# Exploring Ultrasonic Sensors: Benefits Over Radar Technology

*In this interview with Airmar Technology, AZO Sensors addresses the advantages and differences of ultrasonic sensors versus optical sensors.*

## Can you explain what ultrasonic sensors are and how they work?

Ultrasonic sensors generate and receive acoustic waves. The (sound) waves are inaudible to humans because the frequencies are greater than (ultra) the upper limit of our hearing.

Ultrasonic transducers determine the distance to a target by measuring the time-of-flight of an acoustic wave, just like how a bat searches for its prey.

The acoustic signal is generated by driving a piezoceramic with an oscillating electrical pulse, usually the transducer's best operating frequency (resonance). This causes the ceramic to vibrate and create a sound wave.

A portion of the acoustic wave will reflect off a target (an echo) and return to the transducer, producing a smaller but similar voltage signal. Electronic circuits and microcontrollers can then be used to estimate the distance and size of the target.

## What are some of the applications of these sensors, and would any of them be surprising or unexpected for people unfamiliar with the technology?

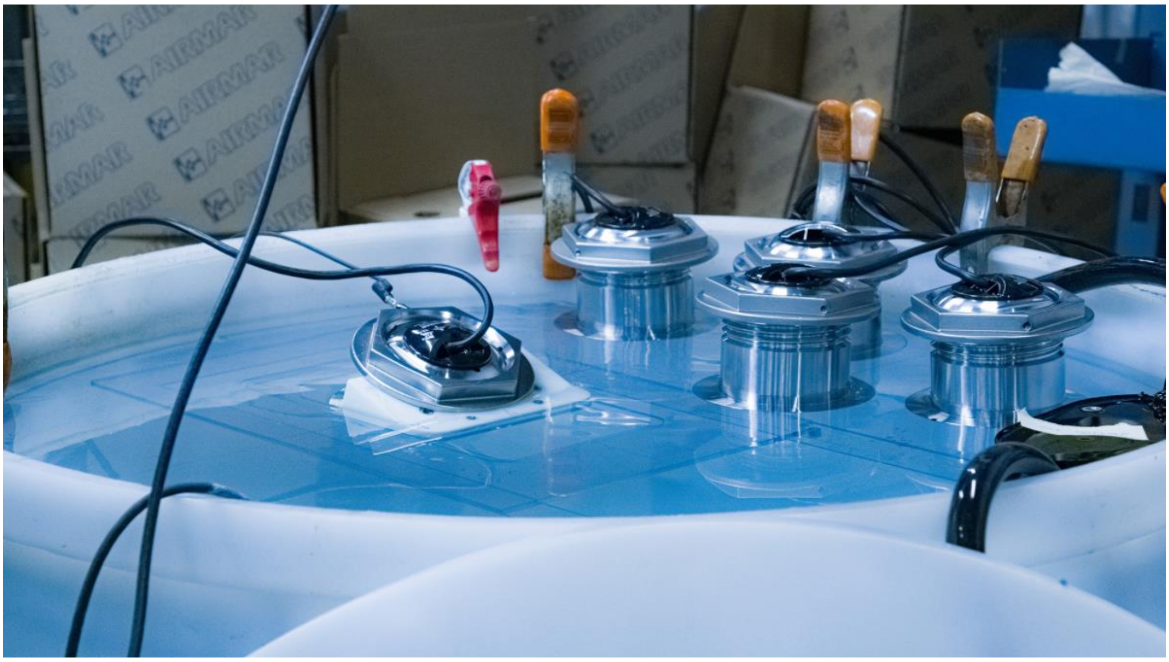
A few examples are mapping and obstacle avoidance for robots, flow measurement (acoustic anemometry), and industrial process measurement and control (in making paper and wood laminates). Sound waves have also been used in bowling alleys for upright pin detection and automatic scoring. Since sound waves can easily penetrate water mist, they are also commonly used in automated car washes to sense vehicle position. Their most common application is back-up sensors in cars.

