

2026

REBUILT

TECHNICAL BINDER

ROBOT NAME: Chris

ARROWDYNAMICS
10079

TEAM #10079 • BOTHELL, WA

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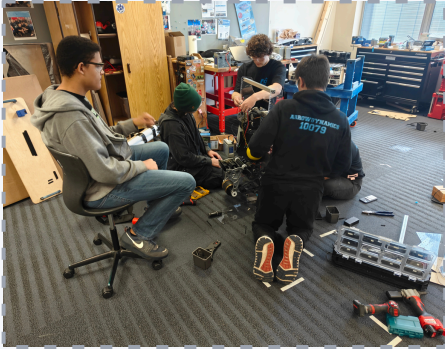
[@arrowdynamics10079](https://www.instagram.com/arrowdynamics10079)

<https://frcteam10079.org/>



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Our team uses engineering processes to guide our thinking and follow a path to success.

HARDWARE — 6 STEPS



- Prototyping of the robot
- Decide system requirements
- Review design to ensure it meets requirements
- Fabricate and assemble
- Test and iterate then hand off to software

SOFTWARE — 4 STEPS



- Define & create subsystem class
- Write commands for all robot behaviors
- Iterate over problems until subsystem is reliable
- Hand off to drive team when ready



Strategy assumption and guidelines Teleoperated

- Hopper capacity matters
- Prioritize qualification performance
- Maximize ranking points
- Be able to move fuel from any zone to any zone
- Score with a high degree of accuracy
- Be prepared for heavy defence during match phases
- Prioritize "throughput"

Auto

- Winning alliance at an advantage
- Contesting the neutral zone early to control the initial spread of fuel is critical to win the autonomous
- Trench will be more consistent

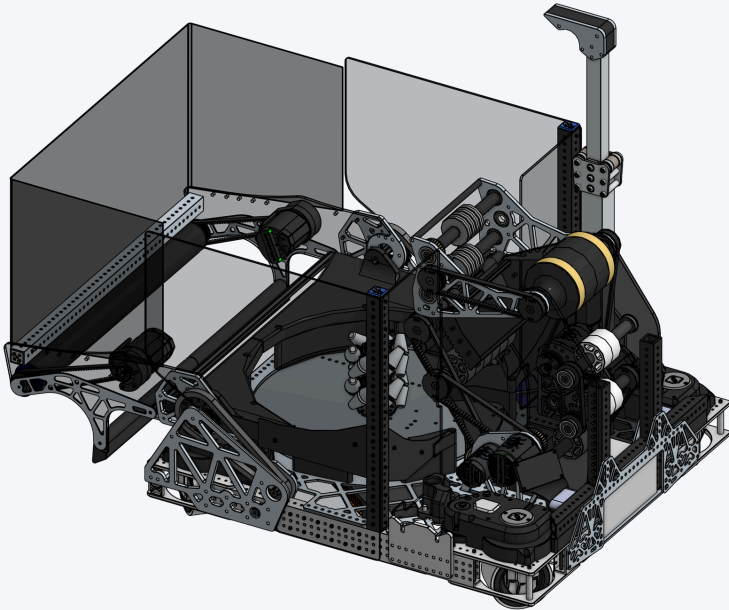
Our team followed two design reviews with the following design minimums needing to be met, or design modifications would be required before proceeding.

Neither the preliminary nor the critical design reviews required major modifications to the design architecture or strategic objectives. L1 climb will be implemented post week 2

NEEDS	WANTS	EXPLORES
a wide fast ground intake	hold upwards of 40 balls	turreting shooter
a fast, variable angle shooter	L1 climb with auto compatibility	L3 climb or L2 climb
shoot from anywhere on alliance zone	expandable hopper	
ferry fuel from anywhere		
L1 climb		
hold at least 25 balls		
traversal under trench		
traversal over bump		

