Waveform Obtained

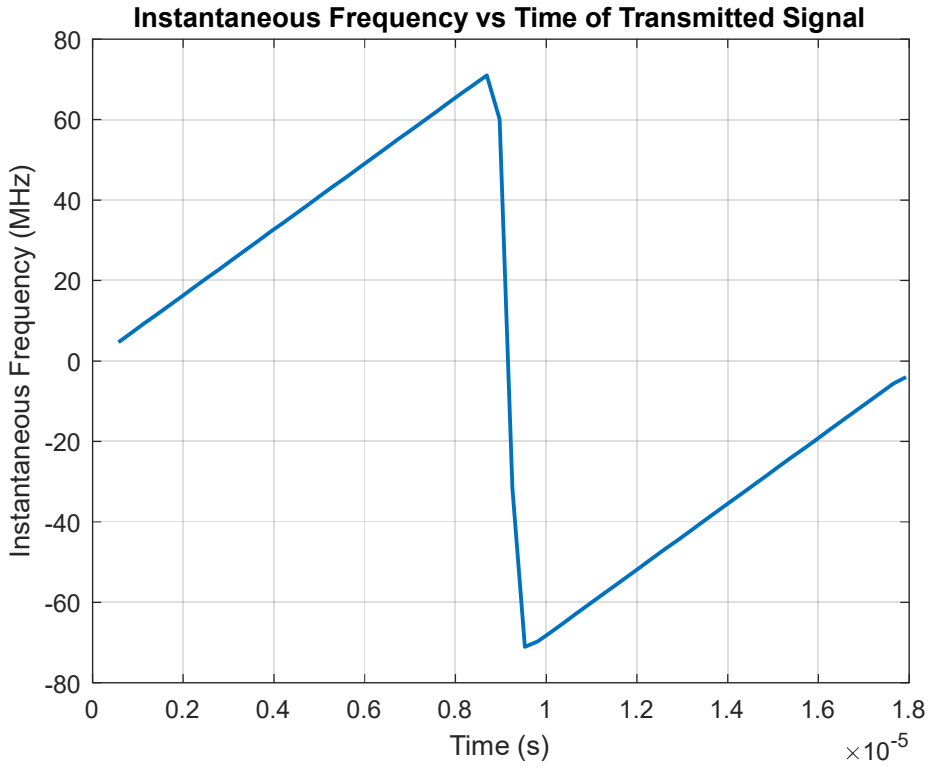

Figure 1 Transmitted FMCW (Chrip) signal

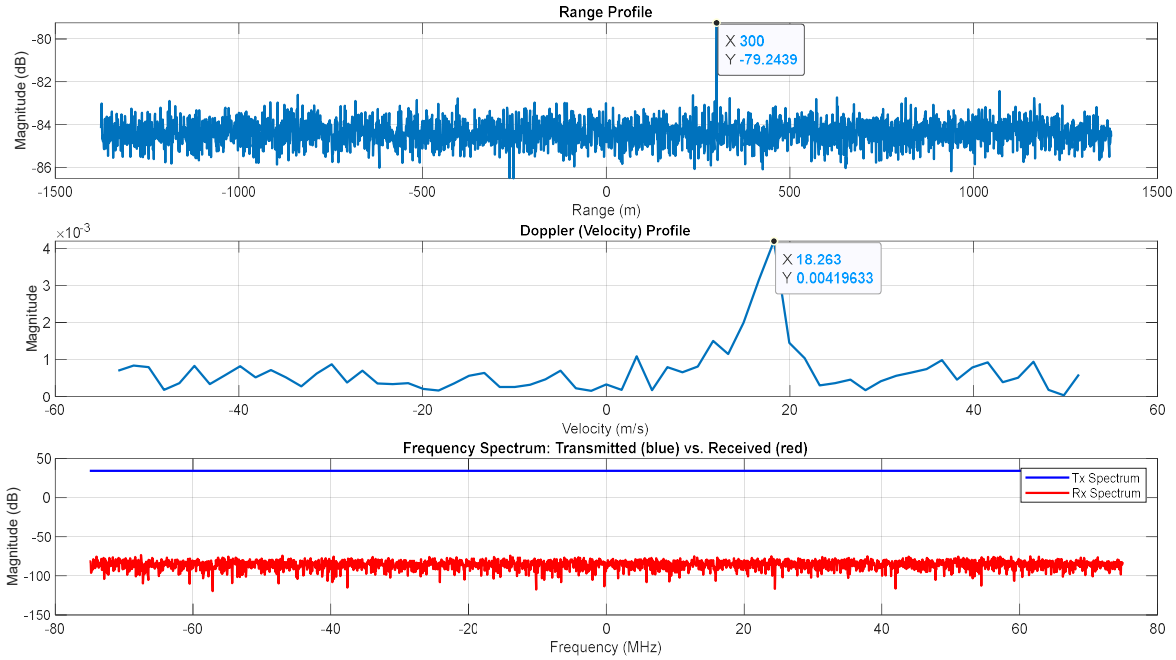

Figure 2 a)Range Estimation b)Velocity Estimation c)Tx Rx Spectrum

About the Simulation

In this simulation, FMCW RADAR is modelled and simulated by taking reference from MATLAB's official page. For this simulation, the Signal Processing Toolbox, DSP toolbox and RADAR Toolbox are required. The modulation of transmitting signal is done by declaring an object using inbuilt function "FMCWWaveform()". Likewise the Transmitting and Reception antenna are also declared as objects using "Transmitter()" and "ReceiverPreamp()" functions. Likewise, for target and channel too, objects are created by using "Platform()" and "channel()" functions. A two-element uniform Linear Array antenna object is declared using "ULA()" function for angle estimations. All these functions are available in "phased" library.

Then around 64 sweeps are calculated and the signal is converted with respect to target's position in terms of spherical coordinates. Then the data is converted into plane waves by using "collectPlaneWave()" and fed into the Receiver and the data is stored as 3D data with respect to each sweep. Then for range and velocity estimation, the normal dft procedure was carried out. For Angle estimation, the formula $\sin^{-1}(\frac{\varphi\lambda}{2\pi d})$ is used.

Inference

This FMCW radar simulation shows that how a chriped signal is used to figure out how far away an object is, it's moving velocity, and from which angle it's moving. By mixing the incoming echo with the signal transmitted out, the beat frequencies are obtained which tells the information about delay between these two signals. Then by using mathematical tools (like FFTs) the object's range and speed are calculated. The results show that even with a basic setup, the radar can accurately measure a target 300 m away, moving at 35 m/s, and located near the radar's boresight.