

# Robotic Locomotion

Mini-Enrichment Course

*Robotics: Intelligent Connection of  
the Perception to Action*

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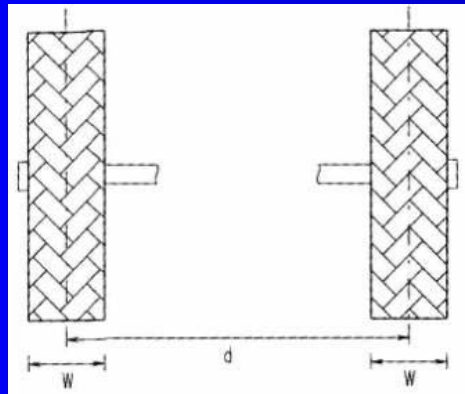
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# 5 Main Types

- **Differential drive**
  - Simplest drive mechanism
  - Consists of two wheels mounted on a common axis
  - Each wheel is controlled by a separate motor
- **Car drive (Ackerman)**
  - Found of most cars
  - The front steering wheels each rotate to provide steering
  - The back drive wheels power the motion of the vehicle
- **Synchro drive**
  - Mechanically or electrically synchronized motors
  - Each wheel is capable of being driven and steered
  - All the wheels turn and drive in unison (usually three of them)
- **Tricycle/bicycle drive**
  - Sometimes called bogey or wagon drive
  - Two/one rear wheel(s) are passive ones
  - The front wheel provides steering and power for the robot
- **Omnidirectional drive**
  - Most complex drive mechanism
  - Each wheel can go forward and sideways simultaneously
  - Robot can go in any direction smoothly

# Differential Drive

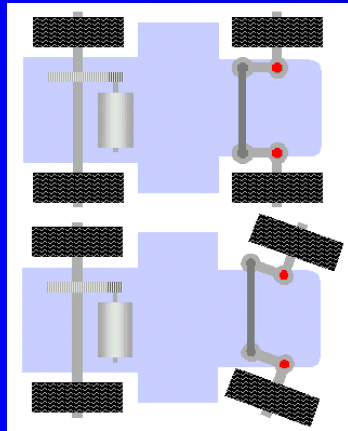
- Cheap to build and easy to implement
- Simple design and most popular wheeled-mobile robotic locomotion



- Easy to control robot motion
  - Spin towards target
  - Drive wheels towards target
- Main disadvantage: difficult straight line control

# Car Drive (Ackerman)

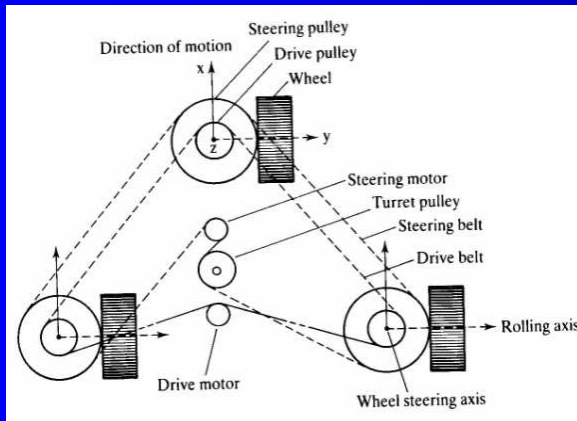
- Great for larger outdoor vehicles
- Can carry very heavy payloads



- Easy to implement
  - 4 bars control the front wheels
  - Common back axle controls rear wheels
- Main disadvantage: can't change robot position and orientation easily (think of parallel parking a car)

