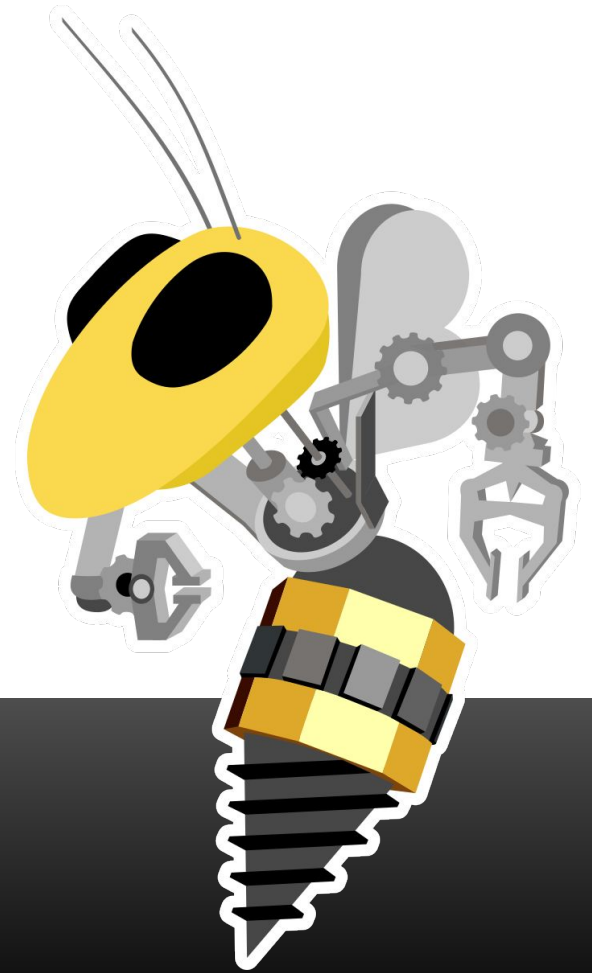


Mechanical Workshop

Nicholas "Nick" Vellenga and
Thanapol "Boss" Tantagunninat



ROBOJACKETS
COMPETITIVE ROBOTICS AT GEORGIA TECH

www.robojackets.org

Open the “speaker notes” for additional info

Materials



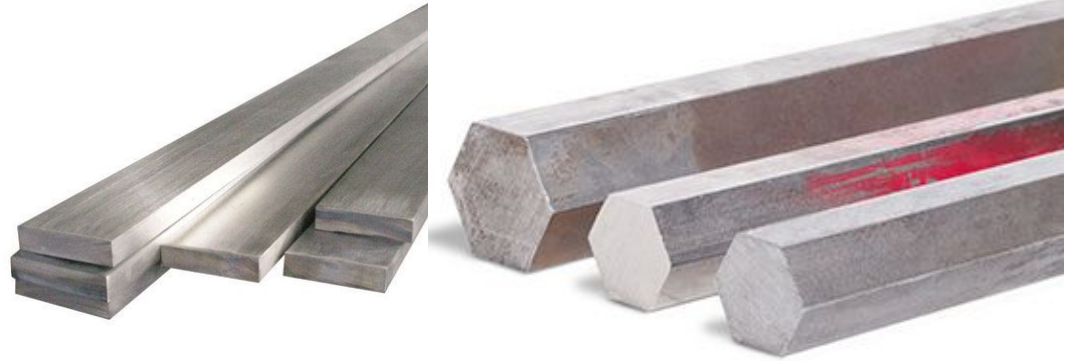
Aluminum

- Alloys: 6061, 7075, 5052
- Lightweight
- Pretty cheap
- Pretty strong
- Easily shaped
- Corrosion resistant
- Harder to weld

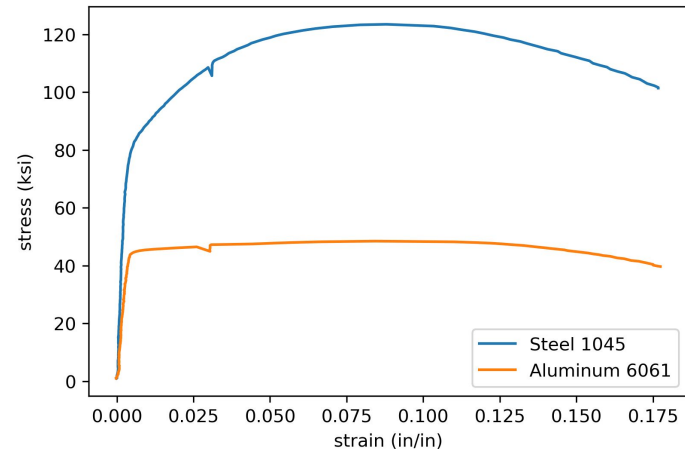


Steel

- Alloys: A36, 1045
- Stainless: 304, 316
- Very strong
- Easy to weld
- Heavy
- More expensive

