Overview

This XeroPath application is a path generation tool. It generates paths the are to be followed by a robot. The XeroPath application has the following features:

- Support for the West Coast style drivebase
- Support for the swerve style drivebase (experimental, not tested on a real robot)
- Supports sets of paths grouped into path groups (generally autonomous modes)
- Maximum velocity control per robot, path, or waypoint
- For swerve, independent control of the robot heading and the robot facing direction
- Visualization of the path, the velocity profile, and the robot following the path
- Keyboard control of waypoint position and heading for precise waypoint control
- Support for multiple path generation backends
- Undo

Getting Started

Concepts

This program provides the capability to generate paths to be followed by a robot. The output is a profile for each driven wheel on the robot that consists of time heading, position, velocity, acceleration and jerk. If these profiles for each wheel are followed, the robot will drive the desired path.

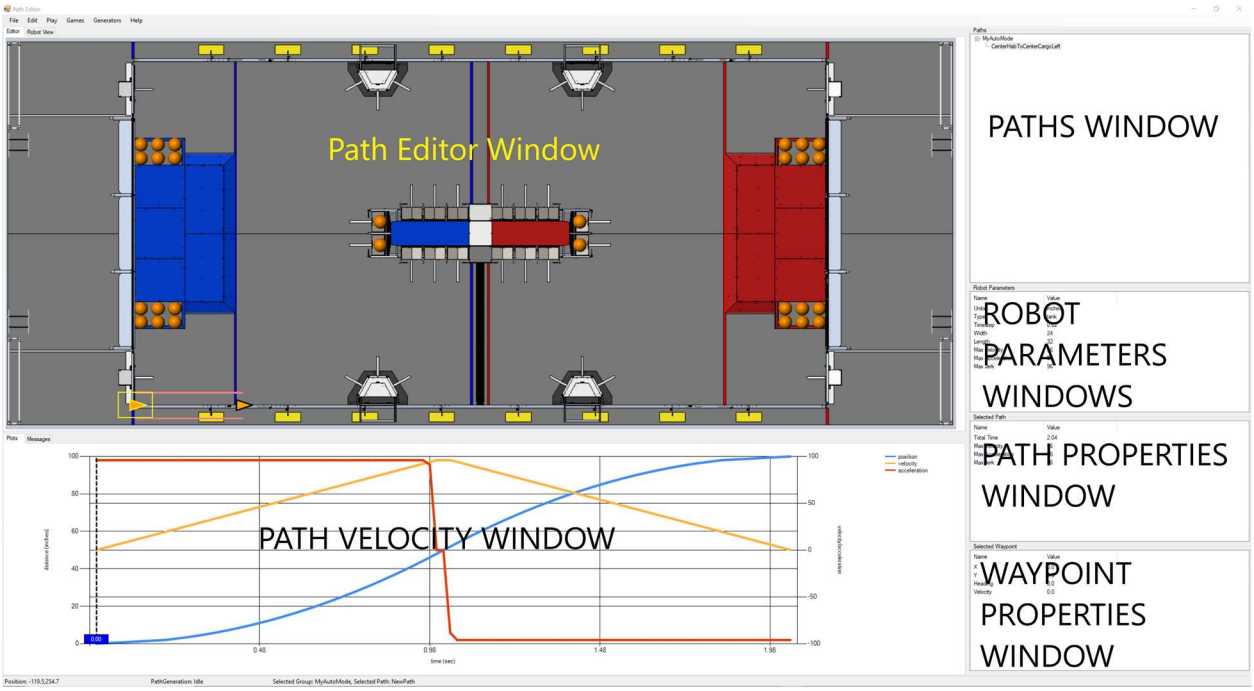
Locations are specified as a set of X and Y coordinates. The origin is at the bottom left of the playing field. The X axis extends positive to the right toward the other end of the field. The Y axis extends positive upward. Headings are given in degrees. Zero degrees is pointing along the X axis. Angles increase in a positive direction rotating counterclockwise.

The program is an editor for a set of paths. Each path belongs to a path group. Path Groups are generally the name of an autonomous mode that uses a given path, but this is a convention and is not required.