Please note that although "turreting shooter" was placed in EXPLORES at kickoff, we made a decision early to not pursue turreting architecture

a thought the bumper style of intake was discussed but discarded due to lack of familiarity, throughput, reliability and jamming concerns



ROBOT NAME: CHRIS

ROBOT SPECIFICATIONS

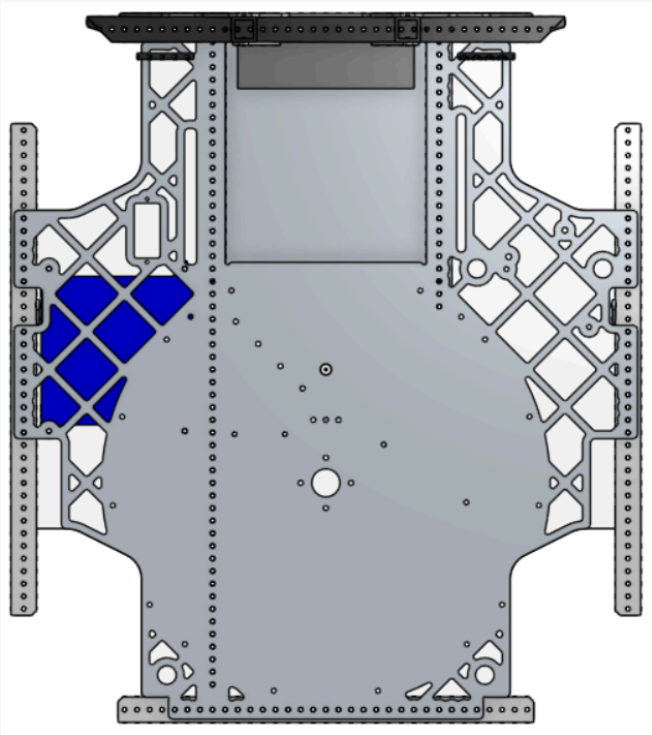
- Frame: 28.5" x 25.5" perimeter
- Bumpers: 35" x 32" perimeter
- Height: 19.75"
- Weight: 113 lb
- Weight w/ battery + bumpers: 133 lb
- Drivetrain: MK5n Swerve (SDS)

CAPABILITIES

- High-accuracy fuel shooting
- Ground intake from any zone
- Shoot on the move
- Under the trench
- Over the bump
- Dynamic shooting angle
- Vision-assisted pose estimation

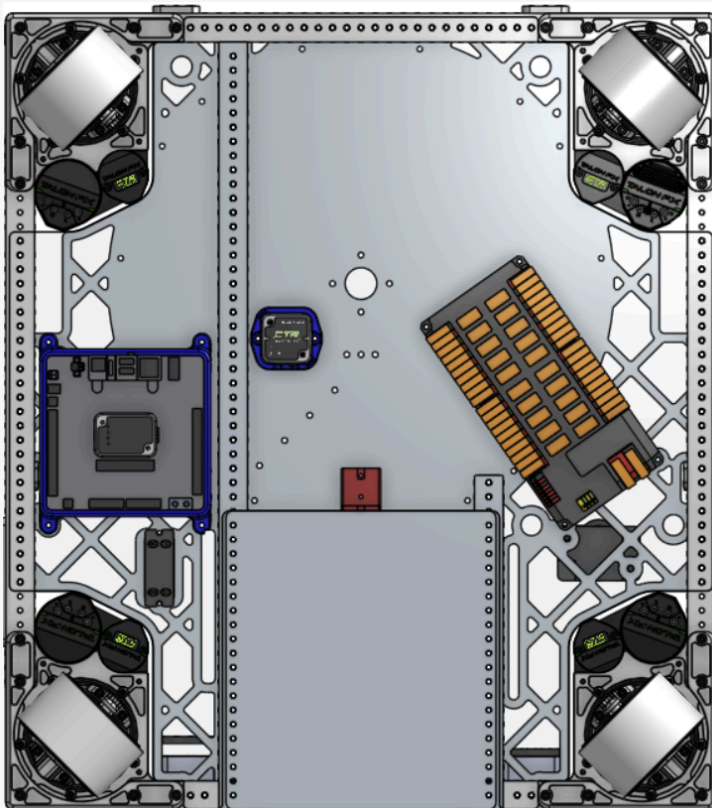
QUICK STATS

- 6 subsystems
- Motors: Kraken X44 / X60
- Vision: Dual Limelight 4
- Language: Java 17 (WPILib Command-Based)



