Summary of Projects

M.Sc. Caner Kadıoğlu

Outline

Structure of Presentation

- Bachelor's Degree
  - Bilkent University

- Internship
  - Aselsan A.Ş.

- Professional Experience
  - Aselsan A.Ş.

- Master's Degree
  - RWTH Aachen University
  - Thesis
  - Research Assistant

- Summary & Skill Set

Bachelor's Degree

## Bilkent University Ankara, Türkiye

- Electrical & Electronics Engineering, 2019

- Microwave Electronics course
  - LNA at 1.45 GHz on PCB
  - Design, fabrication and measurement
  - AWR Microwave Office, Network Analyzer, Spectrum Analyzer
  - Mandatory Internship at Aselsan
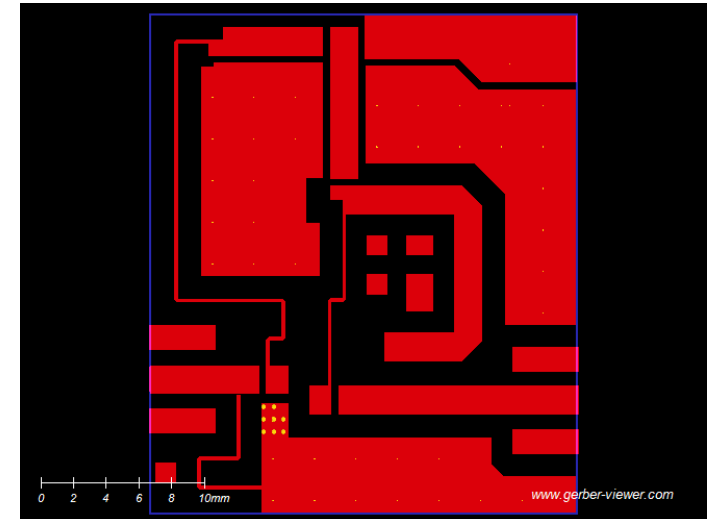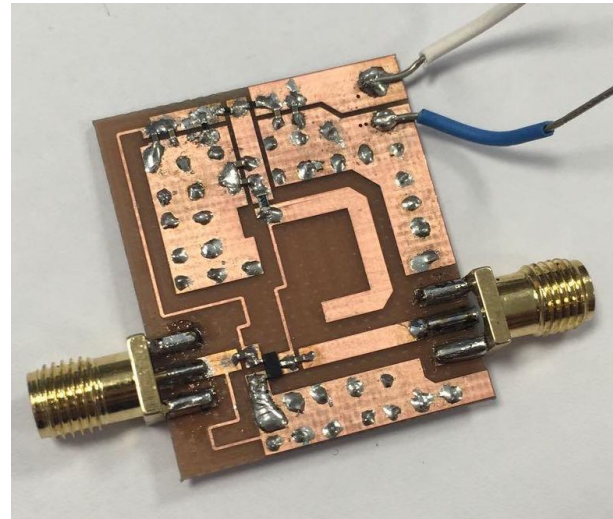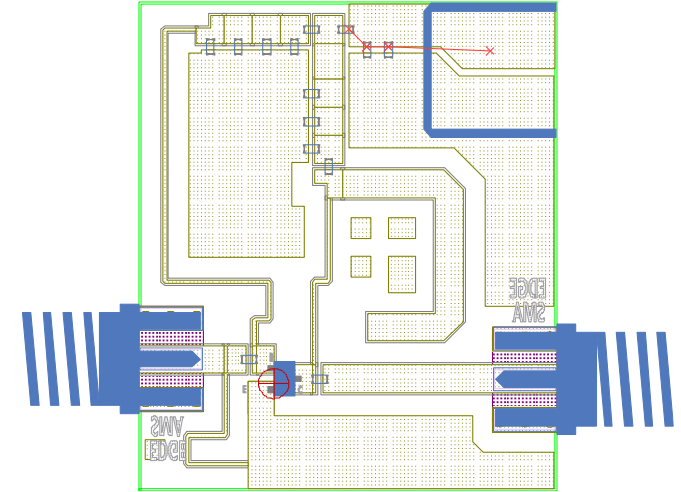
Internship

ASELSAN A.Ş.