A path consists of a set of Waypoints. A Waypoint consists of a X and Y location, a heading, and a velocity. The velocity value limits the maximum velocity of the path from the given Waypoint to the next Waypoint. The velocity value is not honored by all path generators.

The set of waypoints are processed to generate the path segments. Each path segments contains the per-wheel position, velocity, acceleration, and jerk. This means both the position of the robot for the path and the velocity of the robot for the path are generated.

Top Level Window



The Path Editor Window is used to edit the current path. It is selected via the Editor tab at the top of the window. Waypoints and be selected and dragged to new locations. The tip of the waypoint can be used to rotate the waypoint. If a Waypoint is selected, the arrow keys can be used to move the waypoint. Holding the shift key while using the arrows keys move the Waypoint with a finer increment. If a Waypoint is selected the Page Up and Page Down keys can be used to rotate the Waypoint. Holding the shift key while using these keys rotates the Waypoint with a finer increment.

The Robot View shows one or more paths in action. Selecting a path and moving the time bar in the Path Velocity Window moves an outline of the robot to the location it would be in at the selected time. The Play/Current Path/Group can be used to show the robot following the path in real time. The Play/Complete Path File will demo all paths stored in the file one after another.

The Path Velocity Window shows the generated velocity profile for the path. The Position is shown on one axis, and the velocity and acceleration are shown on another. The dashed vertical bar (time bar) shows the current time along the path. Moving this current position will move a white dot on the path showing the position on the path within the Path Editor Window. Moving this current position also has an impact on the Robot View window (discussed below).

The Paths Window shows the set of Path Groups and Paths that are part of this path file. Clicking on a Path Group or Path will select this Path Group or Path and change what is displayed in all other windows.

The Robot Parameters Window shows the robot parameters. This includes the following.

Parameter	Description	Notes
Units	The unit of measurement used in the program. The program supports inches, feet, cm, and meters.	Changing this value will updated all robot parameters, all path

		parameters, and all waypoints to reflect the new units.
Type	The type of drivebase for the robot.	Note, the SWERVE drive is experimental and has not been tested.
Timestep	The time interval for the output of the path segment data which includes per wheel position, velocity, acceleration, and jerk.	
Width	The effective width of the robot between the left and right wheels of the robot.	Wheel scrub can make the effective width of the robot differ from the measured width of the robot. This is best obtained via characterization.
Length	The length of the robot between the front and back wheels of the robot.	
Max Velocity	The Maximum Velocity allowed for any path.	
Max Acceleration	The Maximum Acceleration allowed for any path.	
Max Jerk	The Maximum Jerk allowed for any path.	Note all backends honor this value.

The Path Property Window shows the properties for the currently selected path. This includes the following.

Parameter	Description	Notes
Total Time	The total time required to traverse the path.	This value is read only and appears after the segment generation is complete for a path.
Max Velocity	The Maximum Velocity allowed for this path.	If this value exceeds the robot max velocity, the max velocity is limited to the robot max velocity.
Max Acceleration	The Maximum Acceleration allowed for this path.	If this value exceeds the robot max accelerations, the max accelerations is limited to the robot max accelerations.
Max Jerk	The Maximum Jerk allowed for this path.	If this value exceeds the robot max jerk, the max jerk is limited to the robot max jerk.
Start Angle	The starting angle of the front of the robot for this path. Since a swerve drive can move in any direction, this is different than the robot heading as defined by the Waypoints.	Swerve drive only
End Angle	The ending angle of the front of the robot for this path.	Swerve drive only

