Title: Mechanisms Overview	Author: Jillian Conway
Subteam: Fabrication	Subject: Mechanisms
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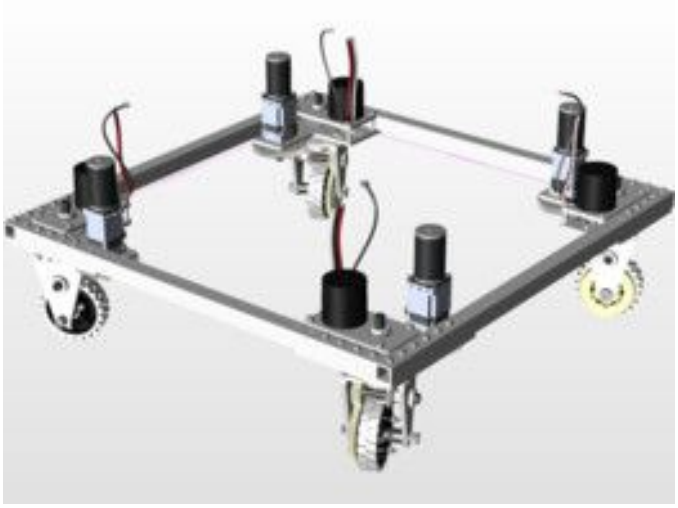
Abstract

The purpose of this paper is to provide an overview of Mechanisms used in FRC in order to assist design and fabrication team members.

Drivetrain

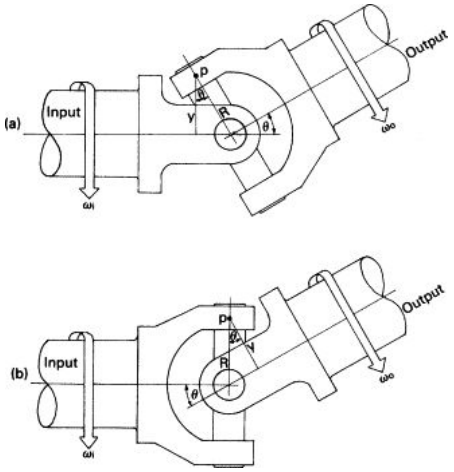
For the 2020 First Robotics competition season, Team 3176 Purple Precision chose a swerve drive train for the robot base frame or chassis. The benefits include more maneuverability (speed and control) and increased agility than the basic tank drive. The potential disadvantages are a more challenging build, limited push power, and uncertain control of the robot over uneven terrain. The team decided to build a CIM-in wheel or Midwest swerve drive instead of a coaxial swerve because the team members' possess limited knowledge of center coaxial shaft design.



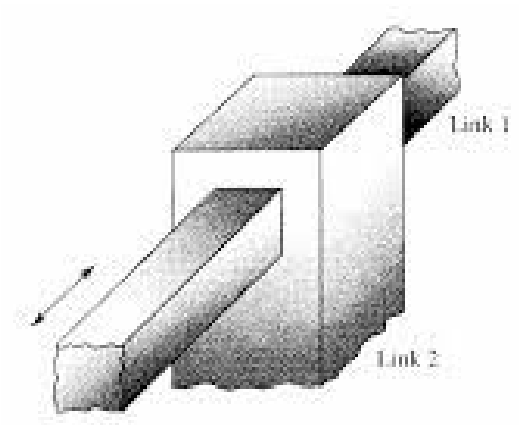
CIM-in wheel or Midwest Swerve Drive

Basic Mechanism Joints

After building the swerve drive train, Team 3176 will begin to attach various mechanisms to it based upon the tools needed for the robot to complete its tasks. Five basic mechanism joints exist: turning joint, sliding joint, rolling joint, roll-slide joint, and screw joint. If the relative motion between two links is a rotation, it is called a turning joint. If the relative motion is a translation, it is a sliding joint. The rolling joint has two links that roll on each other without sliding (think Spirograph), and the roll-slide joint has two links that are kept in contact by force closure with two points of contact on the joint. Furthermore, the relative motion between the links in a screw joint is a combined turning and translating motion.