- Leading electronics defense company in Türkiye

- Radar Electronic Warfare Systems
  - Microwave Components Design Dept.
  - Multilayered Microwave Module Design Team

- Tasks
  - 20 dB coupler, 9-10 GHz
  - 3 dB Wilkinson power divider, 6-18 GHz

- Skills gained
  - RF PCB design, development, layout
  - AWR Microwave Office
  - CST Microwave Studio
 - Vector Network Analyzer
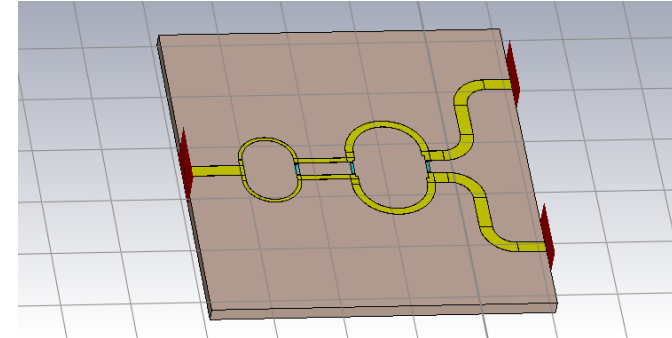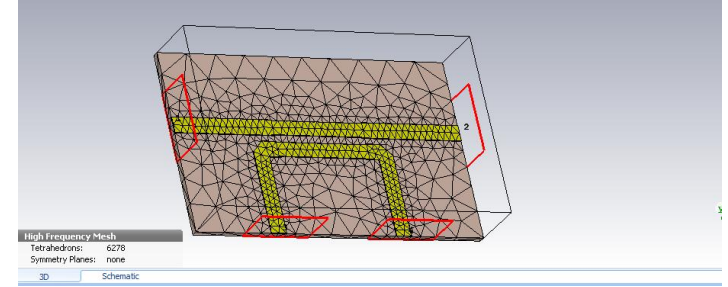
Professional Experience
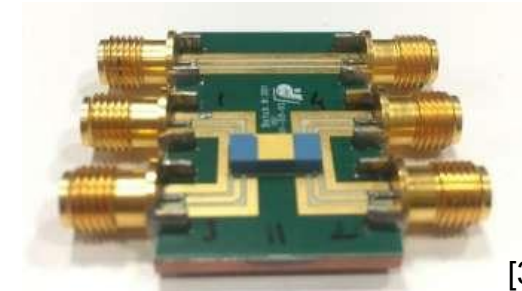
ASELSAN A.Ş.

- RF/Microwave Design Engineer
  - ~3 years of experience, Engineer II
  - Radar technology, 5G systems

- PCB development
  - RF components and traces: matching networks, LNAs, Limiters, PA, etc.
  - Component selection and building of low-frequency units: switches, MOSFET drivers, regulators etc.
  - Involved in PCB manufacturing process: stack-up, material selection, tolerances, etc.
  - Generation of layout and fabrication documents: Gerber, drill, etc.
  - Projects including Flip-Chip, Antenna-in-package, BGA connections, RF test boards

- RF Front-End
  - Design of Multilayer LTCC for signal transition
    - Wire bonding from die chip to RF strip
  - Design of passive LTCC microwave circuits and components
    - Filters, Matching Networks, Dividers
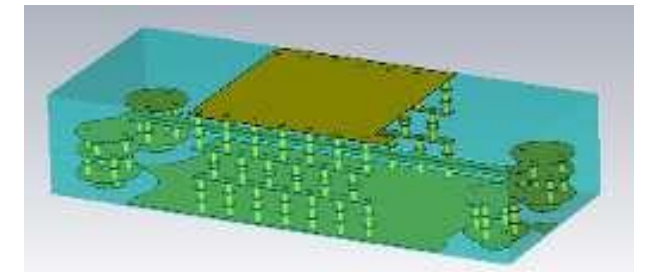   - QFN packages, low-profile Couplers

