Technical Article

The Picture of the Distance: Detecting Range to Help mmWave Sensors Understand Their Environment

RFerguson

Since its introduction many years ago, millimeter wave (mmWave) radar has come a long way, with designers now interested in its use for applications such as traffic monitoring, semi-autonomous vehicles and factory automation. The three key measurements that make mmWave radar valuable in applications like these are range, velocity and angle.

In this second installment of a four-part series, I'll dive deeper into range measurements and how they impact a radar's usefulness in a variety of applications. In my last blog post, I said, "there is more to measuring range than simply the accuracy of the measurement. Range resolution is the ability to distinguish between two closely spaced objects …High-range resolution also helps improve the minimum measurable distance, which means that the system can detect objects closer to it."

This technical article discusses two videos that show the importance of range measurements in a variety of different applications.

The experiment shown in the Sense the world with TI mmWave: See through rain and walls, and detect small objects video was designed to determine the farthest distance at which mmWave technology could still detect an object as small as a coin. We were able to determine that the technology could distinguish a quarter at 2m. While the automotive applications are obvious – being able to see objects or debris in or near the road, as well as pedestrians, cyclists and other cars – you can also imagine how the ability to distinguish small objects would be useful in industrial settings.

Imagine a warehouse staffed by a mixture of robots and humans, which move around the warehouse selecting, packaging and shipping items purchased by customers. If an item is dropped in the path of a robot, an mmWave sensor must be able to detect that object, determine the range or how far away it is, and determine how to get around that object.

Imagine that the mmWave radar sensor is fixed to a traffic light or street lamp. By detecting the distance as well as the number of objects in the path of the radar beam, as well as whether those objects are moving, the traffic light could decide to turn green or red at precisely the correct moment to keep traffic flowing smoothly. Or a street lamp could illuminate just before a passing driver or pedestrian needs light and shut off shortly after, reducing electricity costs.

TI's mmWave sensors can take advantage of their small wavelengths to measure very minute changes in range. As the Driver vital sign detection demonstration using mmWave radar sensors video illustrates, such capability means that mmWave technology can detect vital signs, such as breathing or heart rate. You can imagine a number of different applications for this, including detecting a child or pet left behind in a hot car. Or a semi-autonomous car could navigate off the road in the event that the driver experiences a dangerous health condition, such as a heart attack, stroke or seizure.

As you can see, range is a valuable measurement that enables mmWave radar sensors to detect and understand their environment, both in automotive and industrial settings. Velocity and angle are additional measurements that, when combined with range, produce additional details about an environment, which I'll discuss in the next installments of this series. In the meantime, check out the "The fundamentals of millimeter wave sensors" white paper for more information on how mmWave sensors use these measurements to see and understand their environment.

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