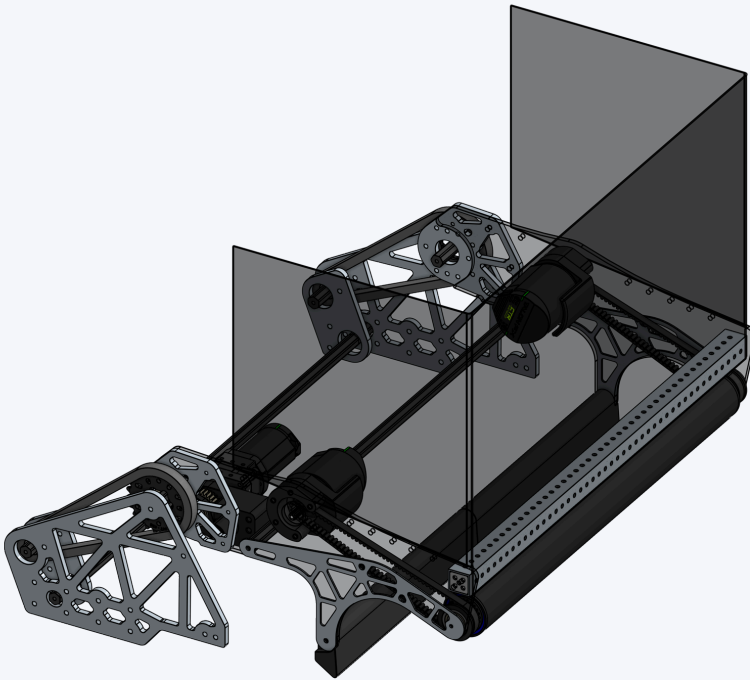
DRIVETRAIN SPECIFICATIONS

- MK5n Swerve Drive Specialties
- L2 gear ratio
- Molded spike grip wheels
- 28.5" x 26.5" frame perimeter
- 34" x 32" bumper perimeter
- TPU electronic static isolation
- Electronics mounted under brainpan
- 1/8" 6061 aluminum frame (weight reduction)
- Belly pan: 1/8" polycarbonate
- Battery mounted under the shooter



KEY DESIGN DECISIONS

- Swerve chosen for maneuverability around field obstacles
- Low center of gravity for stability during bump traversal
- TPU isolation prevents electrical static discharge failures