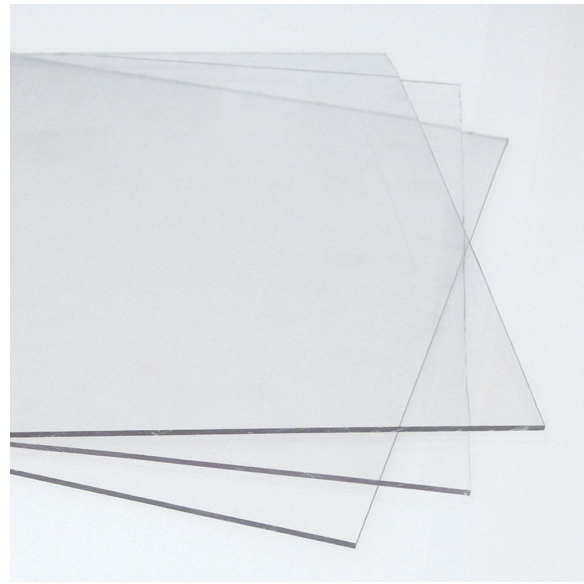


Stress Strain Curve of Steel 1045 and Aluminum 6061 in tension



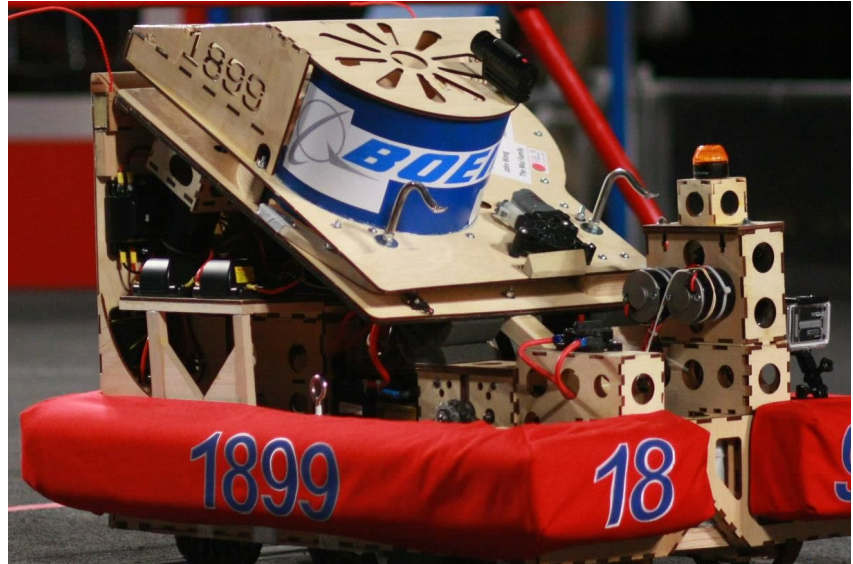
Polycarbonate

- Very light
- Transparent
- Flexible, formable
- Tough
- Weaker than aluminum



Wood

- Versatile: lumber, plywood, composites
- Light
- Cheap (theoretically)
- Easy to cut and join
- Weaker



Tools



Drill

- Create holes of various sizes
- Cordless vs corded, impact driver
- Drill bits vs driver bits



Drill Press

- Bench-mounted drill
- Makes square holes (no, not that kind of square hole)
- Clamps recommended
- Not to be used with end mills or sanding drums



Rotary Tool

- Tiny drills
- Cutting discs
- Sanding drums and grinding burs
- Always clamp workpiece



Jigsaw

- Cut complex 2D shapes
- Quick and effective
- Can be rough and imprecise



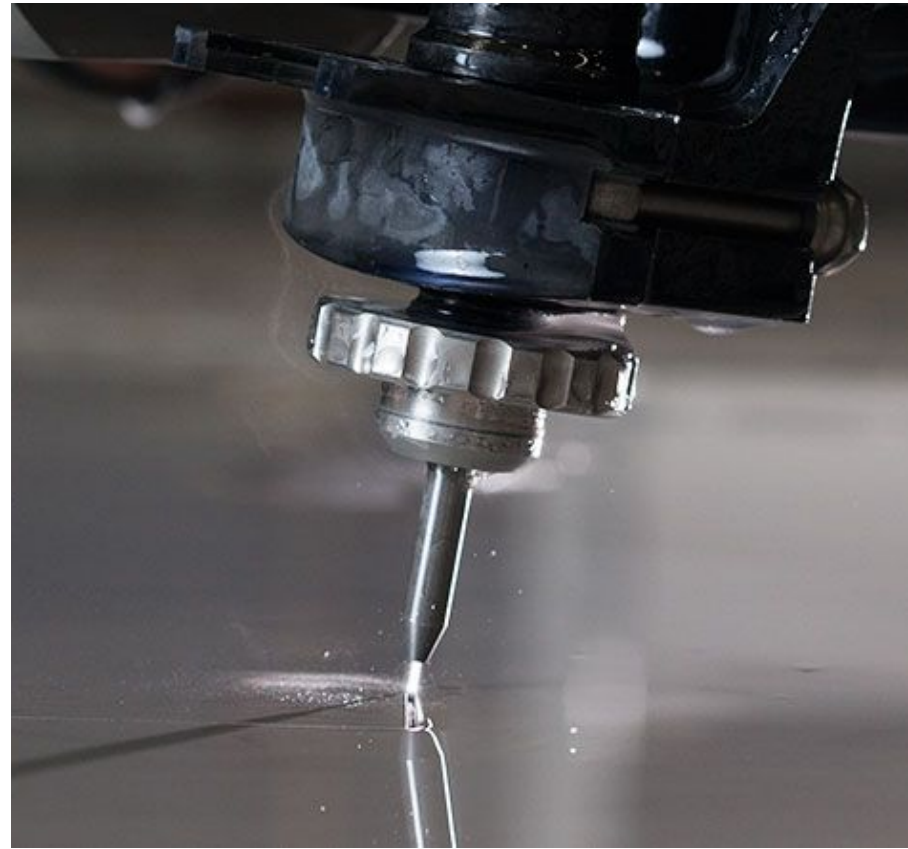
Bandsaw

- Different blades for wood and metal
- Horizontal vs. vertical
- Rip fences and miter gauges



Waterjet

- High precision, repeatable due to CAM
- Some limitations
- Available to all Georgia teams through KSU waterjet sponsor



Post-Kickoff Update

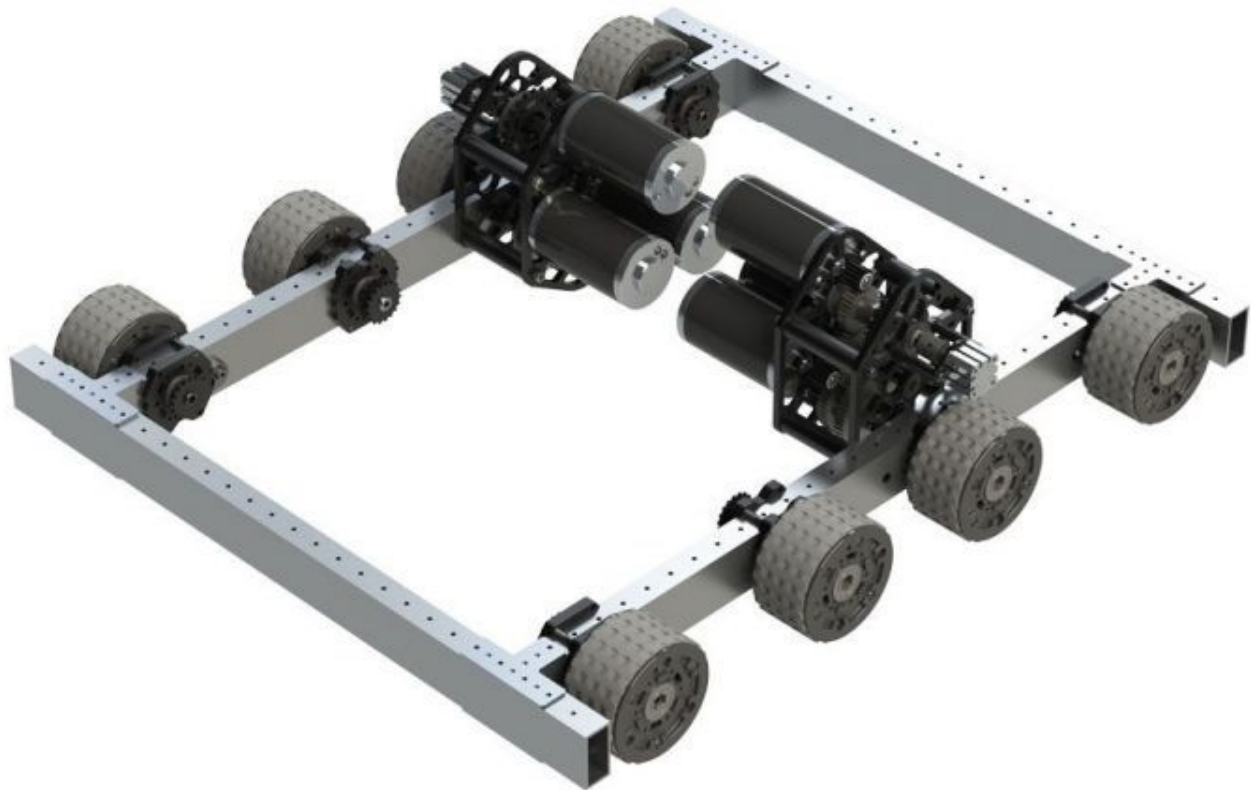
- Follow this link for “Material and Manufacturing Partnerships”:
<http://gafirst.org/for-teams/manufacturing/>
- It appears the waterjet sponsorship is currently on hold, but there are still other opportunities that appear to be open

