2018 FLYSET FTC Workshop

4-wheel Direct Drive

(9/3/2018)

Anthony

Anthony is a 8th grader at Rice Middle School. He has been in First since 2010. He enjoys programming the autonomous part of the game. Anthony started in jr.FLL, going on to do FLL and now FTC.

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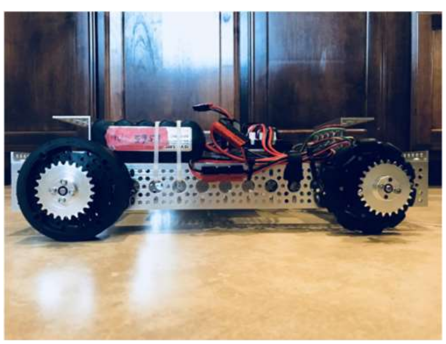
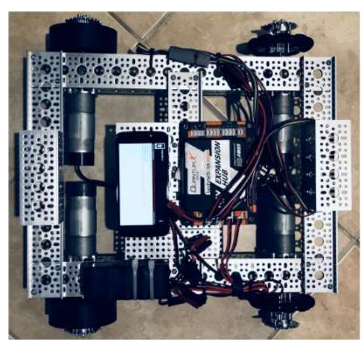
Chassis Specification

4-wheel Direct Drive



Side view



Top view

Bare chassis weight: 10 lbs

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4-wheel Direct Drive


10 lbs


25 lbs


40lbs

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4-wheel Direct Drive Spec

- Modern Robotics based chassis
- Four NeveRest 40 motors
- Four wheel Direct Drive
- Gear ratio from motor to wheel: **40:1**
- Consists of two pairs of omni wheels
- REV expansion hub is horizontally mounted on the robot chassis
- Base chassis weight (without weight holder): 10.0 lbs

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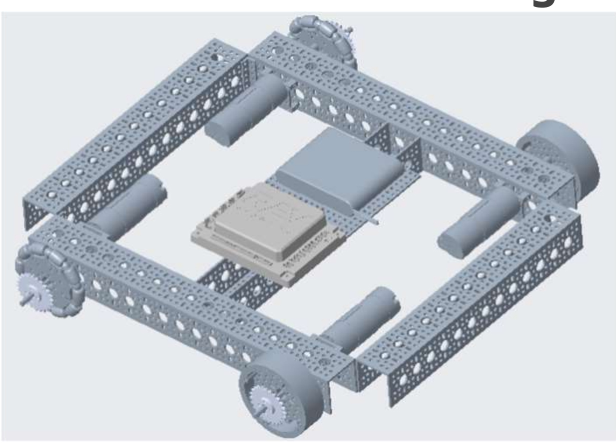
Chassis CAD Design

4-wheel Direct Drive in Design Phase



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4-wheel Direct Drive CAD Notes

- I had no issues during the CAD Phase.
- I used subassemblies to make things faster.

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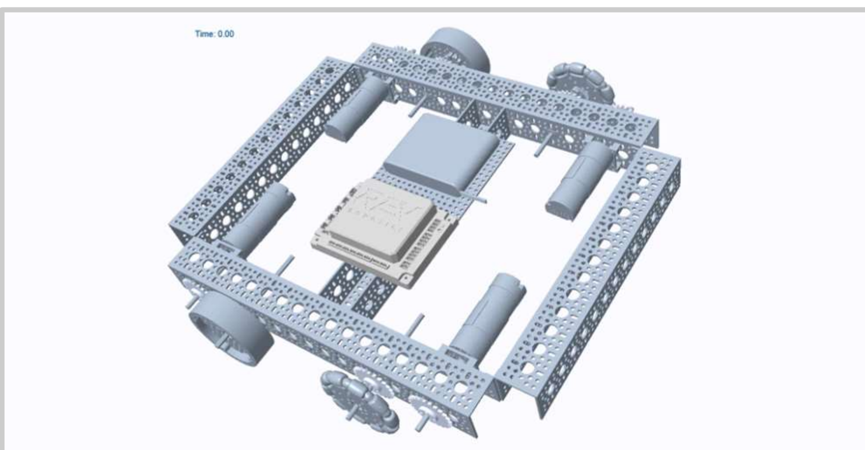
4-wheel Direct Drive CAD Model Simulation