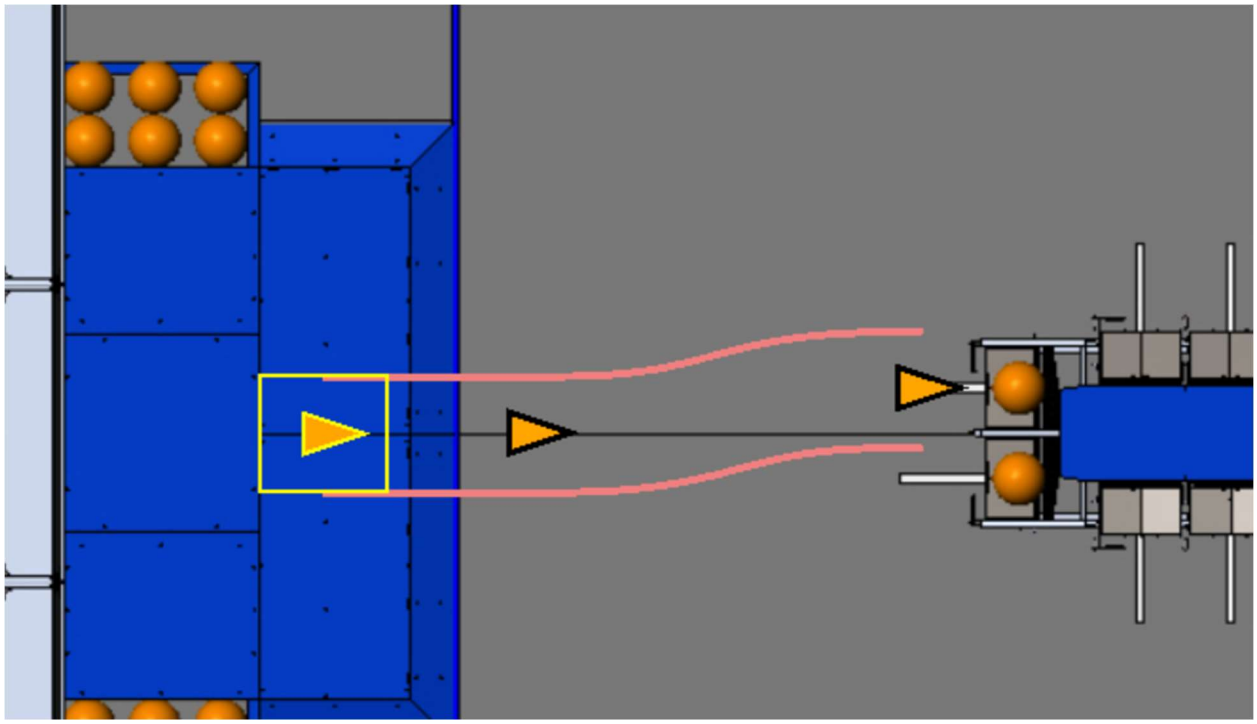
Rotation Start Delay	The amount of time to delay at the start of the path before beginning any rotation required of the robot during the path.	Swerve drive only
Rotation End Delay	The amount of time before the end of the path when the rotation must be complete.	Swerve drive only

The Waypoint Property Window shows the properties for the currently selected waypoints.

Parameter	Description	Notes
X	The X position for this Waypoint.	
Y	The Y position for this Waypoint.	
Heading	The direction the robot is moving.	
Velocity	The maximum velocity for the robot on the current path between this waypoint and the next waypoint on the path.	Not all generators honor per waypoint velocity constraints.

Creating a new set of paths

1. Create a new path file via the File/New menu item.
2. Change the parameters in the Robot Parameters window to reflect your robot and desired units.
3. Add a new path group via the Edit/Add Path Group menu item.
4. Rename the new path group by double clicking on the new path group in the Paths window on the right of the screen. I named mine 'MyAutoMode'.
5. Add a new path via the Edit/Add Path menu item.
6. Rename the new path by double clicking on the new path in the Paths window on the right of the screen. I named mine CenterHabToCenterCargoLeft.
7. Note, that the path is at the bottom of the screen, starting in the bottom right corner of the field. Move this starting waypoint to the desired starting point on the hab platform.
8. The second points is still at the bottom of the screen, move this point to the left side of the cargo ship.
9. Select the first waypoint and selected Edit/Insert Waypoint (or hit insert key). This adds a new waypoints. Move this new waypoint to be directly to the right of the first waypoint, but off of the hab platform.
10. Select the original waypoint, move to the Selected Waypoint window and double click on the velocity. Change this value to 40. At this point the path should look something like this.



And the velocity profile window should look like this.