

MCT 333/334 Mechatronics System Design Spring 2026



Holonomic wheels

Lab objectives:

- Mecanum wheels vs omni wheels
- Mecanum wheels Analysis
- Omni wheel Analysis

1. Comparison between holonomic drive methods



Figure 1. Omni wheel vs Mecanum wheel

Feature	Omni Wheel	Mecanum Wheel
Roller orientation	Rollers are perpendicular (90°) to wheel plane	Rollers are angled (usually 45°)
Motion capability	Allows sideways motion but requires wheel arrangement to control direction	Enables full omnidirectional motion (forward, sideways, diagonal, rotation)
Control complexity	Simpler kinematics and control	More complex kinematics (vector decomposition)
Traction	Lower traction (rollers reduce grip)	Slightly better traction than omni but still less than standard wheels
Load capacity	Usually lower	Typically higher due to roller angle distribution
Efficiency	More efficient (less energy lost in lateral forces)	Less efficient because of force vector splitting

Feature	Omni Wheel	Mecanum Wheel
Cost	Cheaper	More expensive
Common configurations	3-wheel or 4-wheel holonomic platforms	Usually 4 wheels in X or O configuration
Best use cases	Educational robots, light platforms, line followers with lateral correction	AGVs, robotics competitions, warehouse robots, precise maneuvering

2. Mecanum wheel

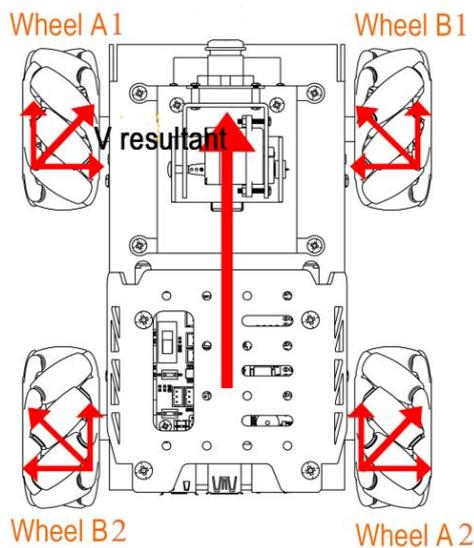


Figure 2. Top View



Figure 3. Bottom View

	Front	Slide right	Rotation CW	Diagonal
Wheel A1	1	1	1	1
Wheel B1	1	-1	-1	0
Wheel A2	1	1	-1	1
Wheel B2	1	-1	1	0

3. Omni Wheels

3.1 Wheel Configurations

3.1.1 3 Omni Wheels (120° configuration)

3 wheels

Each Wheel Separated by 120 degrees

Very Common in Education

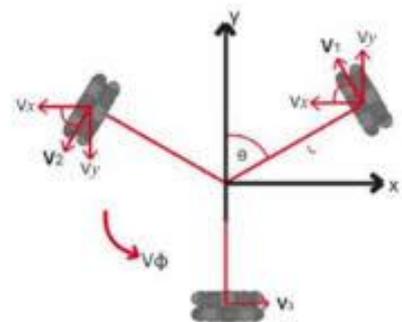


Figure 4. 3 wheel omni Config.

3.1.2 4 Omni Wheels (X-configuration)

4 wheels
Each Wheel at 90 degrees
Mounted at 45° angles
Called X-Drive Omni

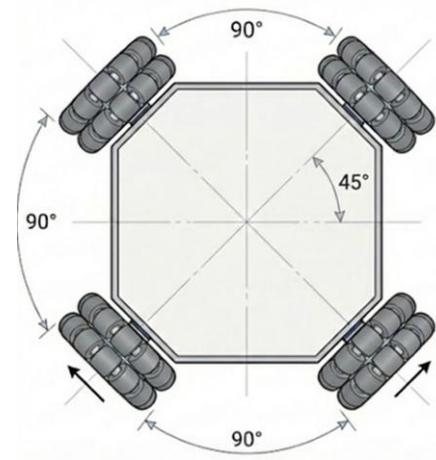


Figure 5. x- Configuration

3.2 4 Omni Wheels Configuration Drive

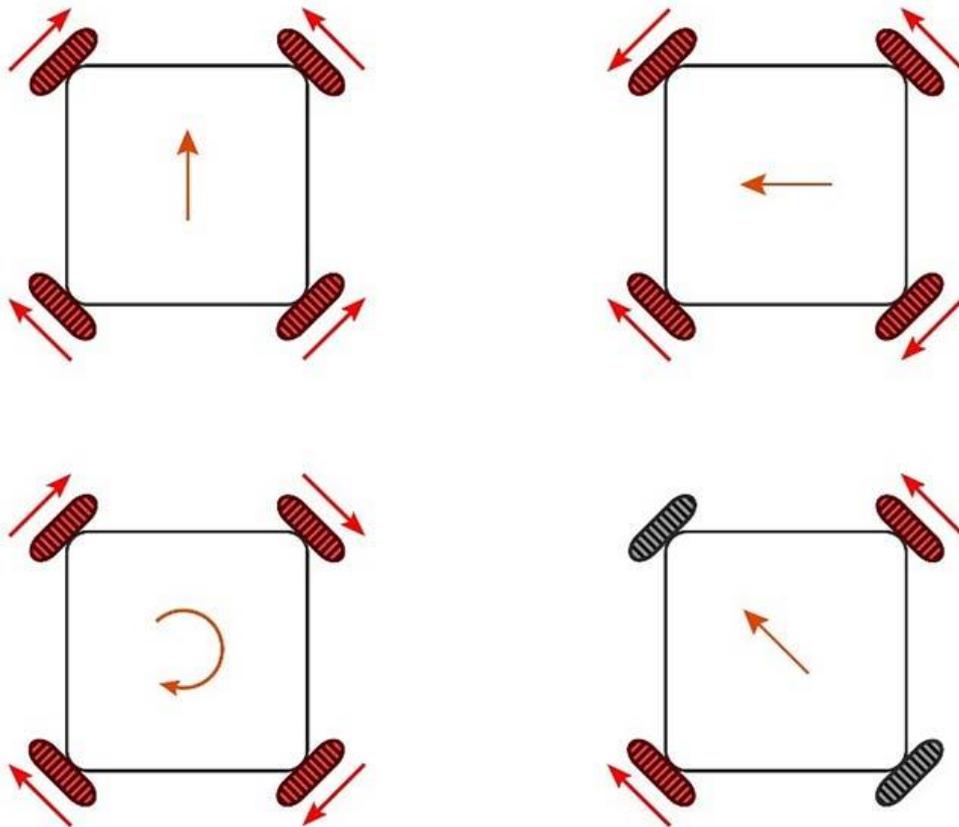


Figure 6. x-Drive

For modelling equations and control

<https://www.youtube.com/watch?v=NcOT9hOsceE>

<https://www.youtube.com/watch?v=B1K-ti5Lqjc>

Read chapter 13.2

<https://hades.mech.northwestern.edu/images/2/2e/MR-largefont-v2.pdf>