Turning Joint

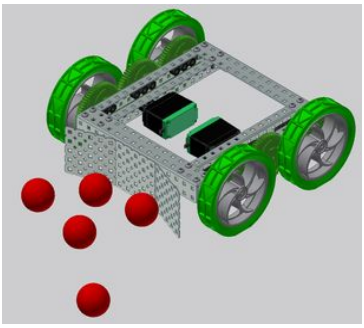


Sliding Joint

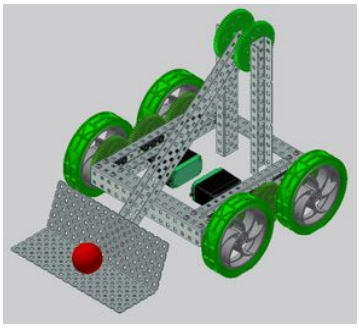
Gear Joint

Types of Manipulators

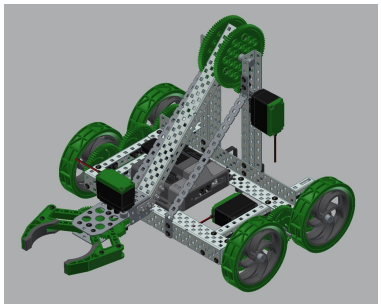
One or more joints or combination of joints will create the skeleton of mechanisms to be attached to the chassis/drivetrain. For example, manipulators can be attached and are mechanisms that manipulate materials without the operator touching it. An example would be the robotic arm. Manipulators include plows, scoops, and friction grabbers. If one of the robot's tasks is to move objects without picking them up, a plow comes in handy because it applies a single force to the side of the object. If the robot needs to elevate and carry an object, a scoop can be created to apply force underneath the object. Then, the object can be lifted or lowered, and gravity will keep the object in place. A friction grabber is helpful when objects need to be manipulated securely and with more control. It applies force to the object in two or more places. The pinching claw and the roller claw are two examples of friction grabbers. A pinching claw should not be used if the object is required to be thrown by the robot. The advantage of the pinching claw is it can be adjusted to grab many different shapes and sizes of objects. Roller claws use rotating wheels or rollers to pull in the object. The friction between the rolling wheels and the object holds the object in place. A roller claw can easily and quickly take hold of an object with no fine positioning required. Once the roller claw is turned on, the rollers pull in the object as soon as they touch it. In addition, the robot may be designed to include a combination of a scoop and a friction grabber; this mechanism is known as a top-jaw grabber. The stationary lower jaw uses normal force in an upward motion under the object; the top jaw presses down onto the object. Together, the lower and upper jaw keeps the object from moving side to side through frictional force. If a robot's design holds multiple objects at one time, the manipulator is called an Accumulator. However, the Team should consult the Game Manual to see if accumulators are allowed.



Plow



Scoop



Friction Grabber

Accumulator

Launchers

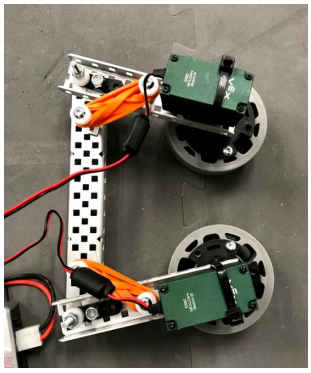
Another useful mechanism is a launcher. Launchers are needed when robots must shoot objects upwards towards a target. Catapults and wheeled shooters are two examples. If a robot needs to launch many objects in a short period of time, a catapult might not be the best launcher because it takes time to reload. Catapults use a long lever arm to toss objects. Three types of catapults are pneumatic, spring-loaded, and motor-driven. Wheeled shooters are efficient at times when the robot is required to launch balls or frisbees.

Catapult

Wheeled Shooter and Elevator

Roller Intakes

Roller intakes help a robot pick up (intake) objects on the floor. These objects can either be brought into the open spaces between the bumpers, over the bumpers, or into a claw. The roller intake should be wider than the object and should move at a fast enough speed to not slow down the robot.

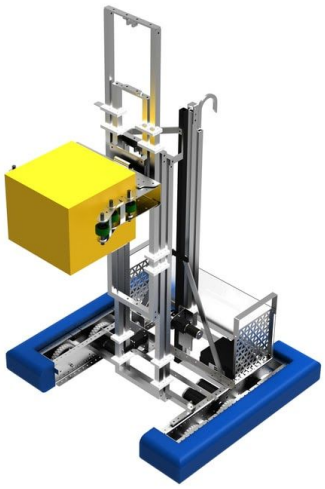


Roller Intake

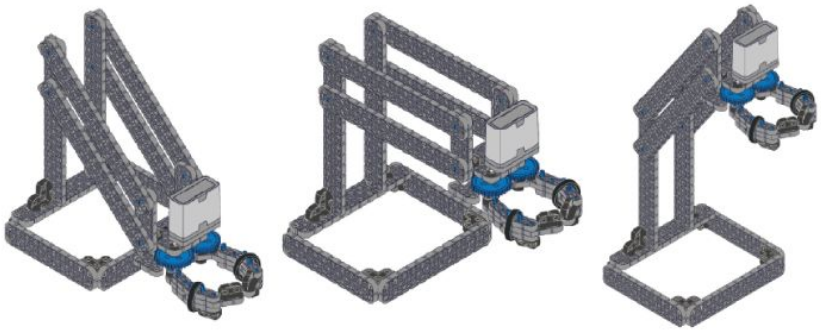
Lifting Mechanisms

In addition, lifting mechanisms may be incorporated into the robot when movement is needed to perform tasks or when an object needs to be lifted. The three basic types are rotating joints, elevators, and linkages. A rotating joint moves in an arc motion. An elevator uses linear motion to lift up an object. Additional mechanisms Team 3176 may consider are storage, winches, and brakes.

Rotating Joint



Elevator



Four-Bar Linkage

Sources Used

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