FRC

DRIVETRAINS

HELLO!

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Purpose of Drivetrains

Mobility

Traverse the field and any obstacles in game play

Defense

Get your opponents out of scoring position depending on the game

Offense

Get your robot in scoring position quickly and efficiently, regardless of defense

More Time

Keep your robot in the scoring position long enough to score repeatedly

BY FAR the most important part of your robot:

Can help you win Regionals and even World Championships

Eg: FRC 148 in 2008

Selecting a Drivetrain

- Is the drivetrain within my team's build capabilities?
- Will the drivetrain get my robot where it needs to be reliably, and quickly?
- Avoid defense with agility and speed, or push through defense with power?
- Drive around obstacles or through/over them?
- How many motors dedicated to drivetrain vs. other manipulators

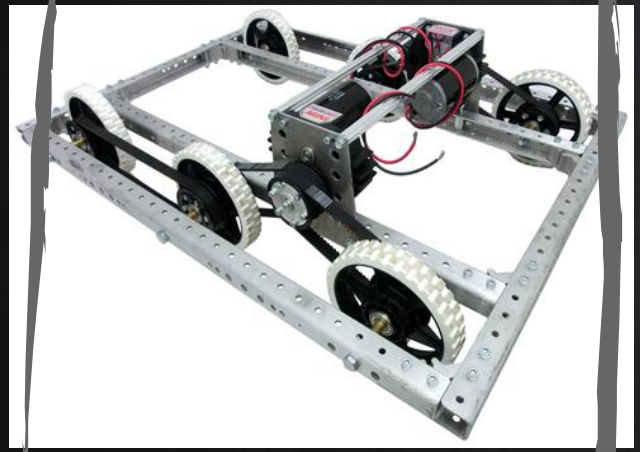
Comparing Drivetrains

	Tank	Mecan	Swerve	Kiwi	Slide	Butterfly
Agility	2	5	5	5	4	2
Strength	5	1	5	1	3	5
Motors	4	4	1	5	3	4
Program	5	3	1	2	4	4
Drive	5	2	1	1	4	4
Traverse	4	4	5	4	3	3
Design	5	4	1	3	2	1
Weight	4	2	1	5	3	4

Types of FRC DriveTrains

- Tank
- Mecanum
- Slide
- Butterfly
- Grasshopper
- Kiwi
- Nonadrive/Butterslide
- Swerve

Tank Drive: the most common



- Includes West Coast Drive, 6WD Tank, 8WD Tank
- Uses a skid steering and traction wheels powered by 2-6 motors
- Many different things to do with tank drives:
  - Teh Chezy Pofs, FRC 254 = crazy code stuff to make tank driving smoother
  - 3 Cim Ball shifters, chain/belts, 6 wheel drop center, etc.
- Tons of resources available for Tank drive

When to use Tank

Pros:

- Easy to Build
- Short learning curve for drivers
- Powerful, reliable, fast, proven to be effective

Cons:

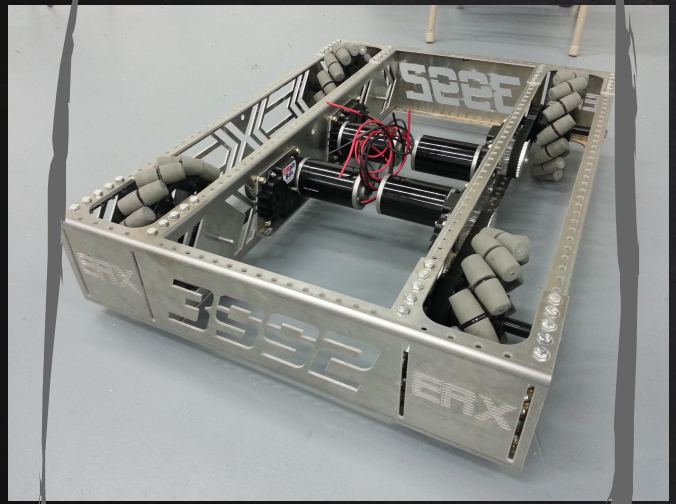
- Can be heavy
- The Roborio is easy to brown out with a 6 cim tank drive
- Can't strafe

"Anything that moves sideways is a waste of time"

–254 Mentor

Conclusion: Tank drive is the most common for a reason. It's rarely a bad choice.

