Drive Essentials

“The best drive train…
- is more important than anything else on the robot
- meets your strategy goals
- can be built with your resources
- rarely needs maintenance
- can be fixed within 4 minutes
- is more important than anything else on the robot”

-Andy Baker
Set a Schedule!

- Get something driving early
  - End of week 2
  - Practice for operators
  - Strategy lessons
- Continuously improve
  - Good enough is not good enough
- Finish final drive train by week 4
Note that...

- Good drive bases win consistently
- Reliable drive bases win awards
- Well-controlled, robust drive bases win **Championships**
- **Boat anchor** = any heavy mass that does not move
- A non-reliable or non-repairable drive base will turn your robot into a **boat anchor**
Note that...

- Speed is game dependent, however, it increases every year.
  - Controllable top speed: 15 ft/sec
  - Average 1-speed rate: 9 ft/sec
  - Good pushing speed: 5 ft/sec
Center of gravity (Cg)

- Robot mass is represented at one point
- **Mobility** increases when Cg is low and centered
- High parts = light weight
- Low parts = heavy (within reason)

Ms Mobile

Battery motors, pump, etc.

Battery motors pump, etc.

Mr Tippy
Drive Essentials

- Decide **together** after kickoff:
  - Speed, power, shifting, mobility
- Use most **powerful** motors on drive train
- Give software team **TIME** to work
- Give drivers **TIME** to drive
- Know your **resources**
Drive systems Information

- Systems differ in **advantages and disadvantages**.

- **Motion Control**
  - **Holonomic**: Controllable DOF equal Positional DOF
  - **Non-holonomic**: Controllable DOF is less than Positional DOF
Holonomic
Non-holonomic
Basic Drive Types

- **Non-holonomic**
  - Tank

- **Holonomic**
  - Crab
  - Omni –including Mecanum
Tank

- Moves in one direction
- Cannot drive left or right without turning
- Navigate on difficult ground
- Simple to construct
- Pushes well in direction of travel

- Classic tank drive
- Wheels can be added at a lower contact point
Crab

- Typically has four wheels
- Diverse
  - Tank
  - Car
  - Swerve drive
- Involves eight motors
  - drive motors and turning motors
- Turning drives require encoders
- Complex software

- High traction wheels
- Pushes and holds position
- Difficult to drive
- Wheel turning delay
Omni

- Moves in one direction
- Typically has three wheels
- Can drive forward, reverse, left, right, turn right and turn left

- Maneuverable on flat surface
- Difficult to drive on terrain
- Difficult to push an object
- Immediate turning
- Incline difficulty
Mecanum

- Typically has 4 wheels
- 4 independent wheels
- Weight should be balanced on all four wheels

- Maneuverable on a flat surface
- Can incline in forward position only
- Pushes fairly reasonably
4 wheel drive, 2 gearboxes

- Easy to design
- Easy to build
- Inexpensive
- Powerful
- Sturdy and stable

- Not agile
  - Turning is difficult
  - Adjustments needed
4 wheel drive, 4 gearboxes

- Easy to design
- Easy to build
- Powerful
- Sturdy and stable
- Many options
  - Mecanum, traction

- Heavy
- Costly
6 wheel drive, 2 gearboxes

*Being Agile
1. Middle wheel at lower point of contact
2. Omni wheels on front, back, or both

+ Easy to design
+ Easy to build
+ Powerful
+ Stable
+ Agile*

**- depending on wheel type

- Heavy**
- Expensive**
Tank tread drive, 2 gearboxes

- Powerful
- Very stable
- Not agile
- Heavy
- Inefficient
- Not fast
- Expensive
- Hard to maintain

Sole ability: to go over objects
3 wheel drive, 2 gearboxes

- Light weight
- Fast
- Various types
- Not standard
## Drive Effectiveness

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<th>Pushing Power</th>
<th>Quickness of Manoeuverability</th>
<th>Effect of Weight Distribution</th>
<th>Effectiveness in Terrain</th>
<th>Intuitiveness of Drive</th>
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<td>Omni Drive with 4 Wheels</td>
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<td>Car Drive with 4 Wheel Steering</td>
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</tbody>
</table>

* in forward direction only
* can improve with software
* can improve with software
Quiz time
#1

- A tank tread drive with two gearboxes can easily
  - A. Push
  - B. Go over objects
  - C. Be designed
According to Andy Baker, “the best drive train …

A. Is the most important thing on your robot”
B. Can be fixed within 15 minutes
C. Needs maintenance throughout the season
#3

- When adding wheels between any two driven wheels what should you do? Why?
  A. Position them at a higher level of contact
  B. Position them at the same level
  C. Position them at a lower level
What type of wheel is this?
A. Omni
B. Mecanum
C. Tank
#5

- How many motors should a crab drive have?
  A. Eight
  B. Four
  C. Two
#6

- Name some characteristics of the following drive types.
Tank tread drive, 2 gearboxes

- Powerful
- VERY Stable
- NOT AGILE
- HEAVY
- Inefficient
- Not fast
- EXPENSIVE
- Hard to maintain

Sole ability: to go over objects
4 wheel drive, 2 gearboxes

- Easy to design
- Easy to build
- Inexpensive
- Powerful
- Sturdy and stable

- Not agile
  - Turning is difficult
  - Adjustments needed
3 wheel drive, 2 gearboxes

- Light weight
- Fast
- Various types
- Not standard
4 wheel drive, 4 gearboxes

- Driven Wheels

- + Easy to design
- + Easy to build
- + Powerful
- + Sturdy and stable
- + Many options
  - Mecanum, traction

- - Heavy
- - Costly
6 wheel drive, 2 gearboxes

- Easy to design
- Easy to build
- Powerful
- Stable
- Agile*

- Heavy **
- Expensive **

** - depending on wheel type