Shopvac

- Clean up after yourself
- Attachments (wide, nozzle)
- Safety, aesthetic, and reputation hazard



Drive- trains



Drop Center Drive

- Most common
- Included in the Kit of Parts
- Easy to assemble, drive, and program
- Great at defense
- Nonholonomic



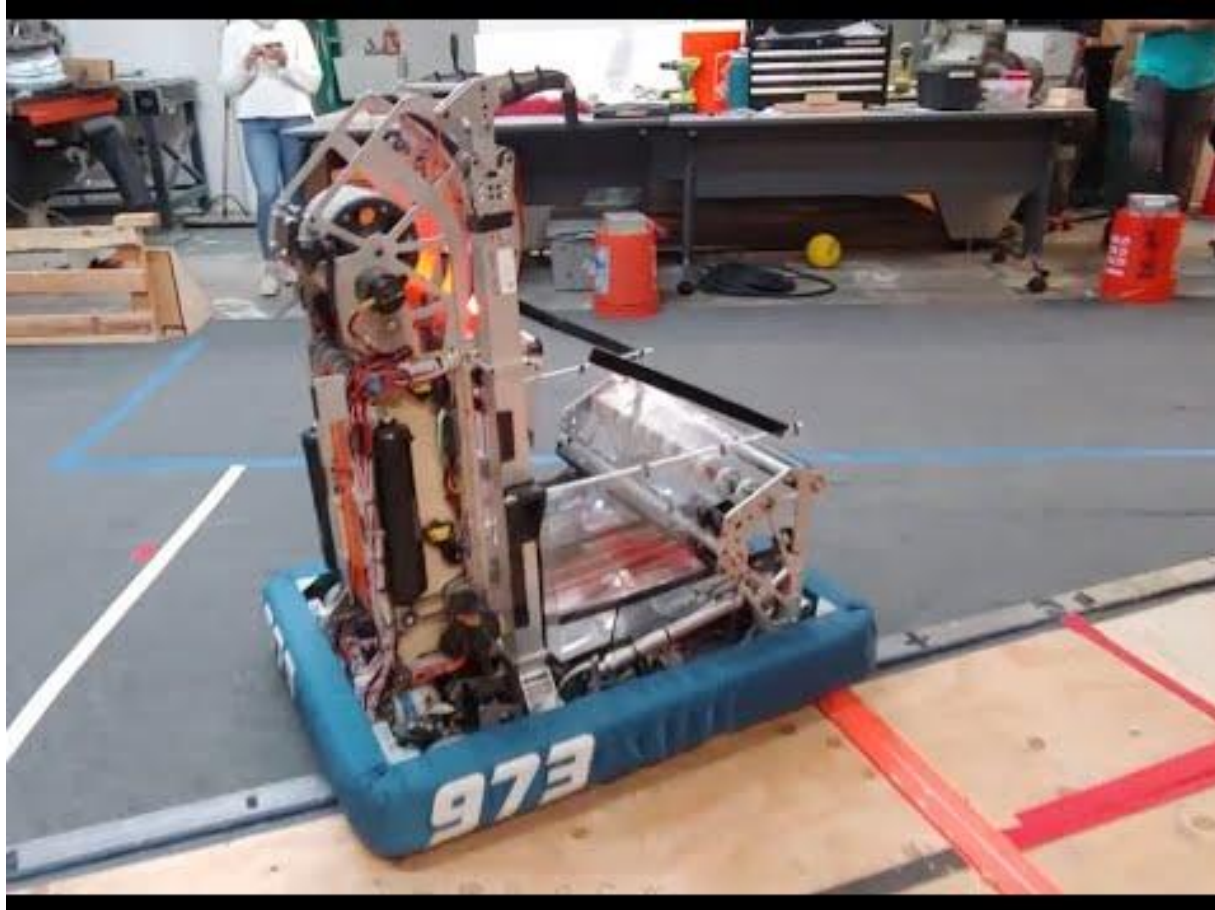


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West Coast Drive

- Pretty popular
- Mechanically very similar
- Easier maintenance
- Lighter weight
- Wheels more susceptible to damage





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Mecanum Drive

- Most common holonomic drivetrain
- Fairly easy to program
- Bad at defense
- Requires independent control of all four wheels

