

Kauai Labs

Build Better Robots®

Measuring motion/orientation, improving your autonomous and tele-operated software, and expanding roboRIO I/O

The navX-MXP Robotics Navigation Sensor provides an accurate, easy-to-use way to measure motion and 3D orientation of any object (for instance, your robot chassis or a robotic arm).

These capabilities enable you improve your autonomous and teleoperated programs by adding intelligent features including:

- Driving in a straight line
- Rotating automatically to a specific angle
- Field-oriented drive
- Automatic Balancing
- Motion Detection
- Collision Detection

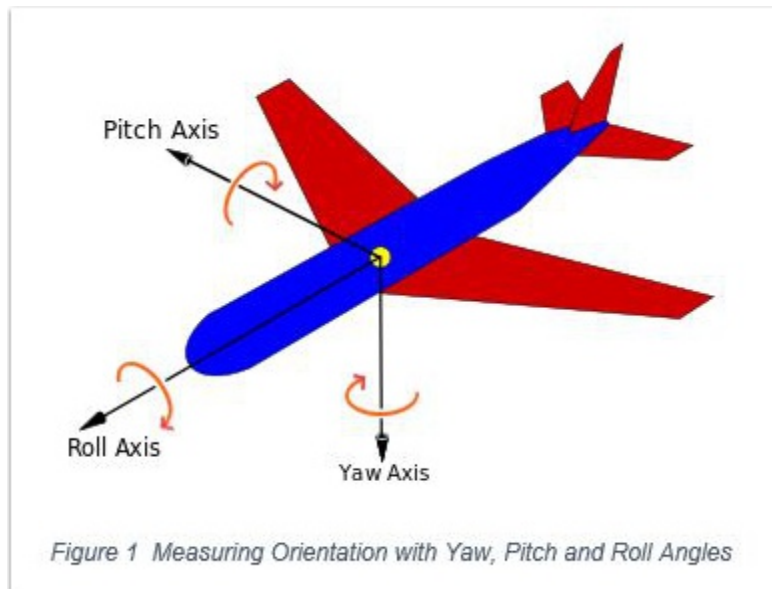
navX-MXP is both a self-calibrating Inertial Measurement Unit (IMU) and an Attitude/Heading Reference System (AHRS).

navX-MXP is simple to install on a roboRIO, and includes roboRIO I/O expansion features.

Inertial Measurement Unit (IMU)

navX-MXP is an Inertial Measurement Unit (IMU), and includes 6 sensors which measure inertial motion: 3 accelerometers measuring acceleration (in units of [Standard Gravity](#) [g]) and 3 gyroscopes measuring [Rotational Speed](#) (in units of degrees per second).

Additionally, through a process called “Motion Processing”, navX-MXP intelligently combines the 6-axis inertial sensing data to create a measurement of relative 3D orientation.



IMUs are typically used to measure aircraft orientation, but are also very useful for controlling a robot. IMUs measure rotation of an object around the Z-axis (known as “Yaw”), the X-axis (known as “Pitch”) and the Y-axis (known as “Roll”).

Pitch and Roll angles are absolute (tied to the earth’s surface); 0 degrees means “flat” with respect to the earth.

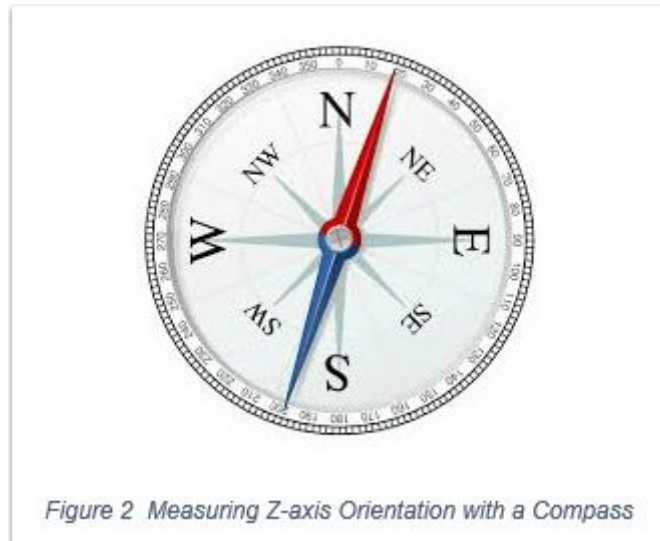
However, IMU Yaw angles are *relative* - not tied to any direction (like North on a Compass).

Therefore, your robot application must decide where 0 degrees is. Usually, FRC robots treat the “head” of the field (the direction driver’s face) as 0 degrees.

For more information, please visit the [navX-MXP Terminology page](#).

Digital Compass and Attitude/Heading Reference System (AHRS)

navX-MXP also includes 3 magnetometer sensors, which measure magnetic fields (in units of Tesla). By measuring the earth’s magnetic field, navX-MXP provides a digital compass which is a different way of measuring the Z (“Yaw”) axis.



And by intelligently fusing the digital compass with the IMU can create a measurement of absolute 3D orientation.

Note: Earth's magnetic field is actually very weak when compared to the magnetic field generated by a nearby motor; for this reason it can be difficult to get accurate digital compass readings on a FRC robot. For this reason, using the navX-MXP AHRS is an advanced feature best suited for teams who have the time to learn about [how to calibrate the navX-MXP digital compass](#) and also how to deal with magnetic disturbances.

roboRIO Hardware Installation



The navX-MXP can be easily connected to a National Instruments roboRIO MXP port. This only takes about 5 seconds and provides a stable, secure base for the onboard sensors that is aligned to the axes of your robot. Two screws are provided with navX-MXP to secure the circuit board to the roboRIO. More information may be found on the [navX-MXP roboRIO installation page](#).

USB (optional, or to connect to your vision co-processor)



A secondary configuration possibility is to connect navX-MXP to a roboRIO or another computer via USB possible because *data from navX-MXP flows simultaneously to the MXP connector and the USB port*. Some teams have connected the navX-MXP USB port to a co-processor in order to integrate navX-MXP sensor measurements into their vision processing. To support access to USB-based navX-MXP data from a Linux-based co-processor, a Linux library was developed by Team 900 (Zebracorns) and is available [here](#).

NOTE: As further described in the navX-MXP [Best Practices](#), a USB cable connected to your roboRIO can also provide a secondary power supply in case of roboRIO brownout.

navX-MXP

Enclosure



An enclosure is recommended to protect the navX-MXP circuit board from excessive handling, “swarf”, [electrostatic discharge \(ESD\)](#) and other elements that can potentially damage navX-MXP.

Visit the [navX-MXP Enclosure page](#) to either purchase an enclosure for navX-MXP or to download a 3D-printable design file.

roboRIO Software Installation

To access navX-MXP from your roboRIO robot application, install the [navX-MXP Libraries for roboRIO](#).

Best Practices

If you want to get the most out of your navX-MXP and achieve results similar to those of the top FRC teams, the navX-MXP [Best Practices](#) is just for you. These guidelines will help you avoid common pitfalls and achieve the highest possible accuracy.

Getting Help

If you have trouble with navX-MXP, please visit the [navX-MXP support page](#); you can join the navX-MXP newsgroup or contact technical support for help.