Mecanum Drive



- The second most common drivetrain in FRC
- Pronunciation: Meck-an-um
- Spelling: Mecanum (no “h”)
- Uses specialized wheels with rollers all around the wheel mounted at 45 degree angles to strafe
- Each wheel must be controlled by an independent gearbox (4 motors and 4 gearboxes required)
- Mecanum drives are often made better by using sensors like gyros and encoders

When to use Mecanum

Pros:

- Strafing
- Relatively easy to build

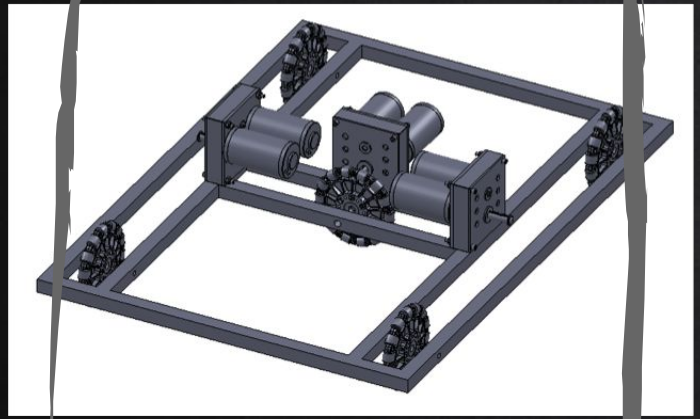
Cons:

- No pushing
- Steep learning curve for drivers
- # of gearboxes/ motors
- Expensive

In Minnesota, we are lucky to have arguably the best Mecanum team in the world- 2052.

Conclusion: When strafing/agility is unusually important, and defense isn't a huge factor (2015), it can be a good choice.

Slide Drive aka H-Drive



- Essentially a tank drive with omni wheels replacing traction wheels and an extra omni wheel and gearbox mounted perpendicular for strafing
- Has the same maneuverability as mecanum with less gearboxes
- The strafe wheel can be difficult to mount – needs to be near the center of gravity, and getting the weight distributed to each of the wheels is not easy

When to use Slide

Pros:

- Agile and fast
- Can drive it like a tank drive & use strafe
- Easier learning curve than mecanum

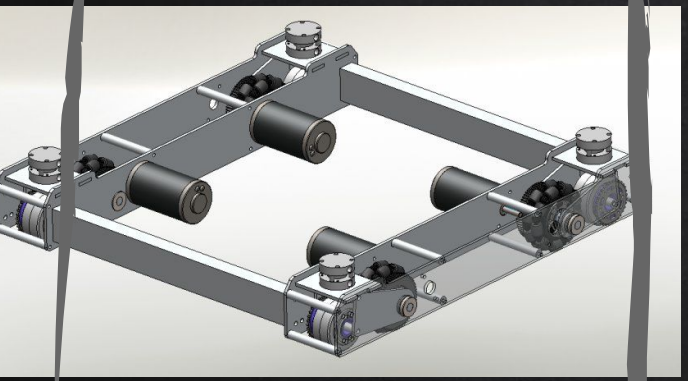
Cons:

- Limited max pushing power
- Weight distribution can be difficult
- Steeper learning curve than tank

The GreenHorns 2015 Ri3D team used a slide drive and successfully built one in 3 days. It was effective for the 2015 game, Recycle Rush.

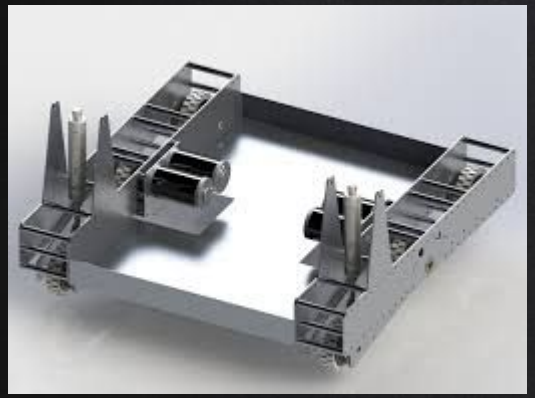
Conclusion: I would recommend slide drive before mecanum, but rarely is it a better choice than tank. In Unique games like 2015 it's a good choice

Butterfly Drive

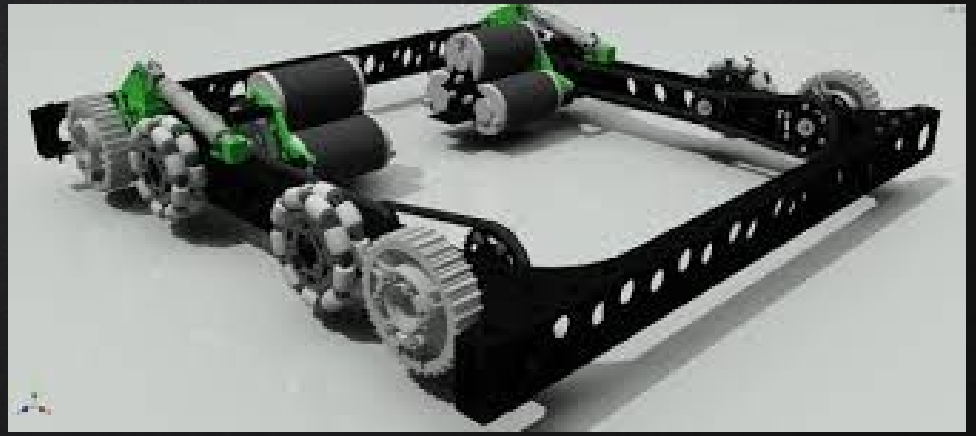


- Uses 4 “butterfly modules” at each corner of the robot with 2 wheels each
- Each module contains an omni wheel and a traction wheel
- Modules shift from omni to traction through the use of a pneumatic cylinder on each module
- Some people gear down the traction wheel compared to the omni wheel
  - When the traction wheel is geared down you can’t “shift on the fly”
- ✘ Having both omni wheels and traction wheels allows for the drivetrain to be versatile