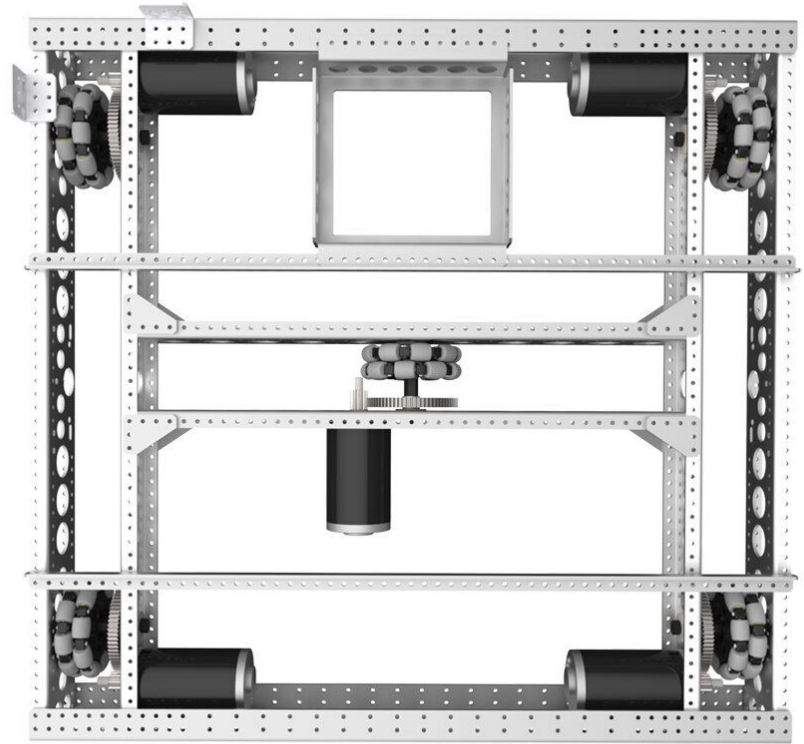




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H-Drive

- Pretty uncommon
- Just as easy to assemble
- Similar limitations (e.g. bad at defense)
- All holonomic options require skilled drivers

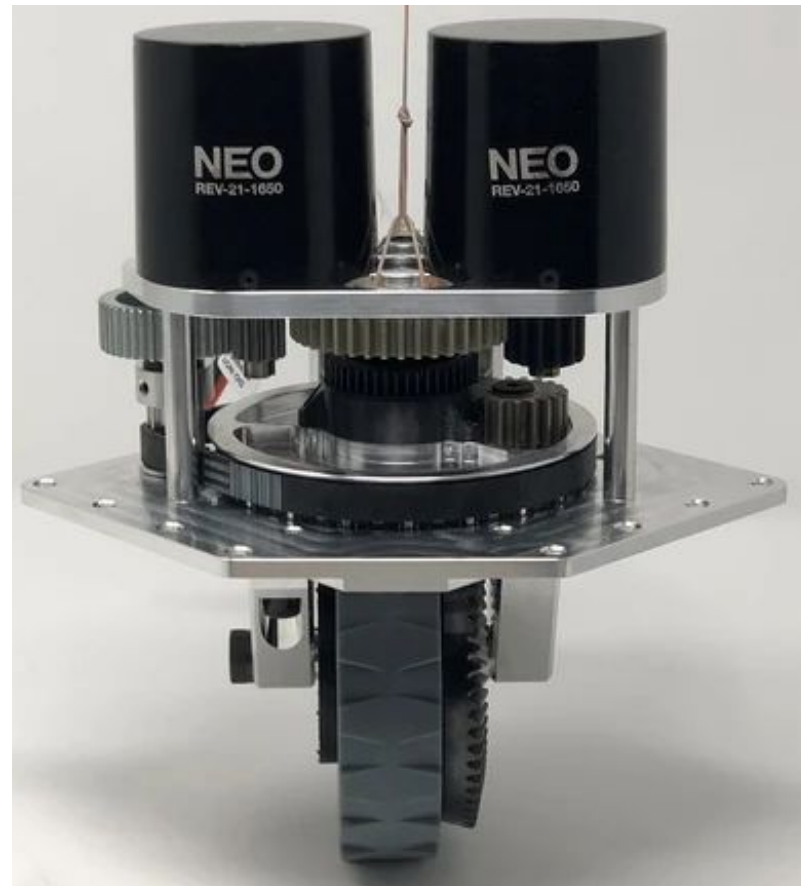




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Swerve

- Holonomic, yet good at defense
- Expensive
- Challenging to assemble and program
- High maintenance





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Question:

Which drivetrain was most popular among the 2022 FIRST Championship Einstein finalist teams?

- A. Drop Center
- B. West Coast
- C. Mecanum
- D. Swerve

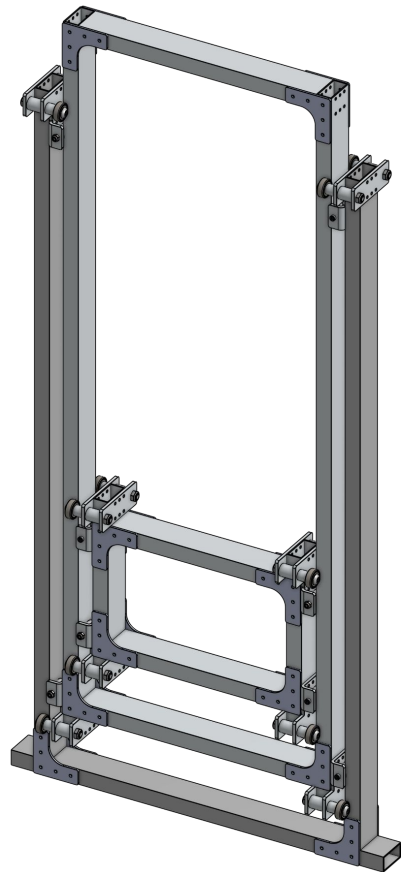
1619: Swerve	1577: Swerve
254: Swerve	4414: Swerve
3175: Swerve	2539: Swerve
6672: Swerve	4099: Swerve

Lifts



Elevator

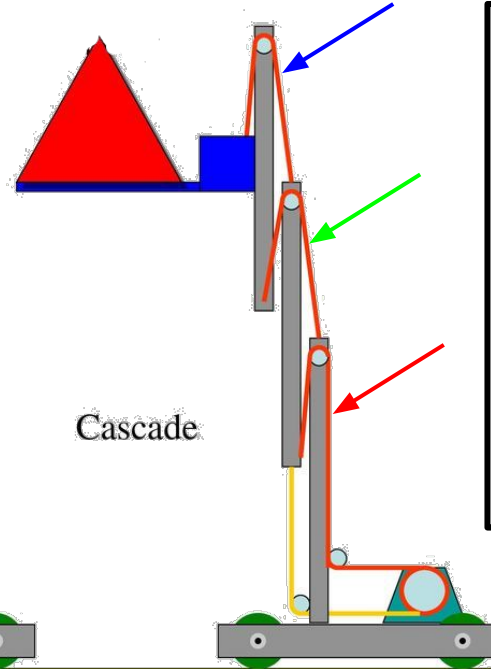
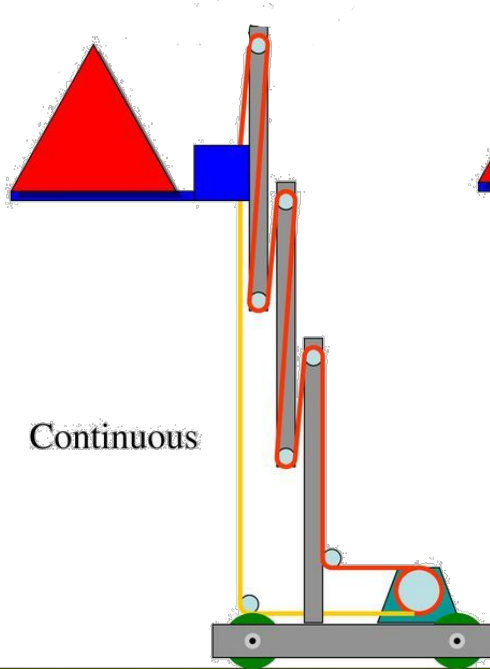
- Most popular
- Driven by strings, pulleys, or chain
- Normally 2-stage, could be more
- The last stage normally carries the grabber/intake module.
- Elevators may need to bear the weight of the robot.



