Pulse_Doppler_Radar_System

Where To Find This Example

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Open Install Example

Design Notes

Pulse-Doppler Radar System

This workspace provides a Pulse-Doppler (PD) radar system design with signal generator, RF transmitter, antenna, clutters, RF receiver, moving target detection (MTD), constant false alarm rate (CFAR) processor and signal detector for simulation purpose.

The simulation designs can be used as a template for different PD applications. The radar signal is a function of pulse repetition frequency (PRF), power, and pulse width (duty cycle). These parameters can be modified for different cases. In the simulation the radar signal also can be replaced by any defined signal through data file reader in which the recorded or other custom data can be easily used.

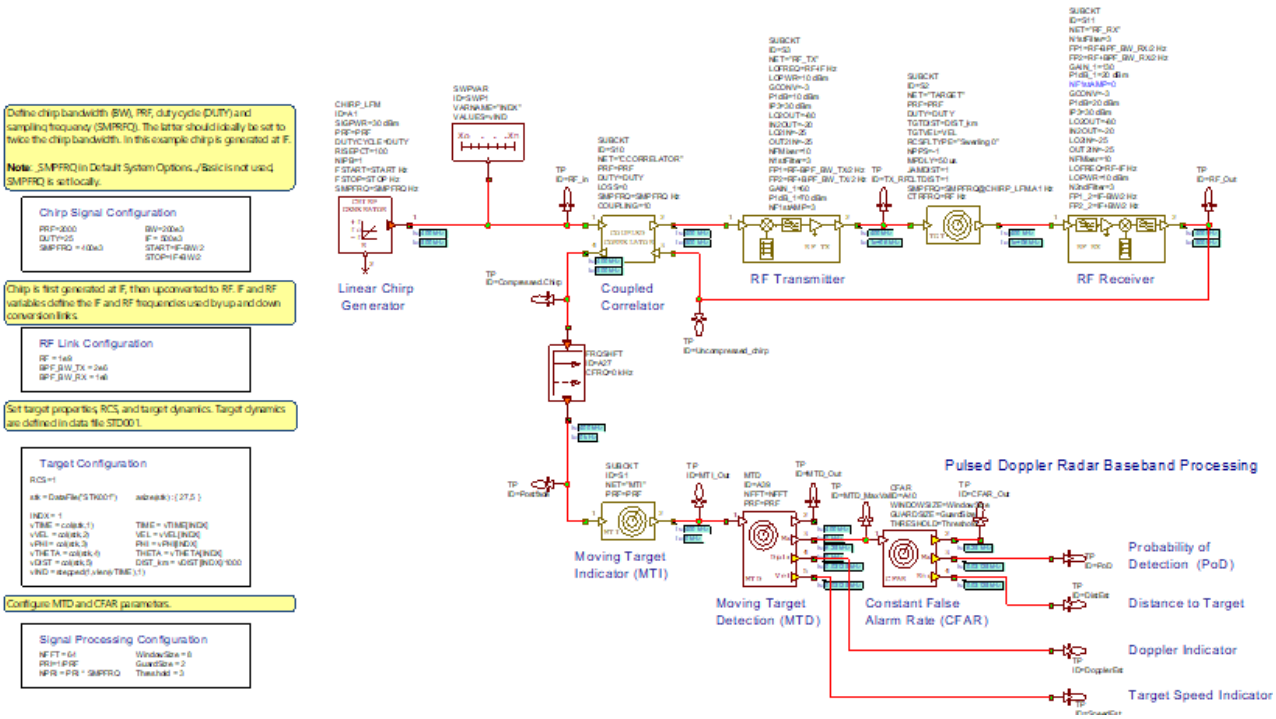
The RF transmitter includes oscillators, mixers, amplifiers and filters. The gain, bandwidth and carrier frequency can be specified based on the test case. Doppler frequency and channel delay are generated for describe the target return signal with different velocities and distance. The radar clutter model included and power spectrum can be shaped.

The RF receiver includes oscillators, mixers, amplifiers and filters. The gain, bandwidth and carrier frequency can be specified based on the test specification. To detect the moving object more effectively, moving target detection (MTD) is used. The MTD is based on a high-performance signal processing algorithm for PD radar. A bank of Doppler filters or FFT operators cover all possible expected target Doppler shifts. The output of MTD is used for the constant false alarm rate (CFAR) processing. Measurements for Detection Rate and False Alarm Rate are provided.