Grasshopper Drive



- Same thing as butterfly drive except it uses just two longer pneumatic cylinders (the back legs of a grasshopper) to actuate from omni to traction mode



When to use Critter Drives

Pros:

- Butterfly modules are now available to buy from Vexpro
- Powerful, fast, and agile

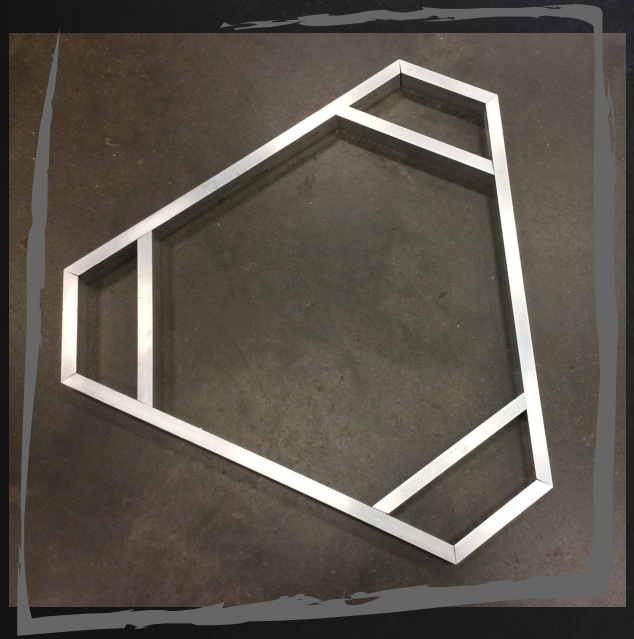
Cons:

- Heavy
- Relies on pneumatics to work
- More complex than tank, slide, and mecanum

Note:
"Critter" =
Butterfly Drive +
Grasshopper Drive

Conclusion: The best time to use a butterfly drive is for defensive games and with good drivers on your team

Kiwi Drive



- Is a version of a “holonomic drive,” essentially meaning there is no defined forward direction
- Use 3 gearboxes and 3 omni wheels
- Can be built without using any chains or belts
- Making sure the wheels are in the same plane isn’t an issue with Kiwi drives,
- Can be made to be much more user friendly through the use of sensors like gyros and encoders

When to use Kiwi Drives

Pros:

- Extremely agile
- Less motors and gearboxes
- Extremely easy to build
- Easy maintenance
- Triangular frame

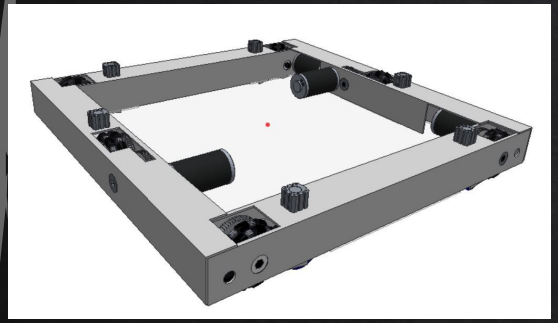
Cons:

- Zero Pushing Power
- Programming can be complex
- Steeper Learning curve

Who can guess the backstory of why it is called kiwi drive and not strawberry drive?

Conclusion: Kiwi is the first strafing drivetrain that I would recommend for teams

Nonadrive/Butterslide Drive



- A combination of a slide drive and butterfly drive
- When in omni mode the center strafe wheel(s) are touching the ground
- When in traction mode, the strafe wheel(s) get lifted off the ground

Octocanum Drive

- Same thing as butterfly except replacing the omni wheels with mecanum wheels
- Same capabilities as butterslide
- Butterslide vs. Octocanum:
  - Same as the debate between slide drive and mecanum drive

When to use Butter/Octo

Pros:

- Can do everything a butterfly drive can do while adding the ability to strafe

Cons:

- There's no way to make a light-weight Butterslide drive

Good game for this =

Aerial Assist in 2014

Conclusion: Use when the game is extremely drivetrain intensive and defense can run rampant (no safe zones)

Swerve Drive

- Swerve is the most capable drivetrain in FRC
- Consists of 4 swerve modules that each contain 1 drive motor, and one motor for turning– 8 motors total
- They are extraordinarily difficult to program, and execute
- Sensors with proper implementation are a requirement

When to use Swerve

Pros:

- Arguably most agile and powerful drivetrain

Cons:

- Heavy (unless you're 4818)
- Beyond most teams' capabilities

For an example, check out FRC 4818 from West Fargo, ND

Conclusion: I wouldn't recommend Swerve to any team in Minnesota, yet. We are a young state in terms of robotics and have a lot to learn before we're ready.

Other Resources:

Simbotics (Gold mine):
http://www.simbotics.org/files/pdf/drivetrain design.pdf

Questions?

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