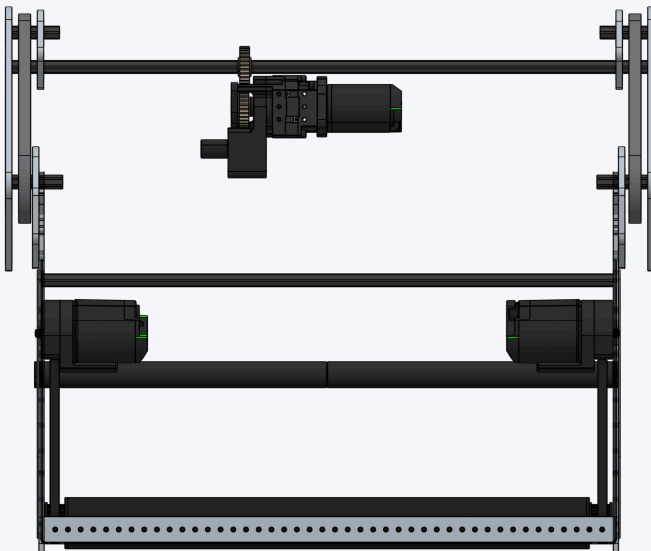


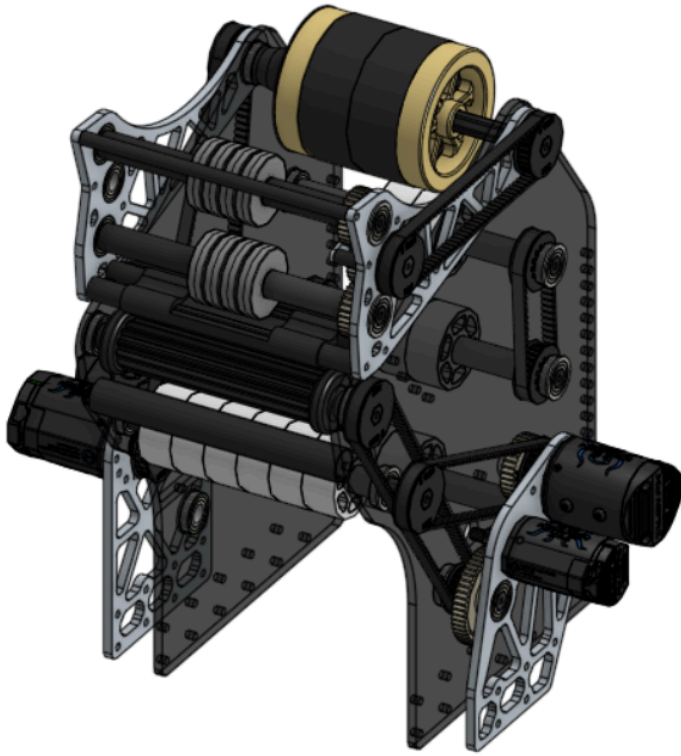
INTAKE FEATURES

- Rotates around 7075 aluminum 1/2" hex dead axle
- 1/16" polycarbonate contains fuel within hopper
- #35 chain with 7075 aluminum intake plates for reliability
- Jack shaft in brainpan powered by 2x Kraken X44
- Intake plates: polycarbonate 1/4" for maximum reliability
- 6-bolt swap for improved repairability

FIELD CAPABILITIES

- Picks up fuel from ground in any zone
- Can intake under trench
- Polycarbonate guides funnel fuel into hopper smoothly
- Agitates fuel in hopper





SHOOT ON THE MOVE

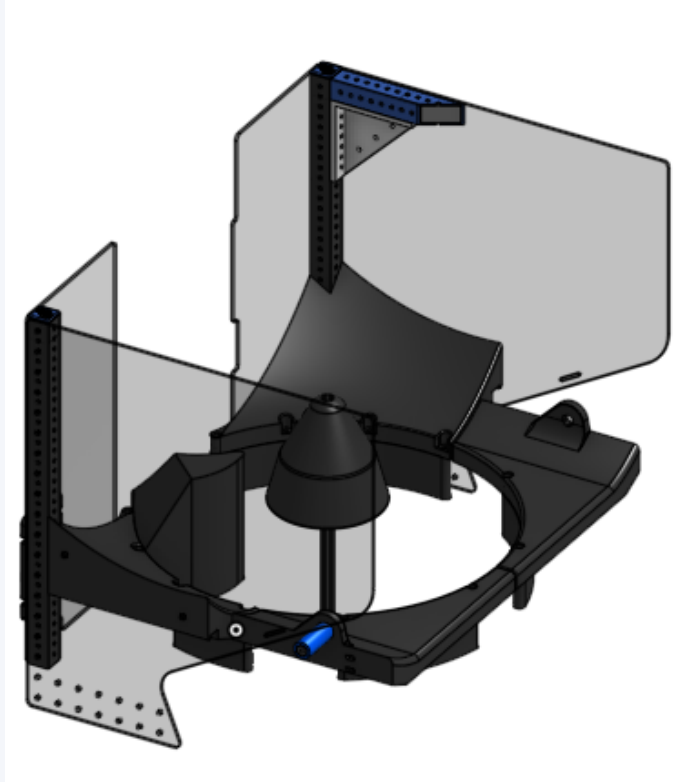
The robot dynamically adjusts shooting angle while driving; no need to stop and aim. Maximizes cycle efficiency.