System Setup

The system is configured using the parameters below:

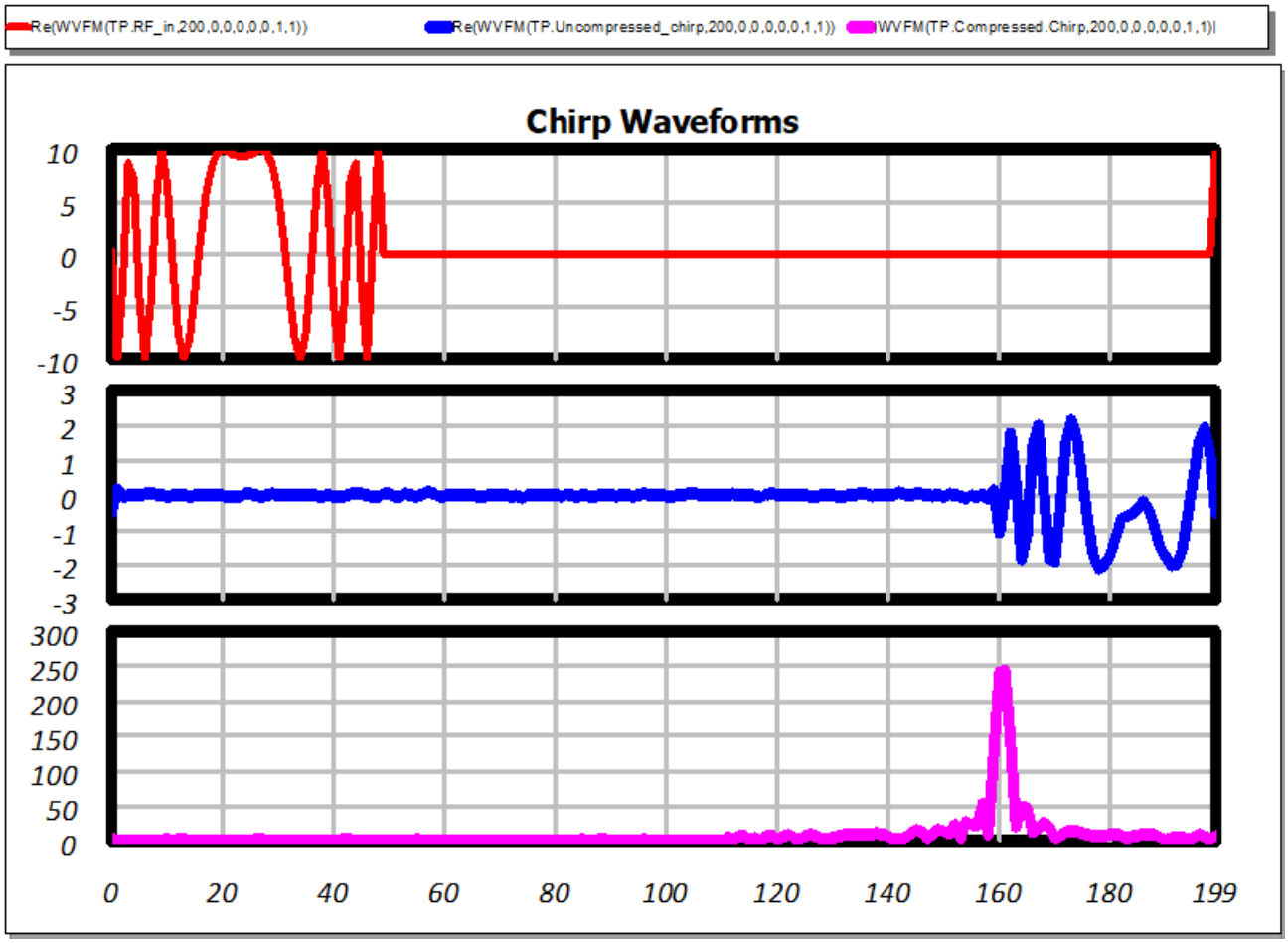
Chirp signal level is set to 0 dBm, PRF = 2 kHz and DUTY = 25%. The Doppler frequency offset, target distance and angles of arrival (THETA/PHI) are defined in a data file and vary over time. These parameters are used to define the target model. The clutter magnitude distribution is set to Rayleigh and the clutter power spectrum is formed as Weibull. In the receiver, the MTD FFT size is set to 64.



