Project 11: Synthetic Aperture Radar (SAR) Imaging (Side-notes)

INTRODUCTION

Radar has been used to image a region of interest from a distance. The advantage of radar imaging over optical imaging such as camera is its capability to image irrespective of the lighting condition. While imaging earth from satellites with exceptional resolution has been realized using Radar in the past, recent interest has been in the imaging of objects that are not far. In one such application, researchers image an object hidden within a carton box using a radar using SAR imaging.

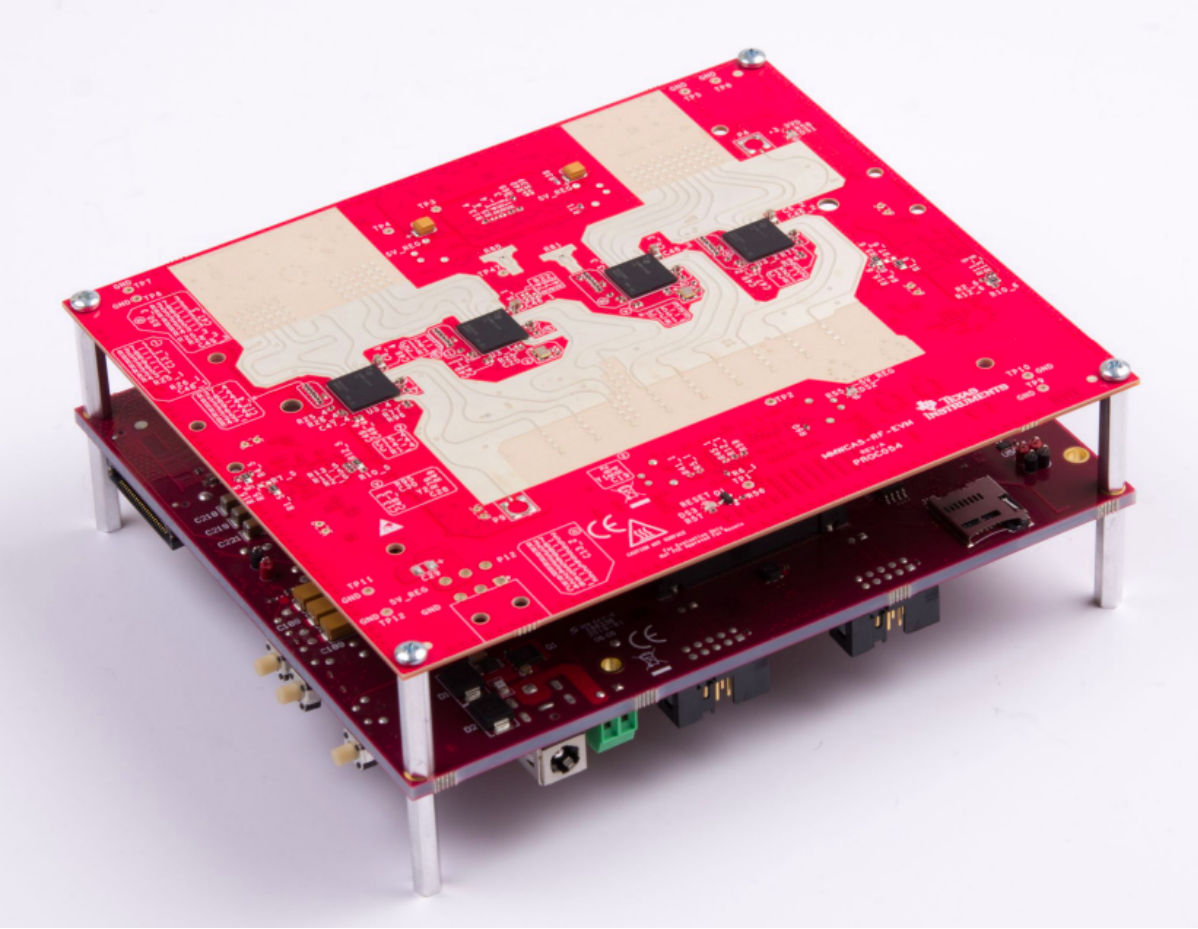
The aim of this project is to understand SAR imaging and the imaging mechanism for such commercial applications. The student will aim to develop the algorithm for imaging.

DESIGN PROCESS

MIMO array calibration, electrical/mechanical synchronization, system-level verification, and performance evaluation.