SHOOTER SPECIFICATIONS

- 2x SDS brass flywheels
- 2x Kraken X60 motors
- Belt drive at 1:2 ratio
- Rack & pinion hood pivot
- 1/4" polycarb side plates
- 6061 aluminum gearbox
- 6061 aluminum hood plates
- Dynamically adjustable angle

SHOOTING PERFORMANCE

- Accurate from multiple field zones
- Fast flywheel spin-up time
- Hood angle updated in real-time via vision feedback
- Hold 35+ fuel before shooting

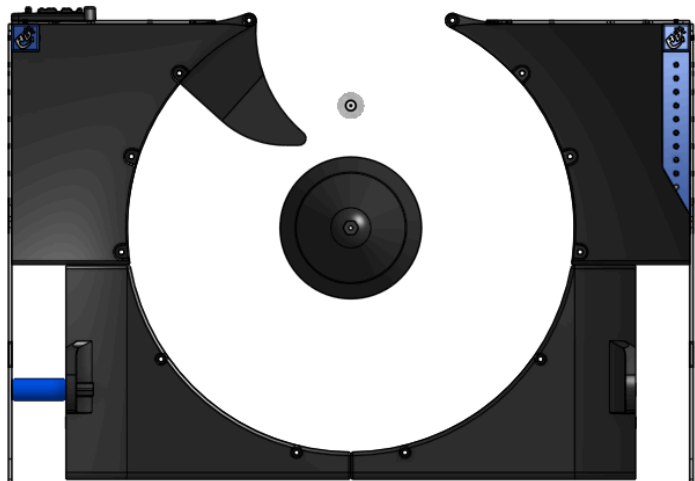
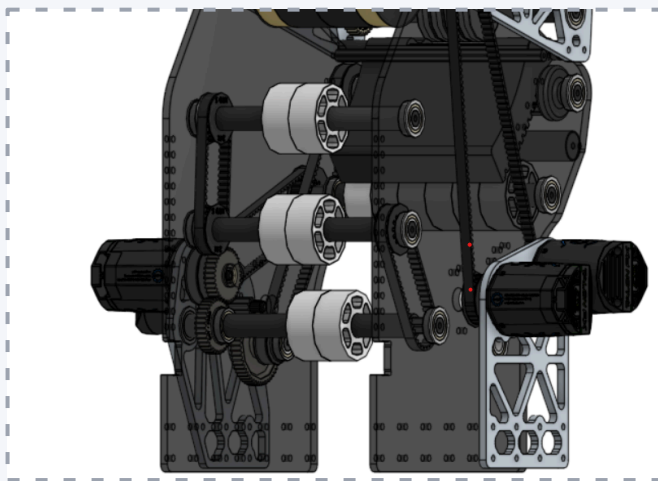


HOPPER

- 1/8" polycarbonate construction
- Holds maximum of 40 fuel balls
- Funnels feed directly into spindexer
- Expandable polycarb walls
- RSL and radio mounted on hopper
- Lightweight design minimizes top weight

SPINDEXER / FEEDER

- Feeds fuel into neck of shooter
- Powered by single Kraken X44
- 90° gearbox + planetary gearbox
- 9:1 total gear ratio
- Spindexer walls: PLA 3D printed
- (Bambu Labs H2D)