2 ways for strings & pulleys

- Low cable tension
- Single long Cable/belt/chain

If one stage stuck
=
other stage still move

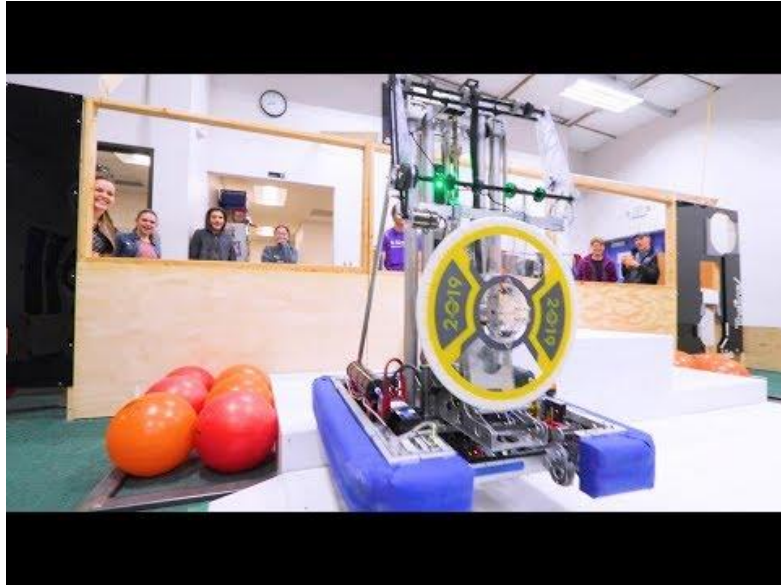


- Each stage will have
 - Half force
 - Twice speed
- High cable tension
- Multiple cables/belts/chains

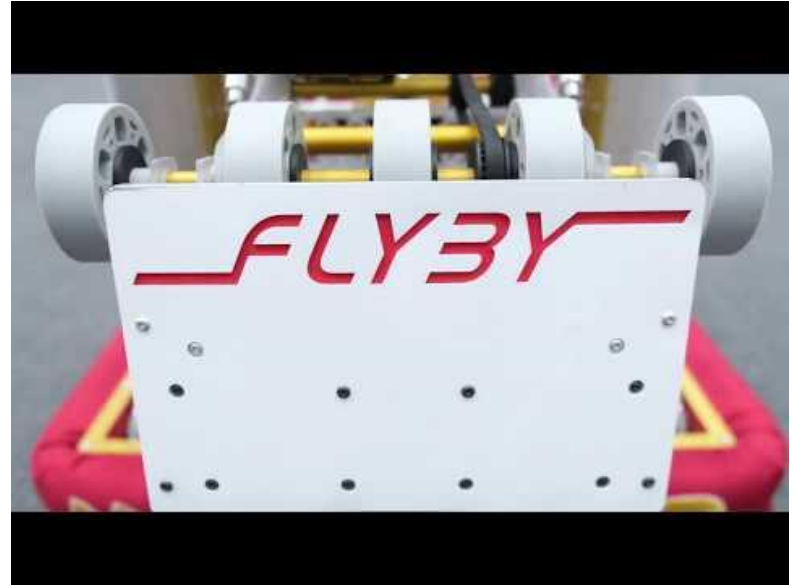
If one stage stuck
=
Every stage stop

Which method is used in the following videos?

Season: 2019
Team: 1619



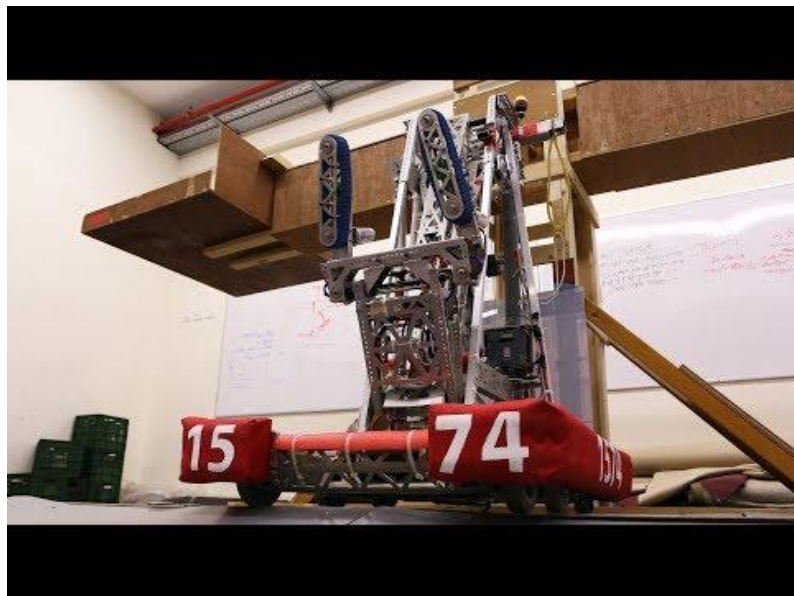
Season: 2019
Team: 118



Multi-segment arm

- Good option for elevating game pieces
- Possible but not ideal for lifting the robot
- Predicting final position is challenging
- Rotary motion vs linear
- Useful for flipping the game piece to the back side of the robot.
- Occupies a lot more space
- Difficult to maintain

