

## FMCW Doppler Radar Measurements with Microstrip Tx-Rx Antennas

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**Abstract :** This study presents a more compact implementation of the 2.4GHz MIT Coffee Can Doppler Radar for 2.6GHz operating frequency. The main difference of our prototype depends on the use of microstrip antennas which makes it possible to transport with a small robotic vehicle. We have designed our radar system with two different channels: Tx and Rx. The system mainly consists of Voltage Controlled Oscillator (VCO) source, low noise amplifiers, microstrip antennas, splitter, mixer, low pass filter, and necessary RF connectors with cables. The two microstrip antennas, one is element for transmitter and the other one is array for receiver channel, was designed, fabricated and verified by experiments. The system has two operation modes: speed detection and range detection. If the switch of the operation mode is 'Off', only CW signal transmitted for speed measurement. When the switch is 'On', CW is frequency-modulated and range detection is possible. In speed detection mode, high frequency (2.6 GHz) is generated by a VCO, and then amplified to reach a reasonable level of transmit power. Before transmitting the amplified signal through a microstrip patch antenna, a splitter used in order to compare the frequencies of transmitted and received signals. Half of amplified signal (LO) is forwarded to a mixer, which helps us to compare the frequencies of transmitted and received (RF) and has the IF output, or in other words information of Doppler frequency. Then, IF output is filtered and amplified to process the signal digitally. Filtered and amplified signal showing Doppler frequency is used as an input of audio input of a computer. After getting this data Doppler frequency is shown as a speed change on a figure via Matlab script. According to experimental field measurements the accuracy of speed measurement is approximately %90. In range detection mode, a chirp signal is used to form a FM chirp. This FM chirp helps to determine the range of the target since only Doppler frequency measured with CW is not enough for range detection. Such a FMCW Doppler radar may be used in border security of the countries since it is capable of both speed and range detection.

**Keywords :** doppler radar, FMCW, range detection, speed detection

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