60+

Java Source Files

13

Git Branches

16

Members

2.5wk

Build Cycle

ARCHITECTURE — JAVA 17 WPILIB COMMAND-BASED

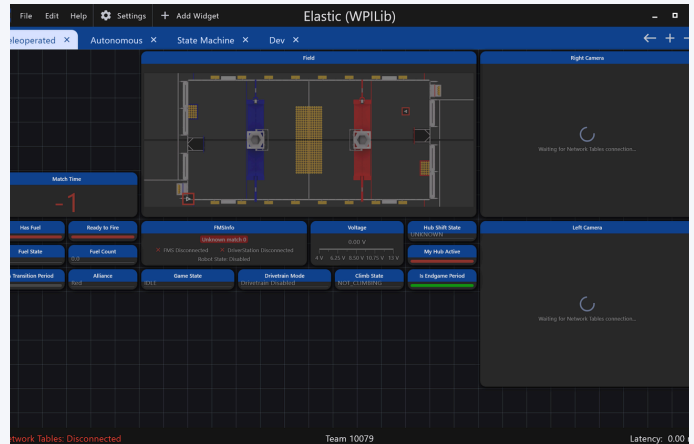
- 60+ Java source files across 6 contributors developed over a 2.5-week intensive build cycle
- Subsystems, commands, and factory patterns (ShooterFactory, AutoCommands) for clean separation of concerns
- Automated Palantir Java style formatting enforces consistent code style; no manual review needed
- 13 active Git branches with PR-based merges and parallel feature development across the full team

VISION SYSTEM

- Dual Limelight 4 cameras for full-field coverage
- MegaTag1 pose estimation; fused with odometry via Kalman filter
- Dynamic std dev model: vision trust scales automatically with distance and tag count
- 5-layer rejection pipeline filters bad tag readings before they corrupt odometry
- Disabled-mode heading correction auto-fixes gyro drift before match start
- Real-time odometry updates at full loop rate

SINGLETON STATE MACHINE

- Over 600 line hierarchical state machine that coordinates the entire robot
- Tracks 6 independent dimensions simultaneously:
 - Match state (Auto / Teleop / Disabled)
 - Drivetrain mode (Field / Robot relative)
 - Game state (Intaking / Shooting / Idle)
 - Fuel state (Empty / Loaded / Full)
 - Hub shift state
 - Climb state (Engaging / Failed)
- Includes history logging, haptic feedback & telemetry throttle



SHOOT ON THE MOVE — BALLISTICS CALCULATOR

NEW 2026

Our Launch Calculator runs a 20-iteration convergence loop to compute the exact flywheel speed and hood angle in real time while the robot drives at full speed.

- Velocity-compensated look ahead — predicts where the robot will be when the ball arrives at the hub
- Phase delay compensation — accounts for motor spin-up lag before the shot releases
- Law-of-sines velocity limiting — ensures shot accuracy isn't sacrificed at high robot speeds
- On-target gating — state machine only fires when RPM, pivot angle, AND heading are all within tolerance simultaneously

RUNTIME TUNING — NETWORKEDLIB

Custom-built NetworkedLib lets us adjust PID gains, feedforward constants, and interpolation table values live from NetworkTables; no code redeployment ever needed during testing or between matches.

Hot-swappable shooter interpolation tables allow field-side angle & speed calibration in seconds.