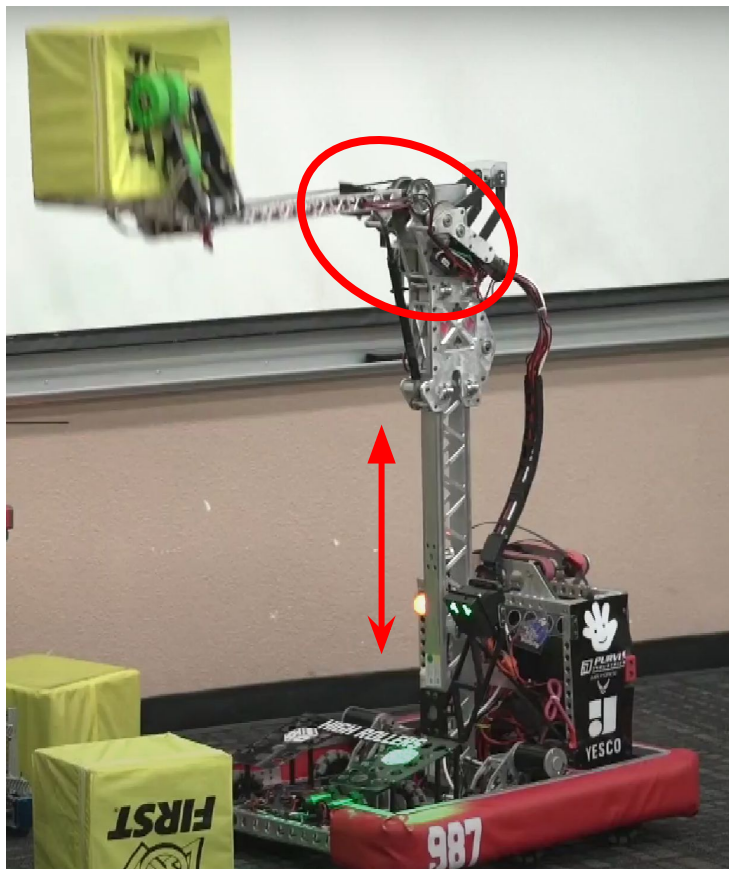




Season: 2018
Team: 1574





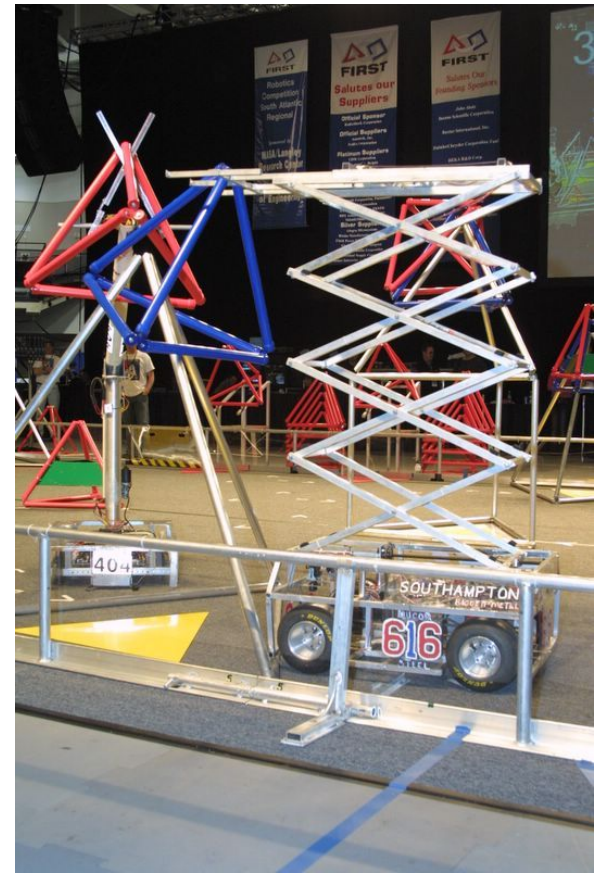


Season: 2018
Team: 987

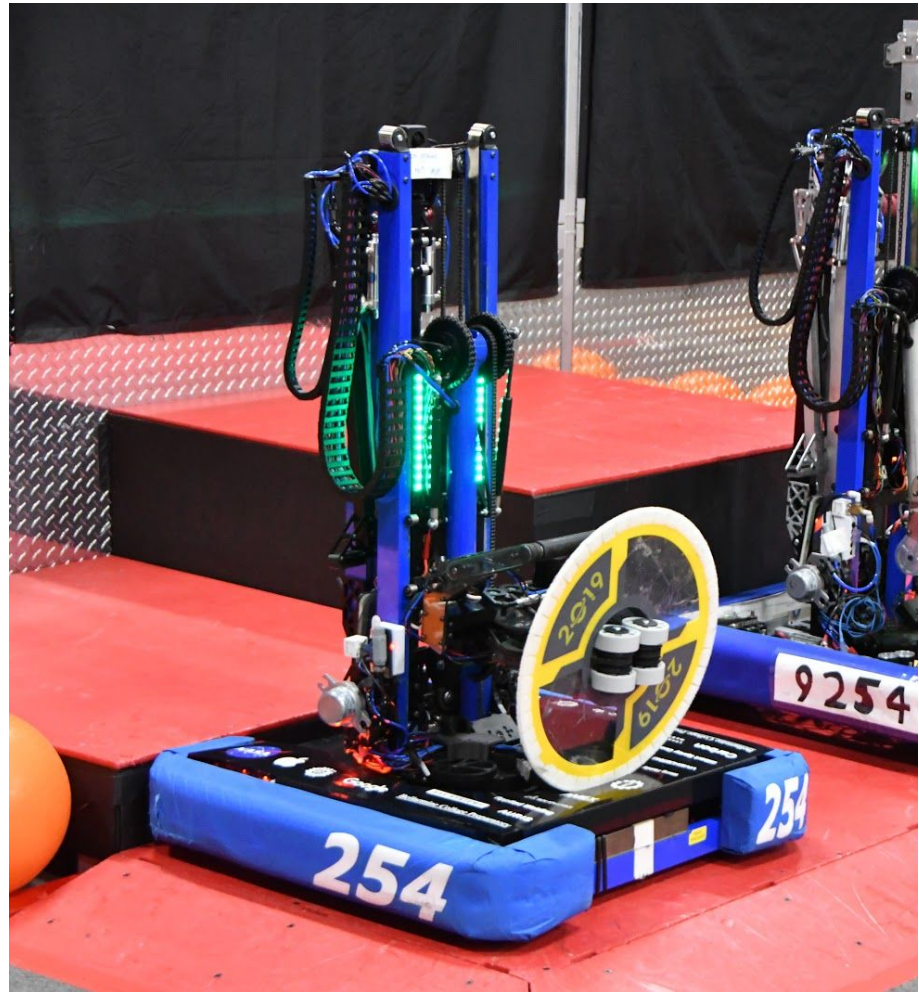


Scissor Lift

- Much less common
- Very difficult to make right
- Requires precise dimensions
- It has very efficient motion,
- Cannot support as much weight as others
- Difficult to maintain. Not so reliable.

