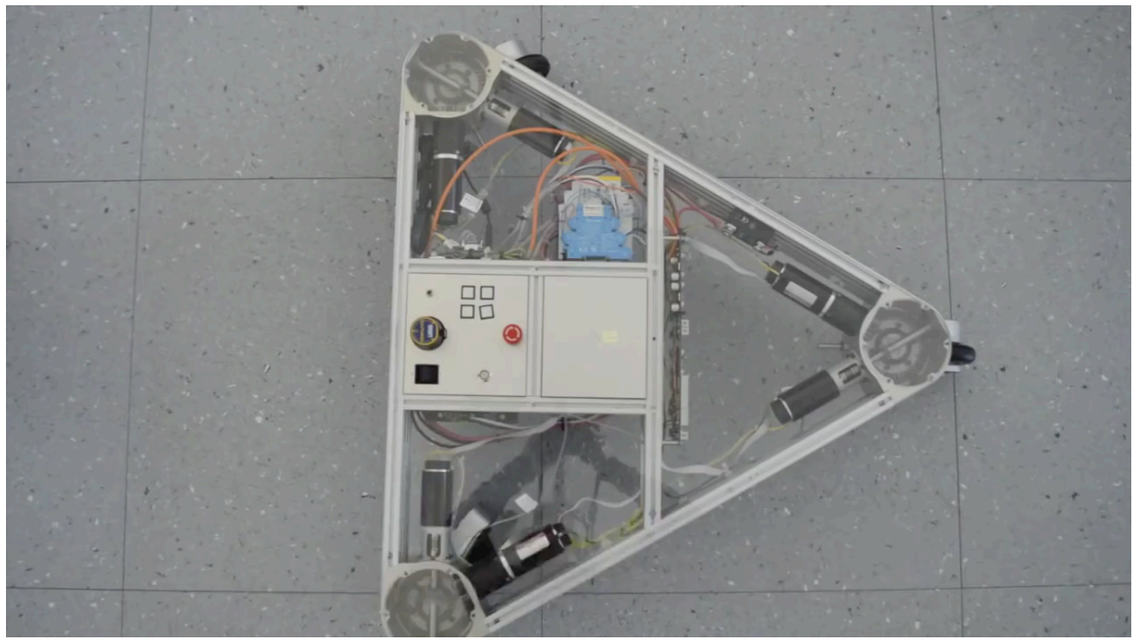
- needed whenever two driving wheels are mounted on a common axle
- a mechanical device that allows the two wheels to move at different speeds



kinematic structures

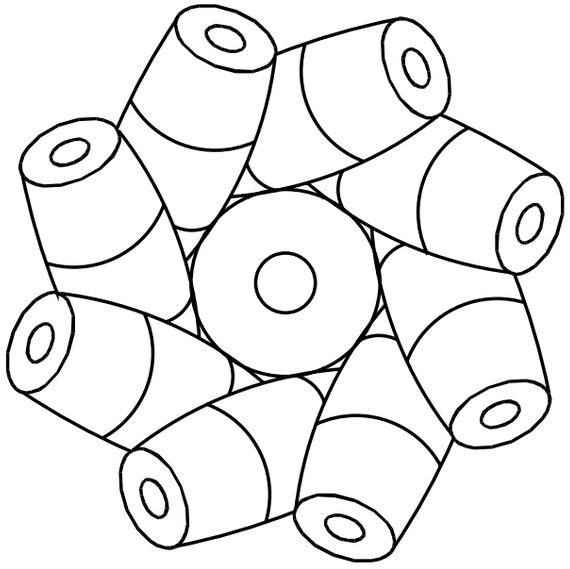
3 active castor wheels





omnidirectional mobile robot with
3 (actuated) caster wheels

kinematic structures



Mecanum (Swedish) wheels can be also used to build omnidirectional mobile robots