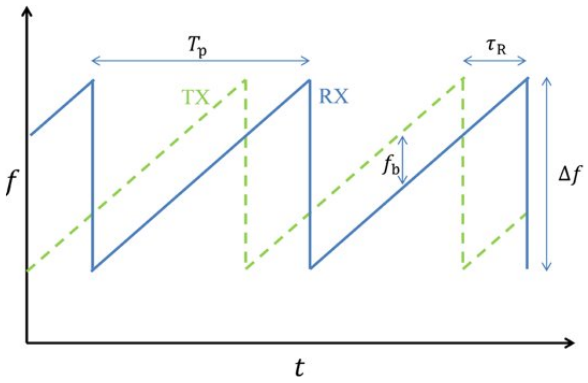
FAQ

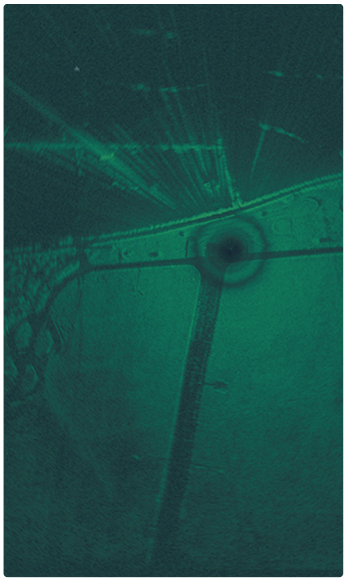
What is an FMCW Radar and how does it work?

Radar (Radio Detection and Ranging) systems measure the time of flight from when the transmitted signal leaves the radar, hits the reflecting target and returns to the radar. Frequency Modulated Continuous Wave radar is a form of radar where the frequency of the transmitted signal is varied over a period of 1ms. The received signal does exactly the same thing but is delayed by the time of flight. The difference between the two signals is directly proportional to the time of flight, which is turn is therefore proportional to the range.



How is this different from automotive radar?

The Navtech Radar takes technology that used to be exclusively for the aviation, marine and military applications and brings it to industrial automation and autonomous vehicle applications. Navtech's FMCW scanning radar allows the world to be observed in 400 equally spaced azimuthal slices with each one containing over 2500 discrete range measurements. This results in the radar being able to scan a circular radius of 500 metres at a resolution of 17.5cm per range bin. These 1 million readings update 4 times a second providing far more information than automotive radar are able to give.



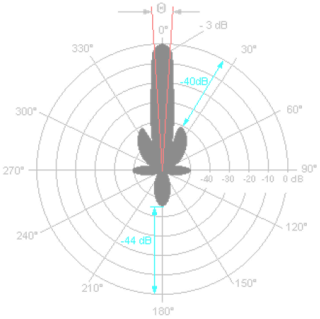
Why is radar needed for autonomy?

Radar is the only technology that can be relied on 100% of the time in all-weather conditions, meaning that safety and availability can be guaranteed. This is essential if autonomous solutions are to be as good as or better than their human counterparts. The Navtech sensor is a field-tested solution that works today and will continue to work for the next 10 years in some of the harshest industrial settings found on earth.

How is the Navtech Radar different from Lidar?

It's important to realise that the radar beam is not a pencil beam like a laser, but has a 3D profile with this in mind think of the beam more like a touch light than a laser. Since the radar returns a value from every range measurement, it is able to see through noisy objects something that most time of flight sensors are unable to do. By "seeing" past the first detection the radar is unlike Lidar, by splitting each azimuth into an array of radially spaced intensity values the radar provides an extra dimension that Lidar is the absence of. It is this functionality that provides the ability for the radar to build up top-

down "photo" like images something that a lidar unit is unable to do without implementing multiple channels. Another crucial difference between the Navtech radar and lidar is its ability to work through adverse weather conditions, the longer wavelength of the radar signal is not affected by dust, fog, rain or snow so the sensor can be used in all scenarios giving the radar a very large operating window, and because it doesn't have a lens it does not require cleaning.



Are there any moving parts?