# Synchro Drive

- Control is much easier to perform
- Can carry very heavy payloads

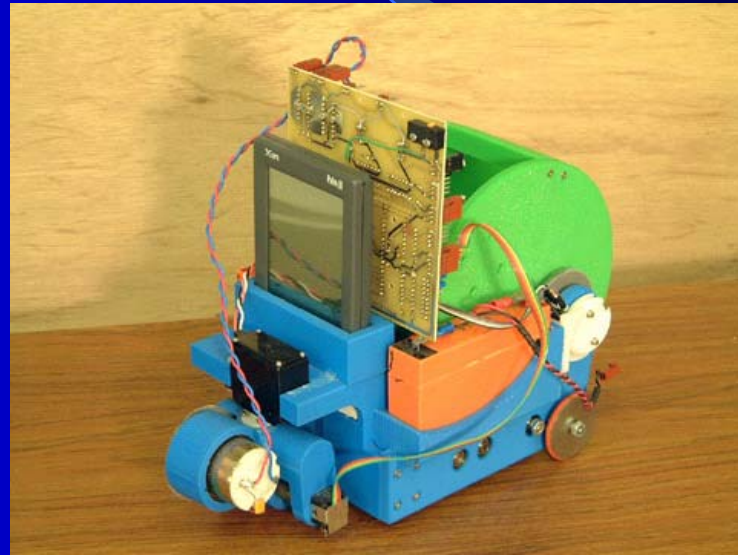
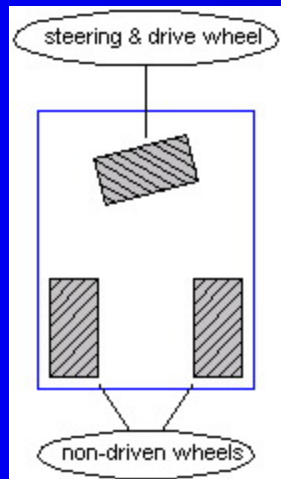


- Easy to control robot motion
  - Steer all wheels towards target
  - Drive all wheels towards target
- Main disadvantage: complex design and implementation



# Tricycle Drive

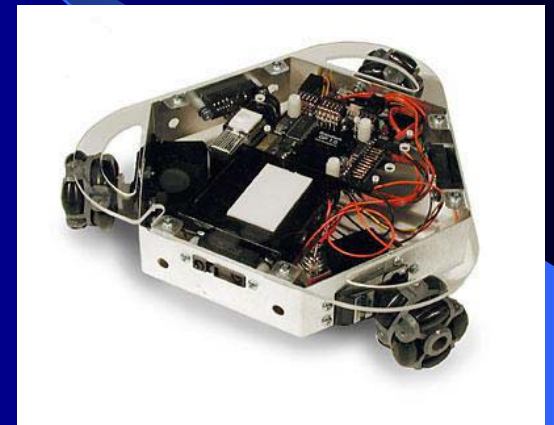
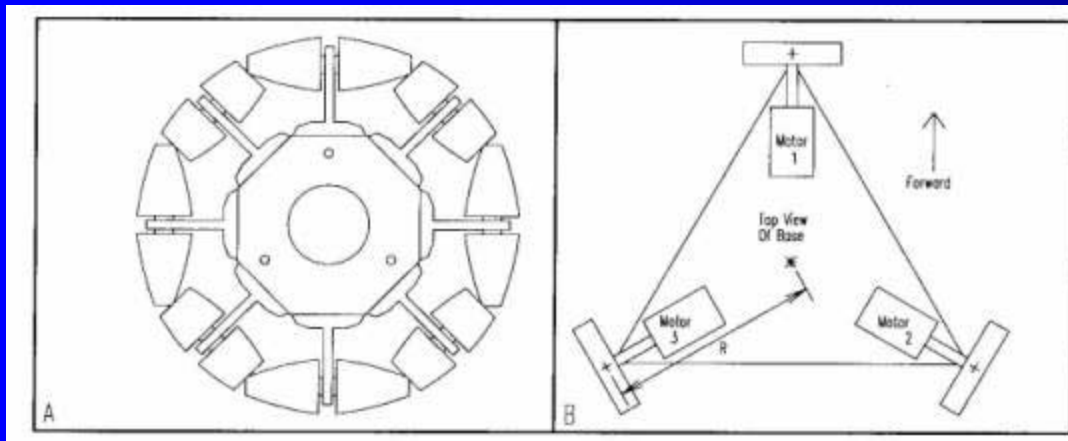
- Easy to control since only one wheel drives and steers



