Radar design and Signal Processing

OSGC STUDENT SCHOLAR: ALEXIS SHEALEY

OSGC STUDENT SCHOLAR: ALEXANDRA SHEALEY

ADVISOR: NKORNI KATTE  PHD
WILBERFORCE UNIVERSITY
Radar fundamentals

- Normal radar functions:
  1. range (from pulse delay)
  2. velocity (from Doppler frequency shift)
  3. angular direction (from antenna pointing)
- Signature analysis and inverse scattering:
  4. target size (from magnitude of return)
  5. target shape and components (return as a function of direction)
  6. moving parts (modulation of the return)
  7. material composition
- The complexity (cost & size) of the radar increases with the extent of the functions that the radar performs.
I designed an Antenna that will operate at 5G frequency, which is the next generation domain for communication.
Antenna Array with MATLAB

We are interested in “Pencil“ sharp directivity
Code from Mathworks : RadarCubePart2

... 
Transmitter Specs 
TX=phased.Transmitter('Gain',20);

% Platform Specs
PlatformModel=phased.Platform;
PlatformModel.InitialPosition = tgtpos;
PlatformModel.Velocity = tgtvel;

% Channel Specs
ChannelModel = phased.FreeSpace;
ChannelModel.TwoWayPropagation=true;

% Tx ans Rx Specs
txArray = phased.Radiator(...
    'Sensor',antenna,...
    'OperatingFrequency',432e6); [2]
Speed Characteristics
f=432MHz

Doppler Processing

Target Speed (m/s)

Magnitude

-250 -200 -150 -100 -50 0 50 100 150 200 250

Range = 19936.1985m

Single Channel Target Return

Time (sec)

Magnitude

Beamformed Target Return

Time (sec)
More Results
Conclusion

-We have shown how smart Antenna are designed at Fundamental level with COMSOL Multiphysics.
-We have assembled these antennas at System level to create arrays which are used for high directivity
-We have outlined analyzed signals from a typical Radar device
-We are interested in addressing issues with Controls for Radar and Lidars

References
[1] Notes from US Naval school on Radars

Acknowledgments
We are very grateful for the continuous support of Ohio Space grant Consortium and for our College of Professional studies who have always supported us to push for quality research and student engagement.