



Citrus Circuits
Fall Workshop Series

Strategic Design

by Mike Corsetto and Austin Haddox

Who Am I?

- Mike Corsetto
- Head Coach of Team 1678
- Director of Hardware Engineering at advanced.farm
- Going into 20th season in FRC
- Started mentoring 1678 in 2008
- I'm not that smart (Credit to Karthik, 254 and others)



Who Am I?

- Austin Haddox
- Strategy, Scouting, and Mechanical Mentor
- Data Modeling and Reporting Consultant
- Going into 11th season in FRC
- Started mentoring 1678 in 2019



Overview

- Pre-Season Prep
- Drivetrain Design
- Mechanism Design
- Electrical and Pneumatics
- Build Season
- Competition Season



Golden Rule #1

- Keep It Simple Silly
- Build Within Your Team's Capabilities
- Simple = Robust
- Function over Form





Pre-Season Prep

Purpose of Pre-Season

- Pre-Season is not a break
 1. Trainings
 2. Try out new designs
 3. Learn and research past FRC games and designs



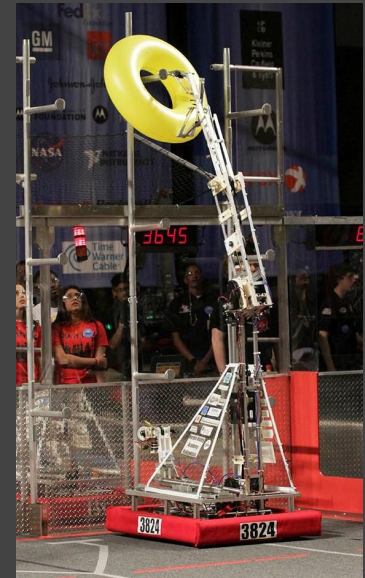
Off-Season Project Ideas

- Ball Shooters
- Ball Intakes
- Elevators
- Climbers
- Kit Bot
- Drivetrains



Learn Your Game History

- Games often have repetition
- Climbing in 2010, 2013, 2016, 2018
- Tubes in 2007, 2011
- Exercise Balls in 2008, 2014
- Foam Balls in 2006, 2012, 2016
- Flat discs in 2013, 2017, 2019



Golden Rule #2

- Steal From The Best, Invent the Rest
- Do Your Research
- Study R13D Teams in-season
- Look at 2056, 610, 973, 330
 - Simple, effective robots



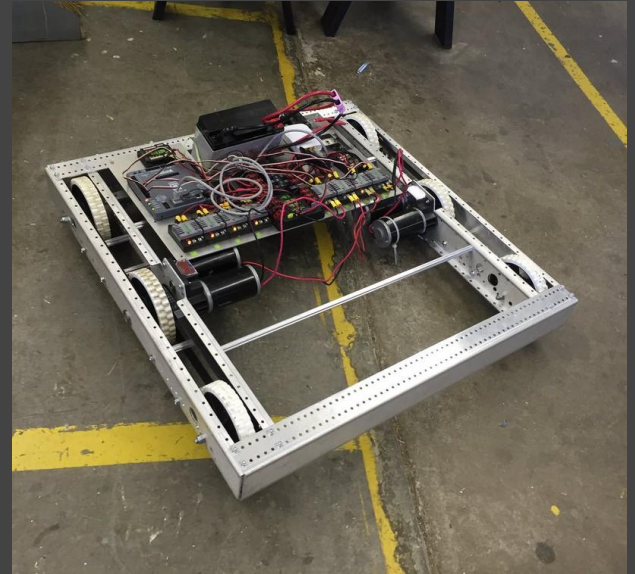


Drivetrain Design



Golden Rule #3

- Use A Proven (for you!) Drivetrain
- Basic 4, 6, or 8-Wheel Drive
- Kitbot
- Kitbot on Steroids (Team 1114)
- Spend Time on Mechanisms
- Story of Rarecab in 2008







