



The University of Texas at Austin Electrical and Computer Engineering

Supplemental Statement for University of Texas at Austin Application

File Number 0180-EX-ST-2020

A. Experiments using National Instruments (NI) hardware with horn antenna:

1. TX

1. Model: 71-76 GHz Millimeter-wave Transceiver System by NI that uses NI 3647 TX for 71 to 76 GHz Upconverter. The NI 3647 TX is connected to PXIe-3620 (8.5 to 13.5 GHz I/Q (de)modulator), then connected to PXIe-3610 Baseband Generator, and then connected to PXIe-7902 FPGA Processing Unit)
2. Tuning Range: 71 to 76 GHz
3. Instantaneous BW: maximum 2 GHz
4. Saturated power without including antenna gain: +24 dBm

2. TX Antenna

1. Horn antenna-1 details (Model SAR-1050-12-S2):
 1. Gain: 10 dB (typical)
 2. 3 dB beamwidth: 50 degrees (E-Plane), 50 degrees (H-Plane)
2. Horn antenna-2 details (Model SAR-2309-12-S2)
 1. Gain: 23 dBi (typical)
 2. 3 dB beamwidth: 10 degrees (E-Plane), 11 degrees (H-Plane)

3. Modulation: QAM symbols or phase modulated sequences such as Zadoff-Chu sequences

4. Location:

1. Around EER Building, UT Austin
 1. Center point 30.2881° N, 97.7354° W (EER Building, UT Austin)
 2. Coverage area: 1km around the center point
 3. Max. building height: 100 feet approx

B. Experiments using NI hardware phased array antenna:

1. TX

1. TX Model: 60 GHz Prototyping Accessory Kit by National Instruments that contains SiBeam phased array. The 60 GHz Prototyping Accessory Kit is connected to PXIe-3610 (Baseband Generator), which is then connected to PXIe-7902 FPGA Processing Unit).
2. Tuning range: 57-71 GHz
3. Instantaneous BW: maximum 2 GHz
4. maximum transmit EIRP: 40 dBm
5. Phased array details (SiBeam)
 1. Gain: 23 dBi
 2. 3dB beamwidth:
 1. Azimuth: 30 degrees for one beam; beams cover a sector of 120 degrees in azimuth
 2. Elevation: 20 degrees

2. Modulation: QAM symbols or phase modulated sequences such as Zadoff-Chu sequences

3. Location:

1. Around EER Building, UT Austin
 1. Center point 30.2881° N, 97.7354° W (EER Building, UT Austin)
 2. Coverage area: 1km around the center point
 3. Max. building height: 100 feet approx

C. Experiments using NI radar target emulator:

1. TX Model: VRTR-77G-M1, 77 GHz Vehicle Radar Test Transceiver by National Instruments. (We have connected the VRTR-77G-M1 transceiver to a National Instruments PXIe-5646R vector signal transceiver.)
2. TX Power (with +20 dBi horn gain): -18 dBm
3. Tuning range: 76 GHz to 81 GHz
4. Bandwidth: Typical 200 MHz; Maximum 3 GHz)
5. Antenna gain and beamwidth: Horn antenna with 20 dBi gain, 20 degrees (Azimuth 3 dB beamwidth), 20 degrees (Elevation 3dB beamwidth)
6. Modulation: FMCW
7. Location:
 1. Around EER Building, UT Austin
 - A. Center point 30.2881° N, 97.7354° W (EER Building, UT Austin)
 - B. Coverage area: 1km around the center point
 - C. Max. building height: 60 feet

We understand that this band includes radars used in vehicular automatic cruise control systems under the terms of § 95.3331 as well as some other radar applications. We will plan the experiments with beams only using negative elevation angles to prevent strong emissions from reaching areas off our campus. We will avoid illumination of campus roads with traffic and the main beam will only illuminate parking lot or unpaved areas in these tests. The campus

speed limit is 15 mph so use of automatic cruise control on any campus road that might be accidently illuminated is not expected.

D. Experiments using Google phased array set-up:

1. TX model: SiBEAM Sil6342 phased array. (The SiBEAM Sil6342 phased array is connected to BasicTX by Ettus Research, which is then connected to USRP N210. In future, we might connect SiBEAM Sil6342 phased array with NI baseband hardware (PXIe-3610 and PXIe-7902 FPGA) mentioned in experiment B.)
2. TX Power: <14 dBm
3. Carrier frequencies: 60.24 GHz and 61.48 GHz
4. Bandwidth: 25 MHz (maximum 1.8 GHz)
5. Beamwidth: 10 degree in Elevation. ~ 10 degree in Azimuth.
6. EIRP: maximum 14 dBm.
7. Modulation: In our experiments, we use 4-QAM.
8. Location: Center point 30.2881° N, 97.7354° W (EER Building, UT Austin), Coverage: < 100 sq.m., Building height: 100 feet

E. Experiments using Radarbook and Radarlog:

1. Models:
 1. Radalog by INRAS: RDL-77G-TX2RX16
 2. Radarbook by INRAS: MIMO-77-TX4RX8
2. TX Power (max RF output power): 10 dBm
3. Tuning range: 76 — 81 GHz
4. Bandwidth: 1 GHz
5. 3dB Beamwidth: 13.2 degree in Elevation. ~ 150 degree in Azimuth.
6. TX Gain: 17 dBi
7. Modulation: FMCW
8. Location: (30.288677, -97.735438), < 1 mile square, 100 feet

Note: Common location for all experiments would be around EER Building, UT Austin: Coordinates (30.288677, -97.735438), coverage < 1 mile square, maximum building height 100 feet

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