[2] https://anysilicon.com/flip-chip/

[1] https://www.intechopen.com/chapters/53075
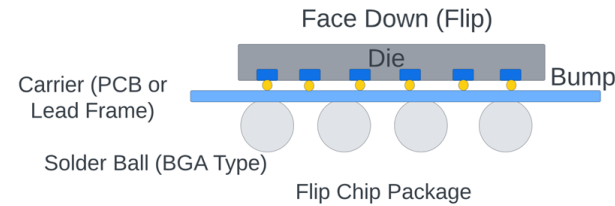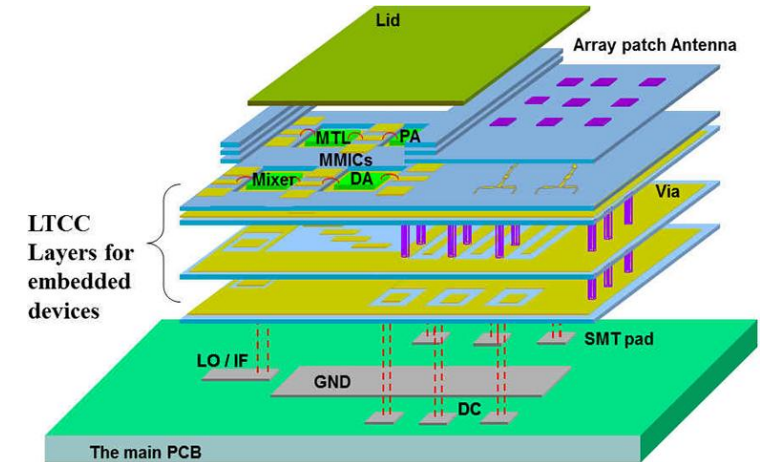
[3]

[3]

[3] https://wwwcdn.aselsan.com/api/file/aselsan_dergi_120_092024.pdf

Professional Experience

ASELSAN A.Ş.

- Coordination with Internal Departments
  - PCB design team for leading DC tracing, stack-up for ground and signals, via grounding, etc. (Mentor Graphics)
  - PCB manufacturing team for leading base material selection, stack-up, design rules, tolerances, etc.
  - Cleanroom team for planning and leading the assembly of submodules
    - Die components, bond wire connections, tuning/matching with capacitive patches, DC connections
  - Mechanical design team for the design and fabrication of RF enclosures of submodules
  - Purchasing department for external processes: manufacturing, ordering components etc.

- Measurement-based verification of PCB and microwave components
  - Spectrum analyzers: In-band spurious signals, non-linearities (P1dB, IIP3), Noise Figure
  - VNA to measure S-parameters (gain, isolation, coupling, etc.) and import to schematic
  - Probe Stations: S-parameter measurement of microwave components (thin-film modules including die components),
  - More: Signal Generator, Oscilloscope, Power meter

- Design Tools:
  - For EM and circuit simulations: Cadence AWR MWO, CST Microwave Studio, Ansys HFSS, LTSpice
  - VBA language for EM modelling (CST)
  - Scripting for automation and testing: Python, MATLAB
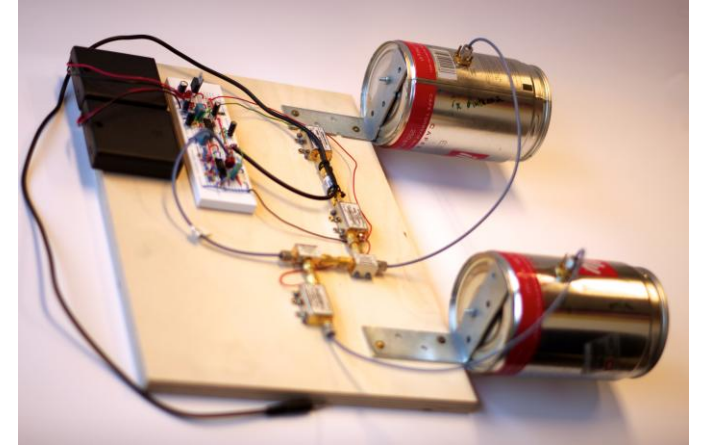
Master's Degree

RWTH Aachen University

- Electrical Engineering, Information Technology and Computer Engineering
  - Focus: **Communications Engineering, (Grade: 1.7 - Good)**

- Related Courses
  - Radar System Design & Applications, Antennas and Wave Propagation, RF Systems, Radar Systems, Signal Processing for Radar and Imaging Radar, Advanced Topics in Signal Processing and Communication

- Radar Laboratory
  - FMCW radar assembly, Antenna modelling and simulation

- Signal Processing for Radar and Imaging Radar
  - Waveform Modulation, Adaptive Array Processing, SAR raw data (range-Doppler processing)

- Thesis
  - **Grade: 1.0 - Very Good**
  - Design of (Leaky-Wave) Antenna (LWA)
  - Compressive Sensing (CS) Algorithm Implementation