Mechanism Design

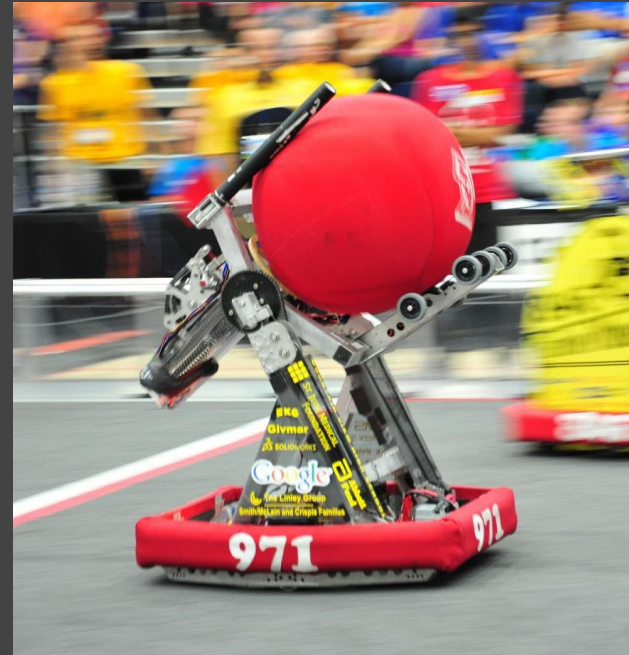
Mechanism Geometry

- Minimum Degrees of Freedom
- Low C.O.G. (Motors and Battery)
- Symmetry When Possible
- Inside Frame Perimeter If Possible
- Robust When Outside Frame Perimeter



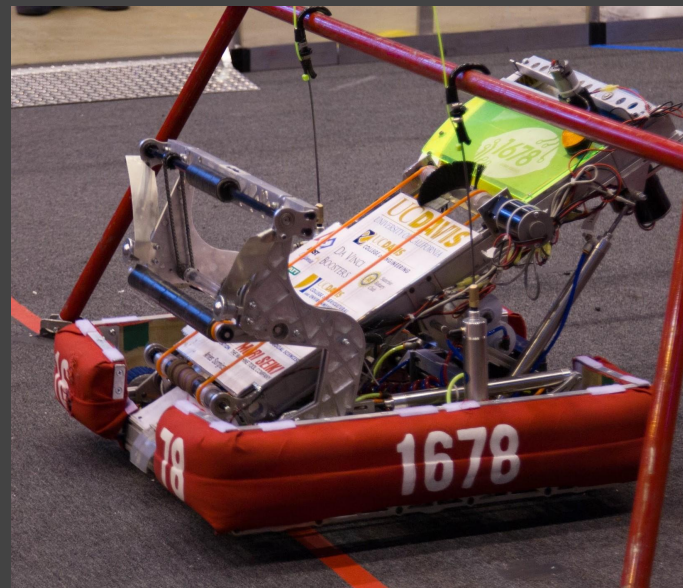
Movement - Motors

- Range of Motor Choices
- Single Speed or Shifting Gearboxes
- Allow Variable Movement
- Harder to Control (Need Sensors for precision motion)



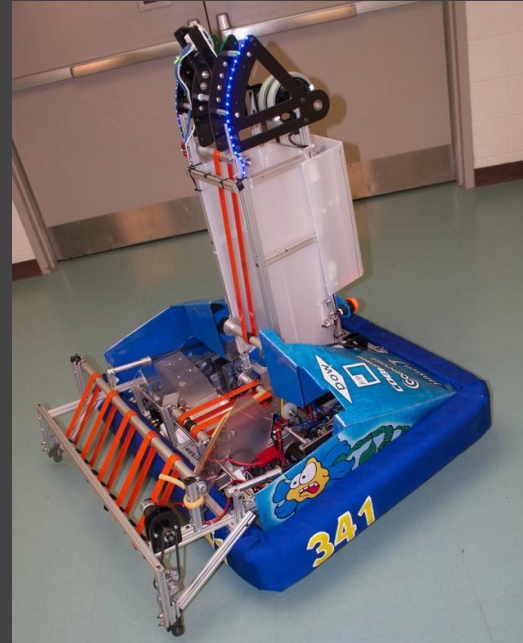
Movement - Pneumatics

- Movement From Point A to Point B
- Very Repeatable and Precise
- Non-Variable
- Requires Compressor and/or Storage
- Usually lighter than motors
- Be careful, can run out of air!