Simulation Results

Under these settings, the simulation results are displayed below.The radar signal waveform is measured in time domain at the receiver input. The target return signal is often blocked by clutter, jamming and noise. Therefore, detection in the time domain is not possible and an MTD is used to perform the Doppler and range detection in the frequency domain. In the MTD model, the data are grouped for corresponding target range and Doppler frequency. Afterwards, a CFAR processor is used to set the decision threshold based on the required probabilities of detection and false alarm.

Results of the simulation are shown in the graph System Metrics.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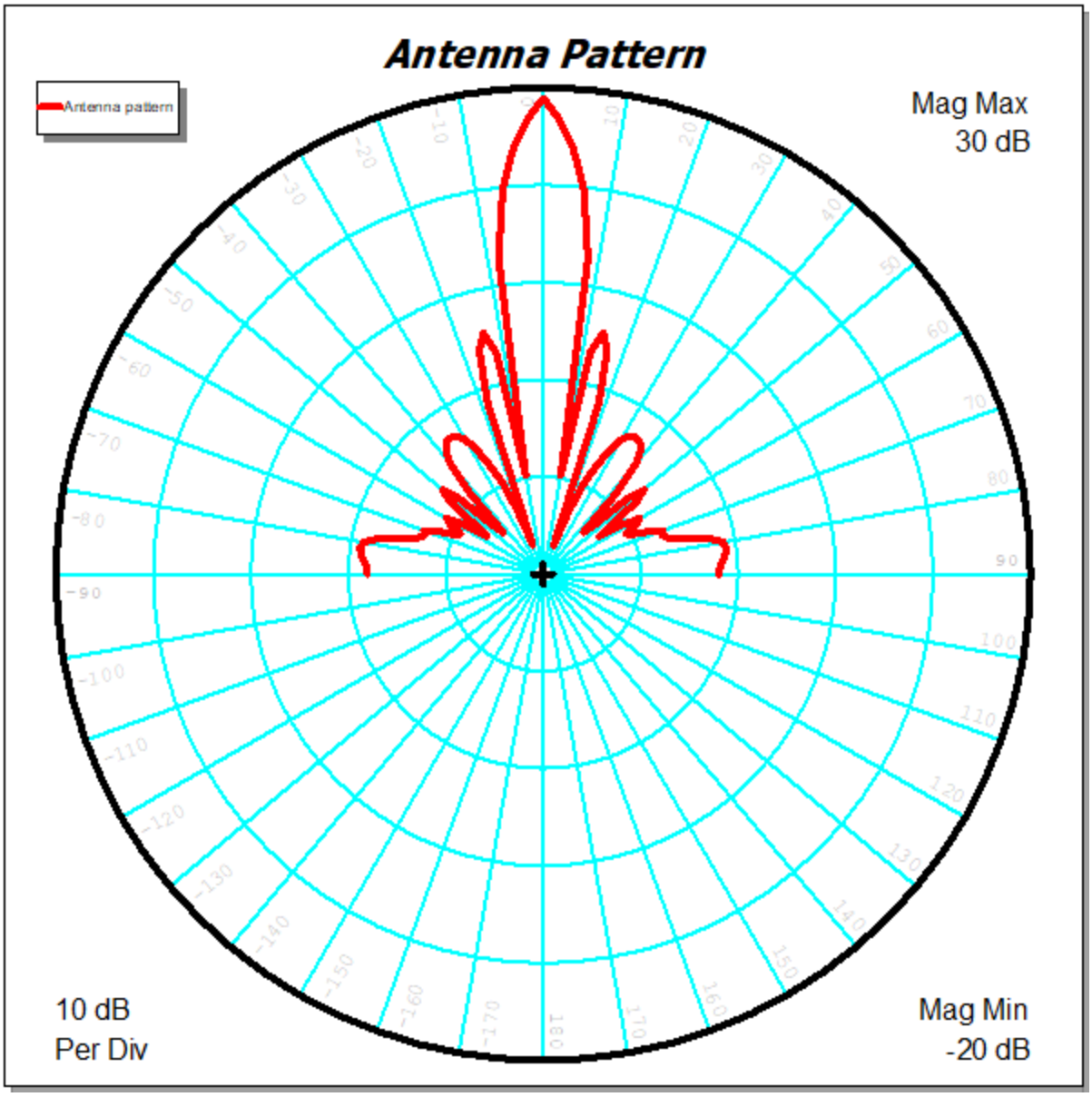
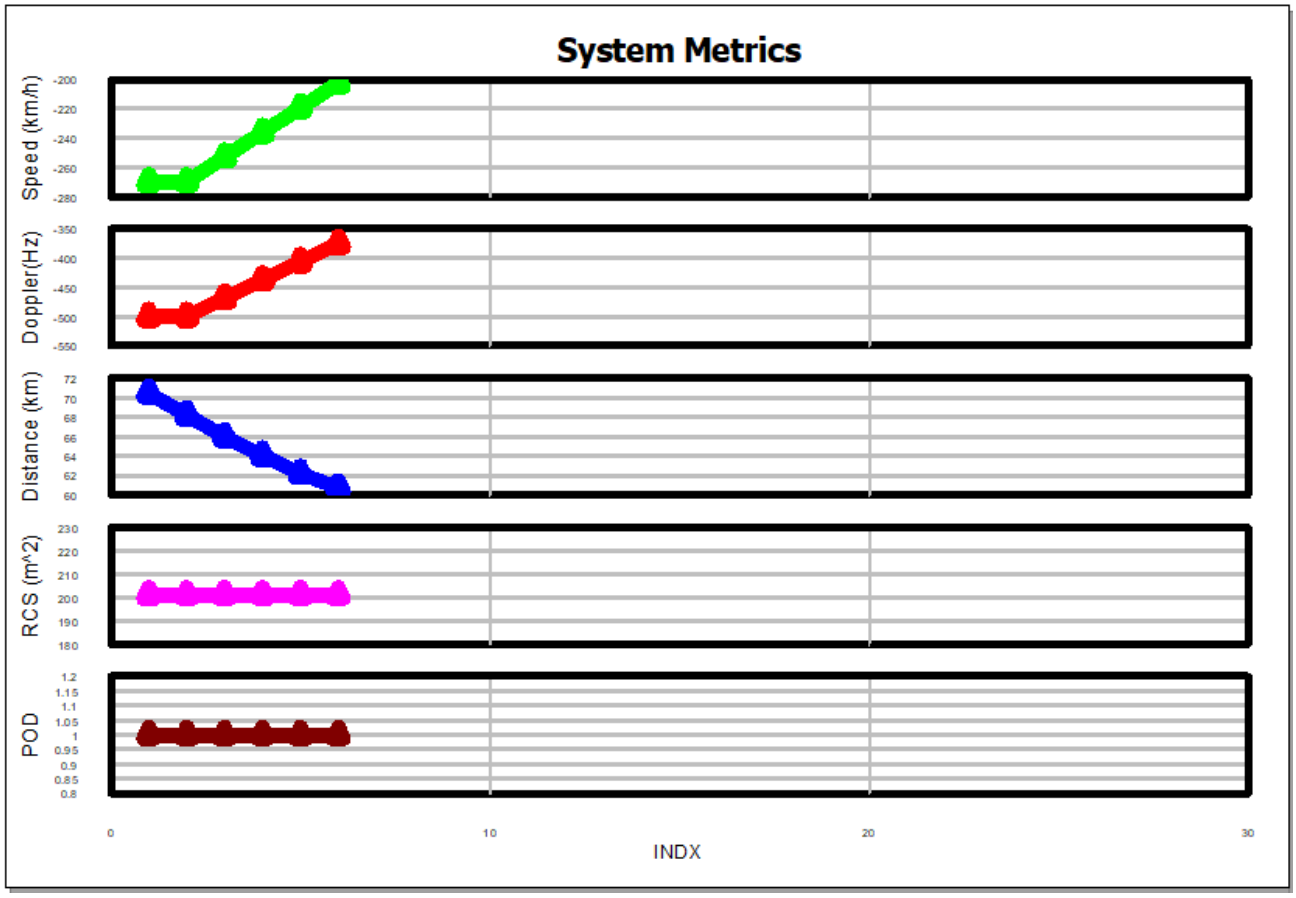
Re(WVFM(TP.Uncompressed_chirp,200,0,0,0,0,0,1,1))
|WVFM(TP.Compressed.Chirp,200,0,0,0,0,0,1,1)|
Chirp Waveforms
10
5
0
-5
-10
3
2
1
0
-1
-2
-3
300
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
180
199


Antenna Pattern
Antenna pattern
Mag Max
30 dB
10 dB
Per Div
Mag Min
-20 dB


System Metrics
Speed (km/h)
-200
-220
-240
-260
-280
Doppler(Hz)
-350
-400
-450
-500
-550
Distance (km)
72
70
68
66
64
62
60
RCS (m^2)
230
220
210
200
190
180
POD
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0
10
20
30
INDX