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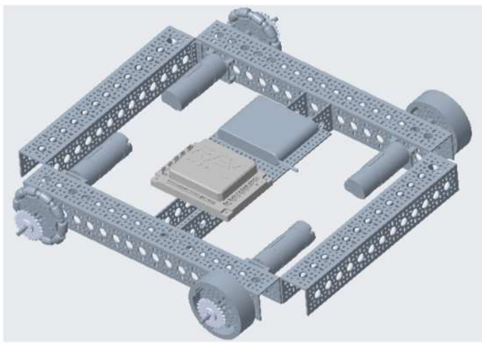
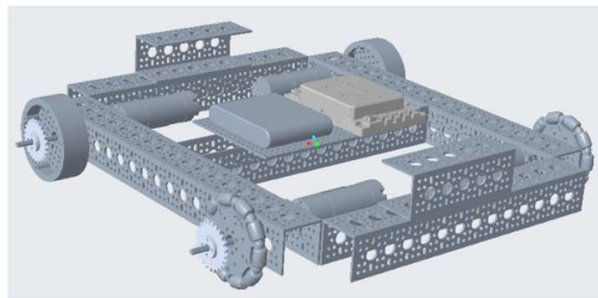
4-wheel Direct Drive CAD Model Comparison



Version 1



Version 2

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Chassis Test Results

4-wheel Direct Drive Build Notes

- My biggest issue was that the screws kept on getting screwed up and I couldn't take them out again when I needed to fix the placement. This is because the screws of Modern Robotics were made of soft aluminum and when I turned the screws too far in, the metal scraped off.

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Test 1: Forward Speed Test

- This robot's wheels are Modern Robotics Wheels, which uses the metric system, instead of the imperial system, which most of the other wheels on the other robots use. The wheels are 96 mms in diameter, which is 3.77 inches, compared to 4 inches on the other robots.
- As a result of the smaller diameter (and circumference), the robot travels less distance because at full speed, it travels less distance than other robots given the same time..

	No load	15 lb load	30 lb load
Distance traveled	3.87 m	3.76 m	3.65 m

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Test 2: Three Second Turn Test

- My robot was comparable to the other 4 wheels drives.
- My wheels were smaller, but that didn't seem to make much of a difference for turning.

	No load	15 lb load	30 lb load
Degree turned	618	535	454

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Test 3: Driving up/down a ramp

- My robot was able to go up the ramp easily.

	No load	15 lb load	30 lb load
Up ramp	Yes	Yes	Yes
Down ramp	Yes	Yes	Yes

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Test 4: Balance Stone Balancing Ability

- The wheel placement on the chassis (too much inside) made it hard for the robot to get on the balancing stone. However, the robot can get on with all weights by getting the wheel on the corner of the board, it's just incredibly difficult and time consuming.

	No load	15 lb load	30 lb load
Go on the stone?	Yes	Yes	Yes
How long on the stone? (forever is settled on the stone)	Forever	Forever	Forever

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Test 5: Pull Strength Test

- My robot was mainly average in this test, maybe a little bit above average.
- My wheels were smaller, but that didn't seem to make much of a difference.
- My chassis always got slower with more load
- Without load, my robot wasn't able to pull 20 lbs.

	No load	15 lb load	30 lb load
10 lb pull weight	4.593 seconds	4.838 seconds	5.074 seconds
20 lb pull weight	N/A	5.372 seconds	5.846 seconds
30 lb pull weight	N/A	N/A	7.101 seconds

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Test 6: Autonomous Straight Line Drift Test (Optional)

- My drift got larger with more weights added, rather than smaller which some other robots did.

	No load	15 lb load	30 lb load
Horizontal drift	2.33 inches	5.66 inches	8.66 inches

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Test 7: Autonomous 90/180 Degree Turn Drift Test (Optional)

- I tuned the load (the kP values) individually which explains why the drift degrees are so close to zero.

	No load	15 lb load	30 lb load
90 degree turn drift	1.833	1.366	1.066
180 degree turn drift	1.3	0.666	5.533

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4-wheel Direct Drive Summary

- Overall, this robot is decently strong as it is a 4-wheel direct drive, and has smaller wheels that offer more torque. It also travels slower due to smaller wheels.
- The wheel placement make the channels get in the way so it is kind of hard to get on the balancing stone (chassis design issue)

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Special Topics

Motor Differences

These were the motor ticks for each of the motors after running for about 5 seconds

- front right : 14407
- front left : 15225
- back left : 14566
- back right : 15064

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Software Compensation

By using math, I changed the motors speeds so that they all traveled within 100 ticks of each other. This was done by setting the motors with more ticks to have less speed and less ticks have more speed.

```
public static final double power=1;

public static final double leftFront=0.84 * power;
public static final double leftBack=1 * power;
public static final double rightFront=0.97 * power;
public static final double rightBack=0.93 * power;
```

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REV Expansion Hub Heading

For some hubs that were mounted vertically, they started having issues and tried to change the XYZ order and that didn't work. However, once we found that heading was automatically set as the axis around the pull of gravity, we always used firstangle variable to get the heading and that solved the problem.

```
imu.getAngularOrientation(AxesReference.INTRINSIC,
AxesOrder.ZYX, AngleUnit.DEGREES).firstAngle;
```

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