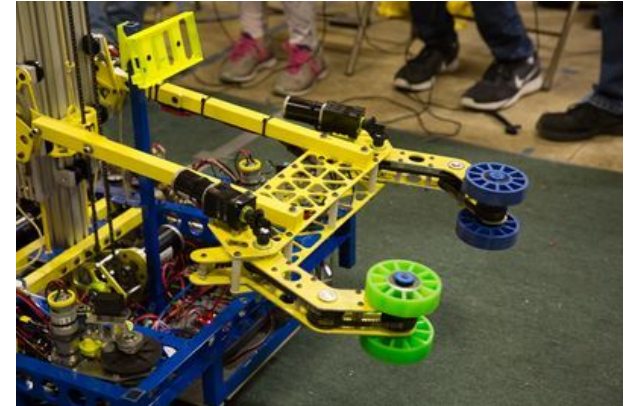
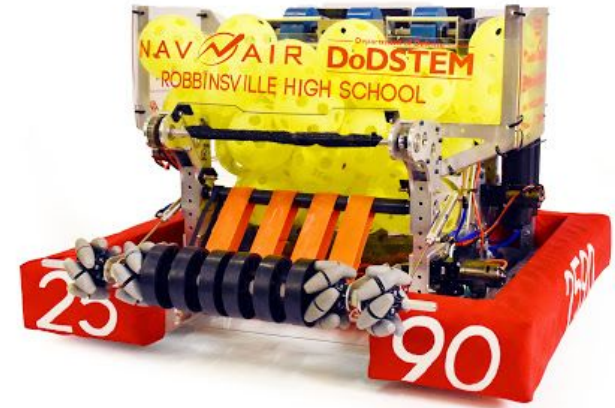


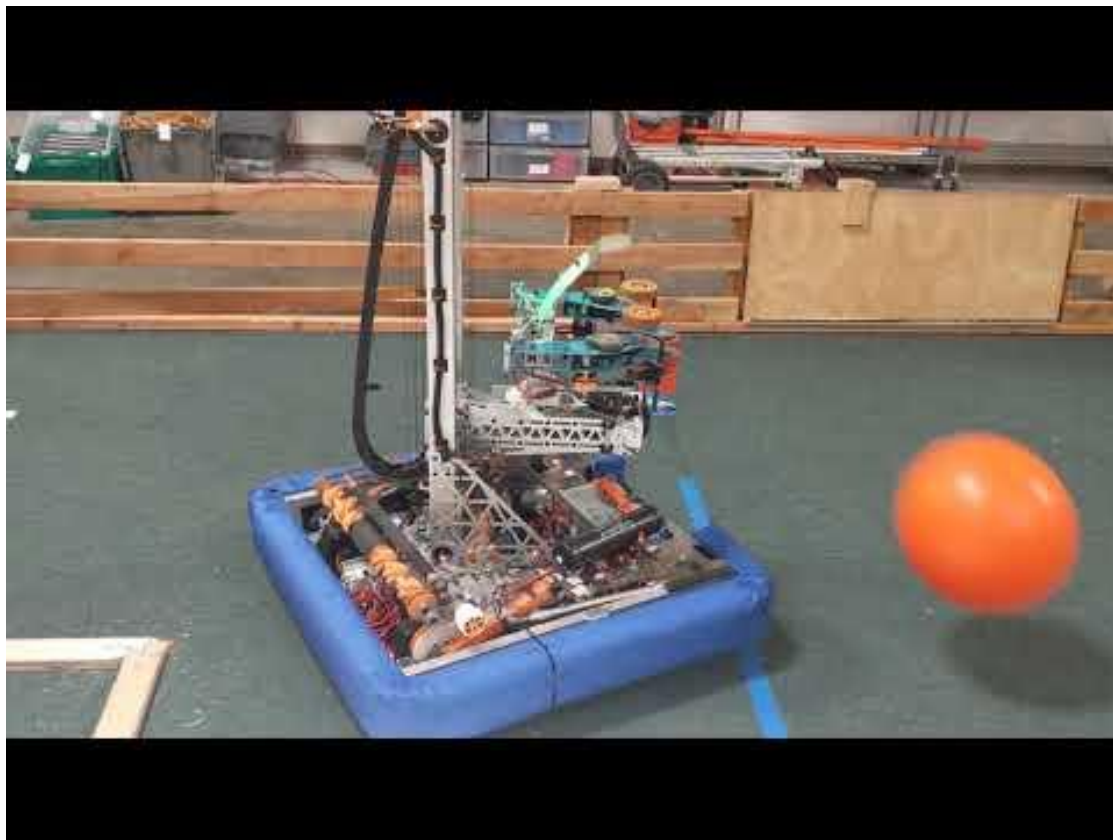
Grabbers/ Actuation



Wheels

- Broad category of devices that use wheels to move game elements
- Intakes are the most common, for balls or elements with volume
- Often, compliant (squishy) wheels are used to provide greater grip on the game elements

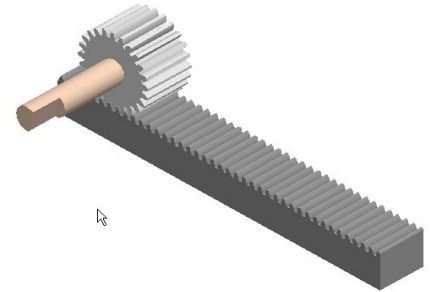




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Rack and Pinion

- Rotational motion → linear motion
- Very simple mechanical system
- Can be used to make a linear grabber
- It is durable and likely won't break
- Can be very slow
- Can get jammed
- Made of steel, so it is heavy



Spring Loaded

- Used as a passive grabbing system
- Pressure from the object it is holding puts the springs in tension.
- The equilibrium force pushes back against object, holding it in place