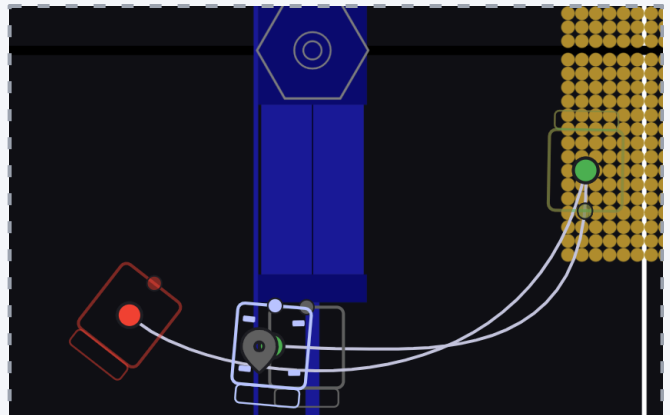
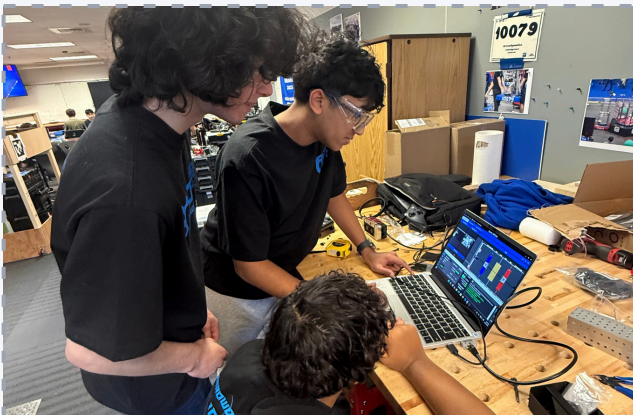
AD* BACKGROUND PATHFINDING

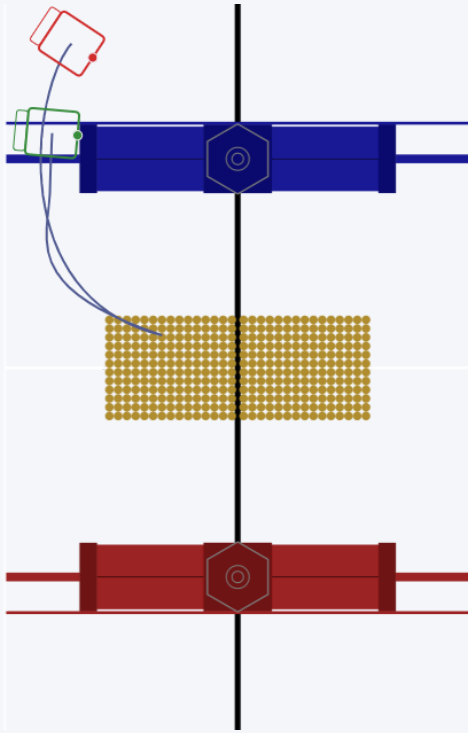
Real-time obstacle avoidance runs on a dedicated background thread using a local AD* algorithm with navgrid obstacle maps.

Allows the robot to dynamically re-route mid-match without blocking the main robot loop; the drivetrain always stays responsive.

DEVELOPMENT PRACTICES

- 13 Git branches with parallel feature development
- SysId (system ID) system characterization for data-driven motor and drivetrain tuning before any PID values are guessed
- Spotless Gradle plugin enforces Palantir Java formatting on every commit; zero style debates
- AdvantageKit full match replay logging; every sensor input is recorded and can be replayed offline for debugging





PATHPLANNER

- Pre-computed optimal paths with scoring events
- Loads during initialization
- Controls intake, shooting, & alignment events