As with lidar and other wide field of view sensors, it is common to have some moving parts. The Navtech sensors have a passive rotating reflector but no active moving parts. Whilst other Flat-panel radars often boast of "no moving parts" and their improved reliability compared to traditional rotating radar equipment by using beam steering scanning techniques. Navtech radar uses mechanical scanning, so the electronic component count and complexity are reduced, therefore circuits will run cooler, which greatly increases the lifetime of the components. This has been optimised over the past 20 years in multiple harsh industrial environments. The sensors have a service life of 5 years and a design life of 10 years.

What beam shape options are available?

A 1.8-degree dish is used meaning that the radar focuses the majority of the power of the beam within a 1.8 degree by 1.8-degree field of view. This gives the radar its high-powered, long-range main beam. The radar's oversampling (every 0.9 degrees) means then that every target will get at least two 'hits' by the main beam. The problem with a very narrow beamwidth is that when mounted high up, the radar will have a larger blind spot. For applications where this is an issue, using a dish with fill-in might be a better option.

How does fill-in work?

A dish with fill-in effectively takes some of the main beam power and focuses it towards the ground. This significantly improves the ability of the radar to see the ground very nearby to where it's mounted. This is especially useful for all our roadside and in-tunnel applications, where a radar is mounted high up on the side of the road to monitor traffic. This is also useful when mounted onboard an autonomous vehicle, so the radar can 'see' objects close to the front of the vehicle. Using a dish with fill-in, therefore, reduces the overall strength of the main beam, so the tradeoff is reduced long-range performance.

What software is available?

Navtech is working in partnership with Oxbotica, to provide data processing software for odometry and localisation. This addresses some of the more challenging aspects of processing radar data and will allow people to fast track their adoption of radar technology. There is an option to embed the Safeguard software onto the radar that allows a relay signal to be operated in the case of object detection on one of the six configurable zones. There is also an accompanying SDK that allows engineers to the sensor up and running.

What drivers are available?

The Navtech IASDK provides the source code for C++ and a simple .NET DLL that can easily be integrated into applications running on Windows and Linux. The SDK contains an example interface for the radar and allows raw FFT data and navigation data extraction. Examples of ways to process the data is also included.

Is the radar ROS compatible?

Yes, the radar is now ROS compatible, within the Software Development Kit SDK there is an example ROS application to get a project started. This includes publishing of Radar data as a pointcloud, laserscan and object identification options.

What is the power consumption of the radar?

The power consumption of the radar is 30 watts and uses a supply voltage of 24V DC.

What connectivity does the radar support?

Communication between the sensor and the software is over an RJ45 Ethernet connector and utilises a proprietary binary communication protocol called Colossus Network Protocol. Documentation for the Colossus Network Protocol can be found here: Colossus Network Data Protocol .

Is the radar safe?

Yes, Radar technology has been used safely for a long time in a wide range of applications. The power output of the radar is 15mW, much smaller than a telephone that has a power output of 500mW. We follow strict guidelines to ensure that the radar passes the required safety standards. The design and manufacture of all equipment supplied by Navtech Radar tracking CE accredited:

- *European Electromagnetic Compatibility Directive*
- *European Low Voltage Directive*
- *European Radio Equipment Directive*
- *A CE certificate and detailed directive information is available on request from Navtech Radar*

What is the data output rate of the sensors?

The data is dependent on the maximum range required but varies between 11Mbps - 38Mbps.

What type of data is produced?

At every azimuth the radar produces an intensity value for every range bin along that azimuth, it does that for all of the azimuths 4 times a second.

Can the resolution improve with a shorter range?

Unfortunately, currently, 4.4cm is the best resolution that is possible with the sensor.

What is the ideal mounting height of the radar?

The ideal mounting height can vary depending on the specific application and if the beam is angled through the use of a dish with fill-in. For example, if a dish with fill-in is used and the sensor is mounted at 2m, this will give a minimum detection range of about 5m and for a person walking upright.

At what ambient temperatures can the radar operate in?

Please refer to the datasheet for the exact model, but most sensors will operate over –20 to +60 degree C.

What is the price?

Please contact our sales team at sales@navtechradar.com for cost enquiries.