- Easy to control
  - Steer front wheel towards target
  - Drive front wheel towards target
- Main disadvantage: difficult to control in tight spots

# Omnidirectional Drive

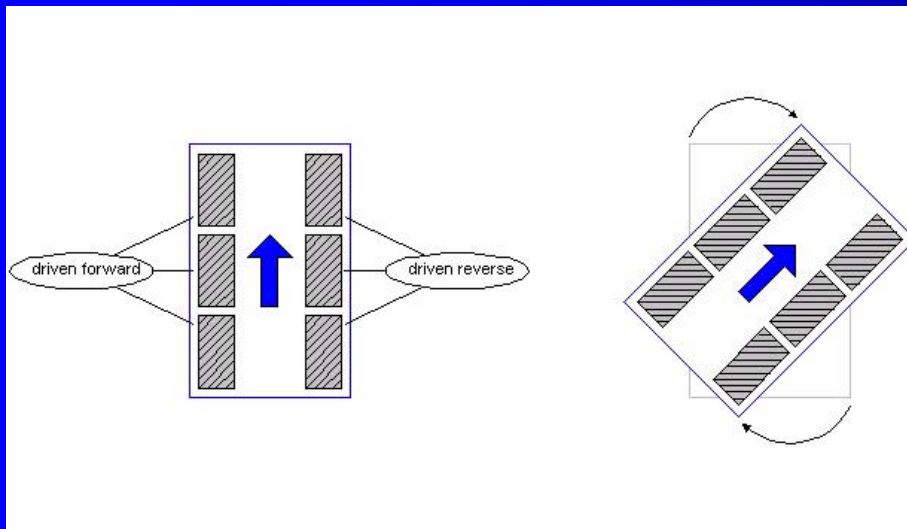
- Capable of very precise movements in all directions



- Difficult to control
  - Forward motion does not involve forward motion to each wheel
  - Complicated motions are possible but with difficulty
- Main disadvantage: complex implementation and control

# Other Locomotion Strategies (1)

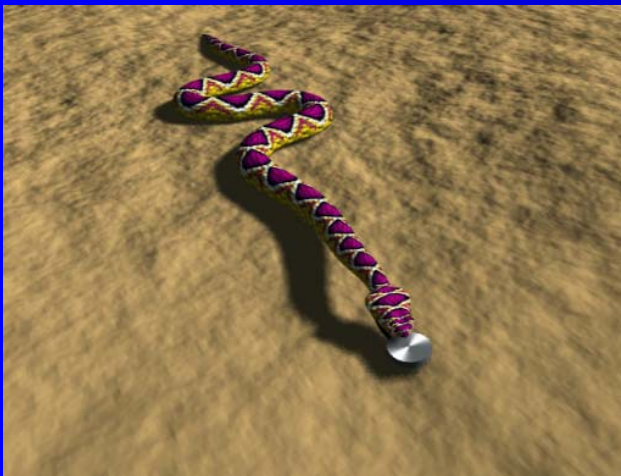
- Tank drive (skid steering)
  - Simple drive mechanism
  - Needs a lot of power to turn





# Other Locomotion Strategies (2)

- Snake robots
  - Very flexible and drives over rough terrains
  - Very difficult to control and path-plan



# Other Locomotion Strategies (3)

- Legged robots
  - Similar to human movement
  - Keeping the robot upright is very difficult



# References

- “Navigating Mobile Robots: Systems and Techniques”  
Borenstein, J.
- <http://arctangent.8k.com/snake/snakemain.htm>
- <http://www.acroname.com/robotics/info/PPRK/PPRK.html>
- <http://www.cs.dartmouth.edu/~robotlab/robotlab/courses/cs54-2001s/skidsteer.html>
- <http://www.cs.dartmouth.edu/~robotlab/robotlab/courses/cs54-2001s/car.html>
- <http://world.honda.com/ASIMO/>
- [http://www.sony.net/SonyInfo/QRIO/top\\_nf.html](http://www.sony.net/SonyInfo/QRIO/top_nf.html)