

Program of Research

a- The complete program of research and experimentation proposed including description of equipment and theory of operation

a.1- Complete program of research and experimentation.

This program of research involves the development of a small, light, and simple radar to be used mainly for object detection on robots. This includes the design, simulation, construction and testing of an FMCW (Frequency Modulated Continuous Wave) radar in the 5.25 GHz to 5.65 GHz band.

The experimentation stage can be divided in two parts:

- 1- Test of the radar on a fixed place. This will involve the test of the radar outdoors where we expect the robots to operate with the radar.
- 2- Test of the radar on a mobile robot. In this setting, the radar will be placed on several different robots to test its functionality.

Also, during the experimentation stage different circuits and antennae will be tried to pick the components that achieve better performance.

a.2- Description of the equipment and theory of operation.

The radar to be developed will have the following specifications:

- 1- Mode of operation: FMCW.
- 2- Maximum output power: 20 mW.
- 3- Operating band: 5.25 GHz to 5.65 GHz.
- 4- Bandwidth: 210 MHz.
- 5- Range: 250 ft.

Theory of operation

Figure 1 shows the radar block diagram. The function generator sends out a triangular wave which controls the frequency of the VCO (Voltage Controlled Oscillator), therefore, at the output of the VCO there is a sine wave which linearly changes in frequency from its minimum value to its maximum and back to its minimum. This signal is then amplified, and sent to the transmitting antenna and the mixer thru the power splitter.

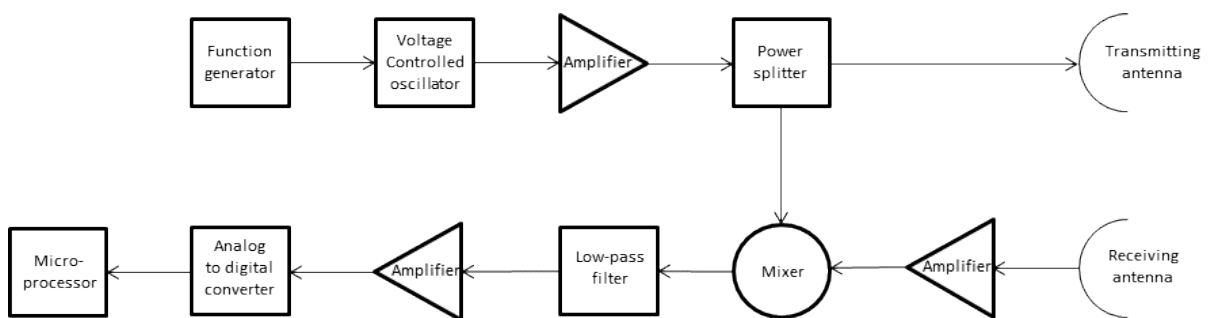


Figure 1. Radar block diagram.

Once the RF signal is sent, and bounces form an object, it is picked up by the receiving antenna, amplified and mixed with the transmitted signal. Then, the signal is filtered to remove the high frequency components. The resulting signal is then amplified and converted to digital by the analog-to-digital converter and later processed by the microprocessor to obtain the range profile.

b. The specific objectives sought to be accomplished.

The specific objectives are the following:

1. The design of a radar in the 5.25 GHZ to 5.65 GHz frequency range.
2. Simulation of the radar.
3. Selection of the components and purchase.
4. Implementation of the radar.
5. Experimentation and testing.

c. How the program of experimentation has a reasonable promise of contribution to the development, extension, expansion or utilization of the radio art, or is along line not already investigated.

There is a gap in the area of sensors for object detection in robots. It is hard to find long range sensors for robots based on RF. This project aims to provide a radar that will fill this gap and will help roboticists develop autonomous robots that can navigate more easily and precisely by letting them "see" objects from longer distances.