## Can you explain the differences and advantages of ultrasonic sensors over optical sensors?

Optical sensors are negatively affected by dust and other debris present in industrial processes. Ultrasonic sensors also have a higher tolerance for surface contamination than optical sensors before the signal degradation occurs. Optical sensors alone cannot measure distance unless a laser is used.

Another advantage is that ultrasonic sensors can use diffuse sound beams to ensonify a space and provide an average measurement of distance, compared to laser-based ranging systems, which only detect the distance to a fixed point. When the target surface has a distributed height, such as grain in a hopper, a measurement from an ultrasonic sensor would be preferable.

Ultrasonic sensors usually cost less, and they are more compact in terms of resolution than small radar systems.




## Can you explain the differences and advantages of ultrasonic sensors over radar?

Ultrasonic sensors can offer a great lower-cost alternative to radar range sensors. For example, Airmar’s long-range ultrasonic ART15 Airducer, with a range of up to 60 meters, is a good option. Sound waves from ultrasonic sensors can also be reflected off most materials, unlike radar waves, which will not reflect off materials with small reflectivity (small dielectric constant).

## What are some of the environmental factors that can hamper ultrasonic sensors, and what are the solutions?

Ultrasound-ranging devices rely on transmitting and receiving sound waves through the atmosphere, so variations in temperature and humidity will impact both the time of flight and the amplitude of the acoustic wave. However, temperature and humidity sensors can be used to measure and account for these effects in systems where precision measurements are required.

## What are the best targets for ultrasonic sensors, and why?

The most signal is generated when wide surfaces are used as a target for ultrasonic sensors. When the diffuse conical sound beams are transmitted to a target with increased surface area, more acoustic waves are reflected to the source, resulting in a stronger signal to estimate the surface range. The vast majority of materials are hard enough to reflect airborne sound sufficiently well. The exceptions are very porous materials such as lightweight foam and fiberglass wall insulation. Materials like this are also used for sound absorption and wall treatment in acoustic measurement chambers as well as concert halls.

## What sets AIRMAR ultrasonic transducers apart from others on the market?

All AIRMAR air-ranging transducers are measured and tuned to maximize sensitivity and bandwidth. They are also designed to be durable for both interior and exterior use.

## What advantages does this confer to the user?

Increased bandwidth reduces the transducer ring-down time, allowing for sensing targets close to the source, while increased sensitivity improves the transducer's ability to sense targets from a large distance. Their durability allows them to work even in challenging conditions.

## What are the most recent changes in this technology?

The transducer design has been changed to allow greater bandwidth signals, like Chirp. Broadband signals improve performance and provide finer-ranging estimates in long-range sensing applications without needing excess power. The electronics revolution, particularly in miniaturizing and microprocessors, has facilitated the use of acoustic bandwidth.

## What are some of the challenges that ultrasonic developers have faced, and how have they been overcome?

Ultrasonic ranging sensors are suitable for use in environments with hazardous chemicals. However, such environments can damage the delicate materials used in the construction of the ultrasonic transducer. In response, AIRMAR has developed ultrasonic transducers packaged in a rugged one-piece PVDF housing for use in caustic environments. The PVDF face of the housing is acoustically tuned to maximize transducer sensitivity while providing high durability.

## What is the future for ultrasonic devices, and what developments are you excited to see?

Data fusion with passive optics (cameras) in robotic applications will expand the sales market. The use of novel materials can also improve the design and performance of the transducer.

## About AIRMAR Technology Corporation

AIRMAR® Technology Corporation, an Amphenol® company, is a world-leading designer, manufacturer and supplier of high-performance ultrasonic industrial, marine and survey transducers, and ultrasonic WeatherStation® multisensors.

Airmar produces the most reliable, high-quality non-contact ultrasonic air transducers for use in today's challenging commercial and industrial applications. Our Airducer® air-ranging transducers are critical components in the development of a myriad of measurement systems in fields that require liquid or solid levels, flow control, automation control, proximity sensing, obstacle avoidance, distance measurement and process control.

Established in 1982, AIRMAR's headquarters are located in Milford, New Hampshire with 11 sales and tech support offices in 7 countries. Visit the Company's website at https://www.airmar.com.

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