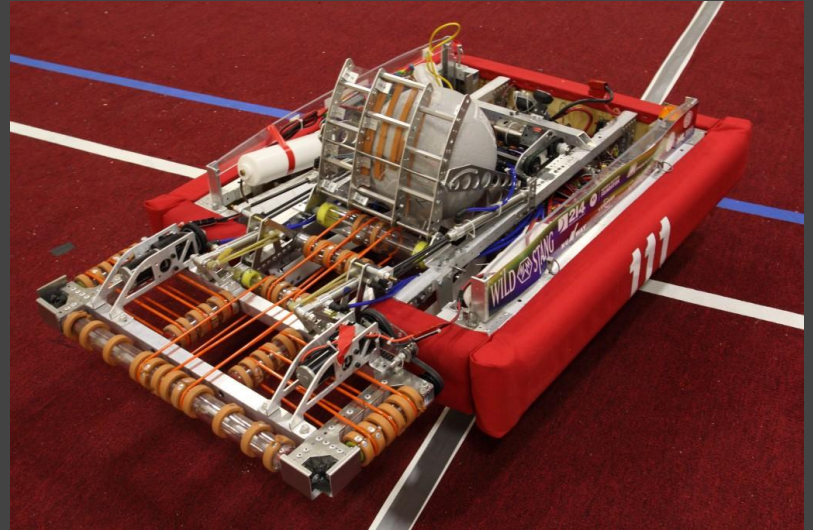
Acquisition Zone

- Effective Intake Area
- Object/Intake Interaction
- Make the Driver's Job Easy
- Stress The Prototype



Golden Rule #4

- Rolly-Grabbers
- Continuous Intake
- Increases Acquisition Zone
- Compare to Single Intake
(claw, hook, scoop)





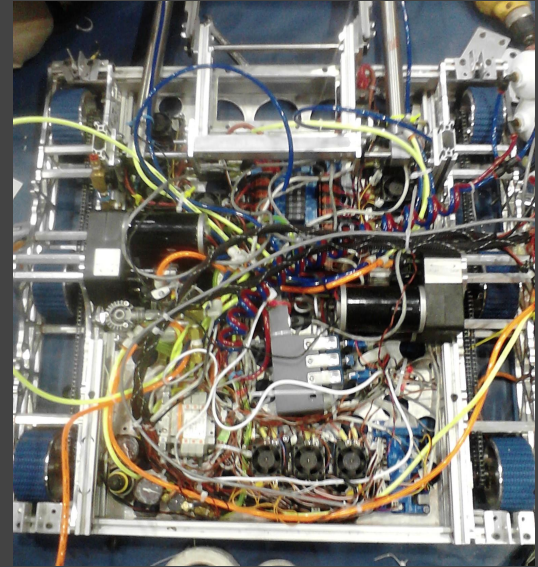




Electrical, Pneumatics and Programming

Electrical and Pneumatics

- So Much Can Go Wrong (Power, Signal, Radio, Leaks, etc)
- Spend time to do it right
- 1678 On Einstein in 2013
- 1678 2019



Programming “Toolkit”

- Precision Autonomous Driving
 - Using encoders + gyro
- Vision Alignment
 - Limelight
- PID for arms and elevators
 - Talon + Mag Encoder
- Bang Bang controller for Shooter
 - Talon + Mag Encoder





Build Season

Build Season Overview

- Accelerated Schedule is Important
- When setting schedule: “Aim for the Moon, Land among the Stars”
- Students ALWAYS assume there is more time than there is
- Often, Mentors do too!



Week 1

- Days 1 – 3
 - Brainstorming
- Day 3
 - Design Drivetrain
- Days 4 – 14
 - Prototyping Mechanisms
 - Drive-base electrical layout
 - Fabricate/Assemble Drivetrain
 - Begin writing code for expected mechanisms



Brainstorming

- Most important weekend of your entire season
- Three Steps (in this order!)
 1. Read the Rules
 2. Answer the “What” Questions
 - a. What is our strategy? What will the robot do?
 3. Answer the “How” Questions
 - a. How will the robot carry out this function?



The “Whats”

- What are the ways to score?
 - a. What is each task worth (Points/RP)?
 - b. What is the difficulty of the task?
 - In game
 - To build during build season
- Design Points
 - a. Specialization is a goal not compromise!
 - b. Just because another team is doing it, doesn't mean you should.