CHOREO

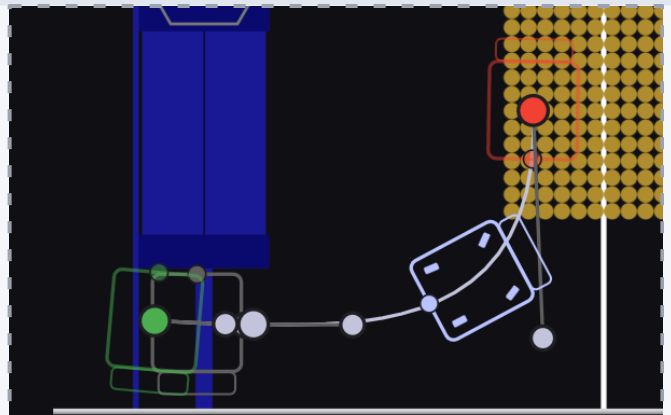
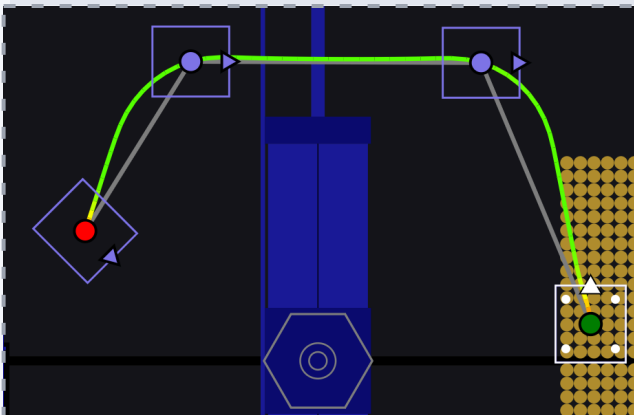
- Pre-generated time-optimal trajectories
- Dual auto system with shared named commands
- Automatic alliance side flipping

AUTONOMOUS SELECTION — via Elastic Driver Dashboard

Custom library enables on-the-fly tuning from Elastic during testing; no code redeployment required.

AUTONOMOUS OPTIONS

- Multiple unique autos; each designed for alliance integration
- Blue and Red side auto is a mirror; 20-second autonomous period

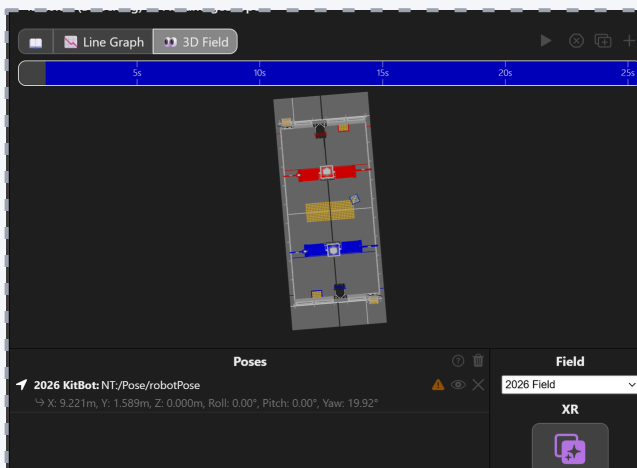


LIVE MATCH DASHBOARDS

- Elastic; live match dashboard for drive team
- Custom library built for On-the-fly tuning via Elastic (no code redeployment needed)
- Easy parameter adjustment during testing sessions

POST-MATCH DEBUGGING

- AdvantageScope with AdvantageKit logging
- CTRE SignalLogger; high-frequency module states & odometry logging
- Full replay of match data for analysis



CODE ARCHITECTURE

- Modular architecture; robot split into fully independent subsystems
- Each subsystem independently testable and deployable
- Heavily documented code + dedicated 81-page integration notebook
- Automated Palantir Java formatting ensures consistent style across all contributors

VISION AUTO-ALIGNMENT

- Hub auto-align: robot aligns with hub for effortless, accurate shooting
- Trench auto-align: vision-guided entry through the trench; reduces driver workload

THANK YOU

FELLOW FIRST TEAMS

- Velocity Raptors (9450)
- Miso Mechanics (9442)
- Chill Out (1778)
- Royal Robotics (2522)
- SOTAbots (2557)
- Robototes (2412)
- Jack in the Bot (2910)
- Otter Chaos (4512)
- Saints Robotics (1899)
- Sonic Squirrels (2930)
- CyBears (5041)
- CPR (3663)

MENTORS

- Kevin Finney
- Chris deVidal
- Shane Lambing
- Andrew An
- John Bush
- Brian Tax
- Bobby Thakalath
- Jason West
- Debra Tan
- Flynn Duniho
- Pete Duniho
- Eishan Mohammed
- Tim Swartz
- Andrew Bush

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