EQUIPMENT

1. A four-chip cascaded mmWave sensor
    a. TSW14J56
    b. Four-Device Cascade Radar RF Board with TDA2 Based Capture Board

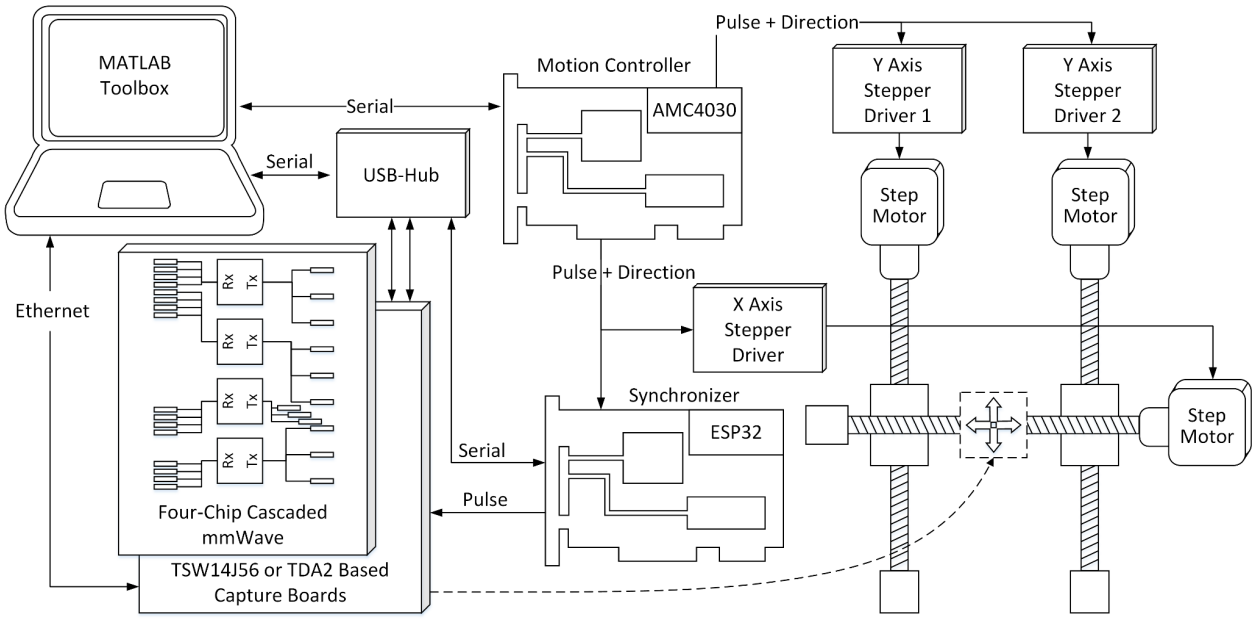


2. A two-axis mechanical scanner
    a. Stepper Driver 3
    b. FBL80 belt driven linear rails 3
3. A motion controller,
    a. AMC4030 motion controller
4. Synchronizer ESP32 Based microcontroller

The overview of the TI's mmwave sensors, Texas Instruments.
Available: http://www.ti.com/sensors/mmwave/overview.html

Building cascade radar using TI's mmwave sensors, Texas Instruments.
https://training.ti.com/build-cascaded-radar-using-tis-Mmwave-sensors

Imaging radar using cascaded mmwave sensor reference design.
Available: http://www.ti.com/tool/TIDEP-01012



The tests were performed using the older generation AWR1243P four-device Cascade Radar RF board from Texas Instruments together with TDA2 based capture System. With the newer generation of the sensor, AWR2243, the RF performance is improved as shown in the AWR2243 data sheet.

TASKS

1. Learn the precise process to collect data, i.e., the setup, timing of acquisition and the use of the microcontroller to trigger data acquisition - Srijan.

2. Data Format, assimilation and the interpretation of SAR data that is acquired - Saad.

3. Image reconstruction using their code. Get the code working, then understand why and how such an image is obtained - Rutvi.

REFERENCES:

[1] Yanik, Muhammet Emin, Dan Wang, and Murat Torlak. "Development and demonstration of MIMO-SAR mmWave imaging testbeds." IEEE Access 8 (2020): 126019-126038.

[2] Gao, Xiangyu, Sumit Roy, and Guanbin Xing. "MIMO-SAR: A Hierarchical High-resolution Imaging Algorithm for FMCW Automotive Radar." arXiv preprint arXiv:2101.09293 (2021).

https://sigport.org/sites/default/files/docs/SAR_Imaging_Tutorial_0.pdf

https://github.com/NNaka/sar

https://www.ti.com/lit/ug/tiduen5a/tiduen5a.pdf?ts=1646924926886&ref_url=https%253A%252F%252Fwww.google.com%252F