Tension Spring



Compression Spring



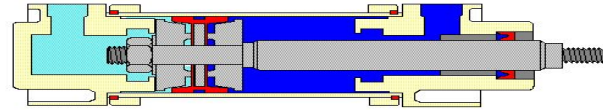
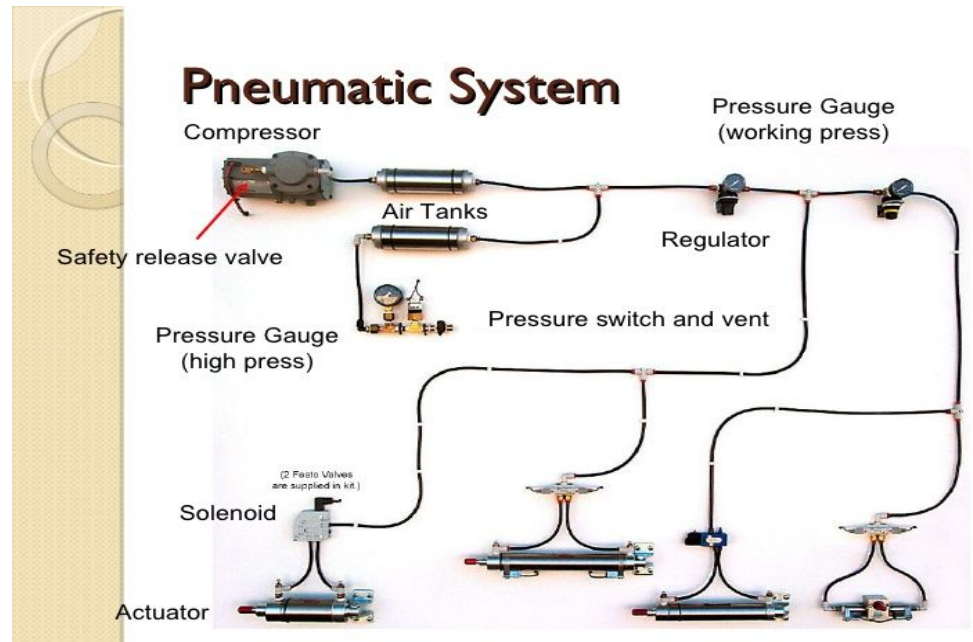
Torsion Spring



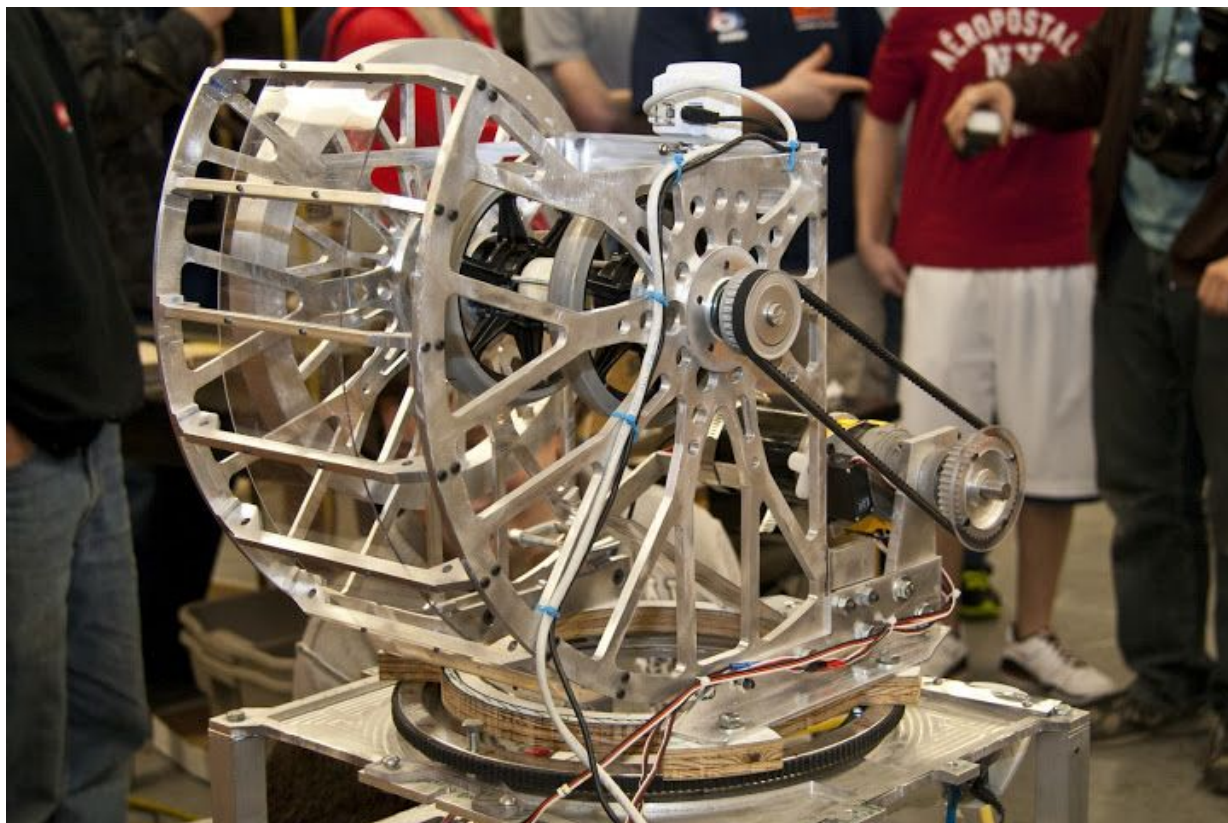
Spiral Spring

Pneumatics

- A common element on many robots, wide variety of uses
- Two-position pistons are the most common, which can be either retracted or extended
- Does not allow for granular control other than speed of extension



Shooters



Stationary Shooter

- Most common variety of shooter

Pros:

- Easiest to build
- Easiest to tune
- Fewest variables

Cons:

- Limited shooting locations



Flywheel

Stationary Shooter



Adjustable Hood

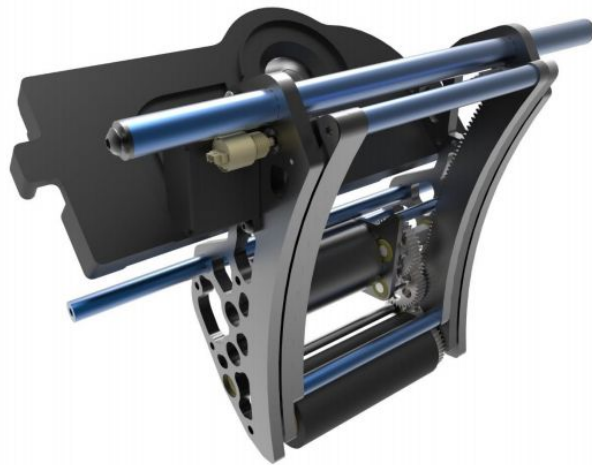
Improvement on top of standard stationary shooter

Pros:

- Increases range and available shooting locations of shooter
- Can shoot from very close angles

Cons:

- Difficult to tune
- Introduces more shooting variables



Team 254 "Dropshot" technical binder

Adjustable Hood



Turreted Shooter

Improvement on top of standard stationary shooter

Pros:

- Allows shooting from multiple robot orientations

Cons:

- Challenging to maintain
- Challenging to program



Team 254 “Dropshot” technical binder

Turreted Shooter



Q&A