The “Hows”

- How will the robot carry out this function?
 - a. Do you have experience with a design like this?
 - b. Passive vs Active
 - c. Processing a game piece
- Typically through hand drawings.
 - a. No need to make it complicated.
 - b. Show basic mechanism ideas with correct scale.



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REQS

General

- high goal
- low bar
- ground intake
- 6+ 2x $\frac{1}{2}$ defenses
 - A, B, D both ways
 - C from courtyard

Auto

- 2 ball (via lowbar)
- pickup ball from Midline immediately
- 1 ball (via other defense)

Teleop

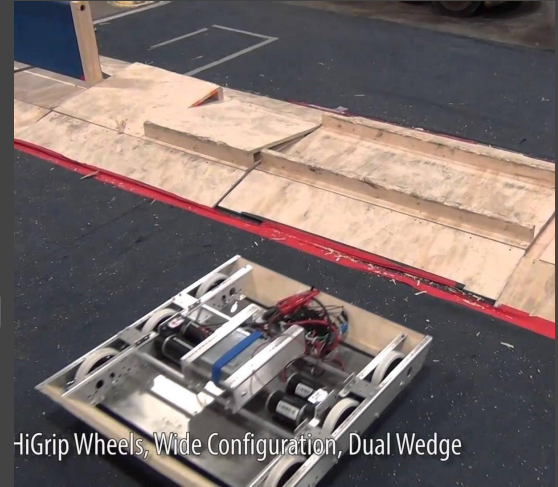
- high goal from batter and OW 1, 3, 4
- challenge
- scale
- shoot over defender from OW

- Day 14
 - Finish Drivetrain
- Days 15-16
 - Wire up entire drive base, test functionality
- Days 8 – 21
 - Build Mechanisms
 - Program Mechanisms
- Days 22-28
 - Mechanism Integration/Wiring
 - Test code with assembled robot



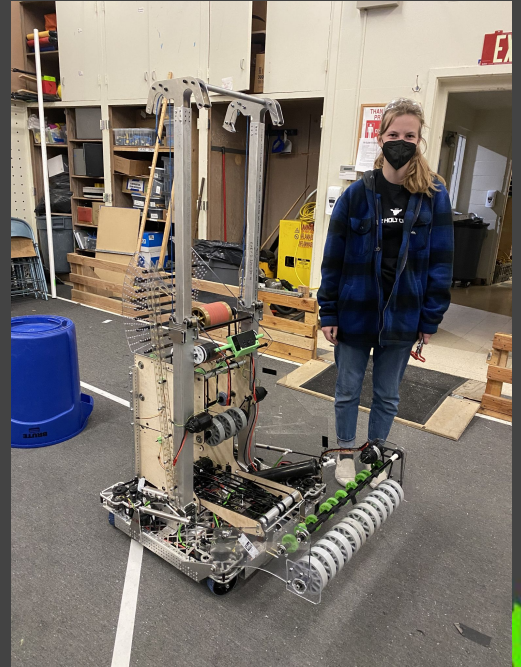
Golden Rule #5

- Day 29
 - Robot “finished”
- Days 29 – 45
 - Testing, BREAKING, fixing, iterating
 - **#5: Fail Faster!**
 - Driver Practice
 - A Good Driver Beats a Good Robot



Citrus Twist - Alpha Build

- In 2022, we build a functional prototype that we called “Alpha”
- Alpha taught us many things like:
 - What auto paths would work
 - Early software and driver practice
 - Start to understand game nuance
- We will be doing this again in 2023
- We haven't formalized schedule impact





Competition Season

No Bag

- Working through competition season is more important than ever!
 - a. Be careful
 - Keep a tight schedule
 - Don't be overly ambitious
 - b. Other teams won't stop



Watch Other Competitions

- Watch other regionals
- Webcast parties
- Read Chief Delphi
- Watch FUN and Gamesense
- Volunteer at events
- Look at other robots for ideas



Summary

- Pre-Season Prep – Golden Rules #1 and #2
- Drivetrain Design – Golden Rule #3
- Mechanism Design – Golden Rule #4
- Electrical and Pneumatics – Keep It Neat
- Build Season – Golden Rule #5
- Competition Season – Time to Improve



Resources

- Chief Delphi – chiefdelphi.com
- TCA – thecompassalliance.org





Thank You! Questions?

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Questions?



Give us Feedback!