# Master's Degree – Courses

Radar Laboratory

- FMCW Radar
  - Building and configuration of FMCW radar components
    - IF Assembly: Power Supply, Ramp Generator, LPF, Video AMP
    - RF Assembly: Power Oscillator, Attenuator, PA, Duplexer, Mixer, Antenna

  - Analytical modelling of waveguide and aperture antenna in MATLAB

  - Design and EM characterization of the antenna using CST

  - Practical measurement of the antenna
    - S-parameters, radiation pattern, co-polarization, two antenna method, three antenna method

  - Signal Processing
    - MTI, clutter rejection, time-range plot

[4] RWTH Aachen University, Radar Laboratory Script

**Signal Processing for Radar and Imaging Radar**

- Pulsed Radar
  - Pulse Compression
    - Waveform Modulation, Matched Filter, Doppler effect, Ambiguity Functions

  - Phased-Arrays & Array Signal Processing
    - Beamforming, Array Factor &Taper Functions, Interference Suppression,

  - Target detection and parameter estimation
    - MLE, False Alarm, probability of detection

  - SAR imaging
    - Range-Doppler Processing, Curvature Correction, Range & Azimuth Compression
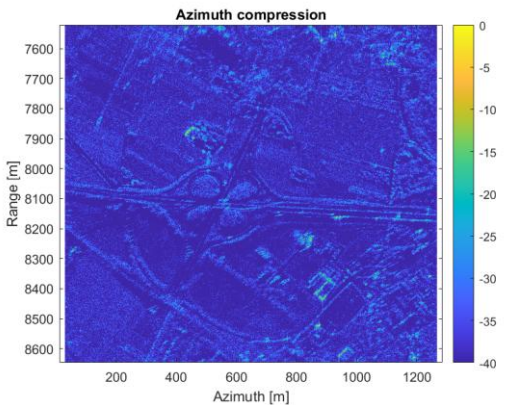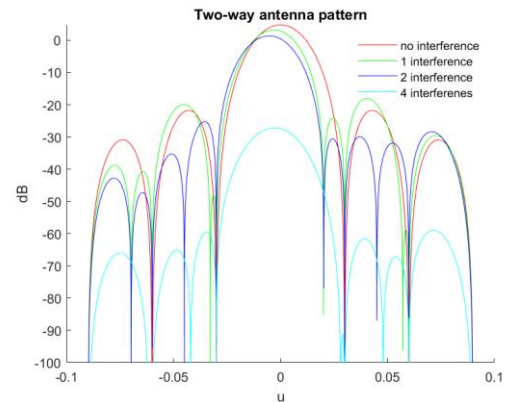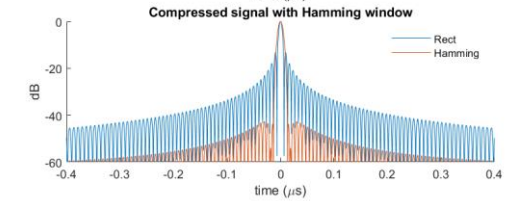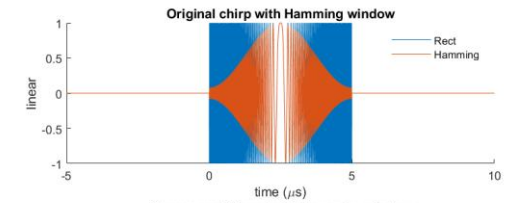
# Master's Degree – Thesis: Design of Leaky-Wave Antenna

Summary of Proposed Antenna

- Substrate and Conductor
  - Rogers RO4350B
  - $\epsilon_r = 3.66$
  - $\tan \delta = 0.0037$
  - $h = 0.762$ mm
  - $t = 0.017$ mm

- Frequency and Physical Parameters
  - $20 - 25\ GHz$ (K-band)
  - $N = 33$ rows, $n_c = 17$
  - $d = 3.33\ mm$ at $f_0 = 22.5\ GHz$
  - $D_x \approx D_y \approx 110\ mm$
  - $\alpha = 154°$

- Pattern Diversity
  - 33 element array mask configuration → Azimuth
  - 5 uniquely placed patches on each row → Elevation
  - Frequency-diverse technique → Elevation

Inputs Ports

$D_y = 109.9$ mm

$D_x = 115.6$ mm
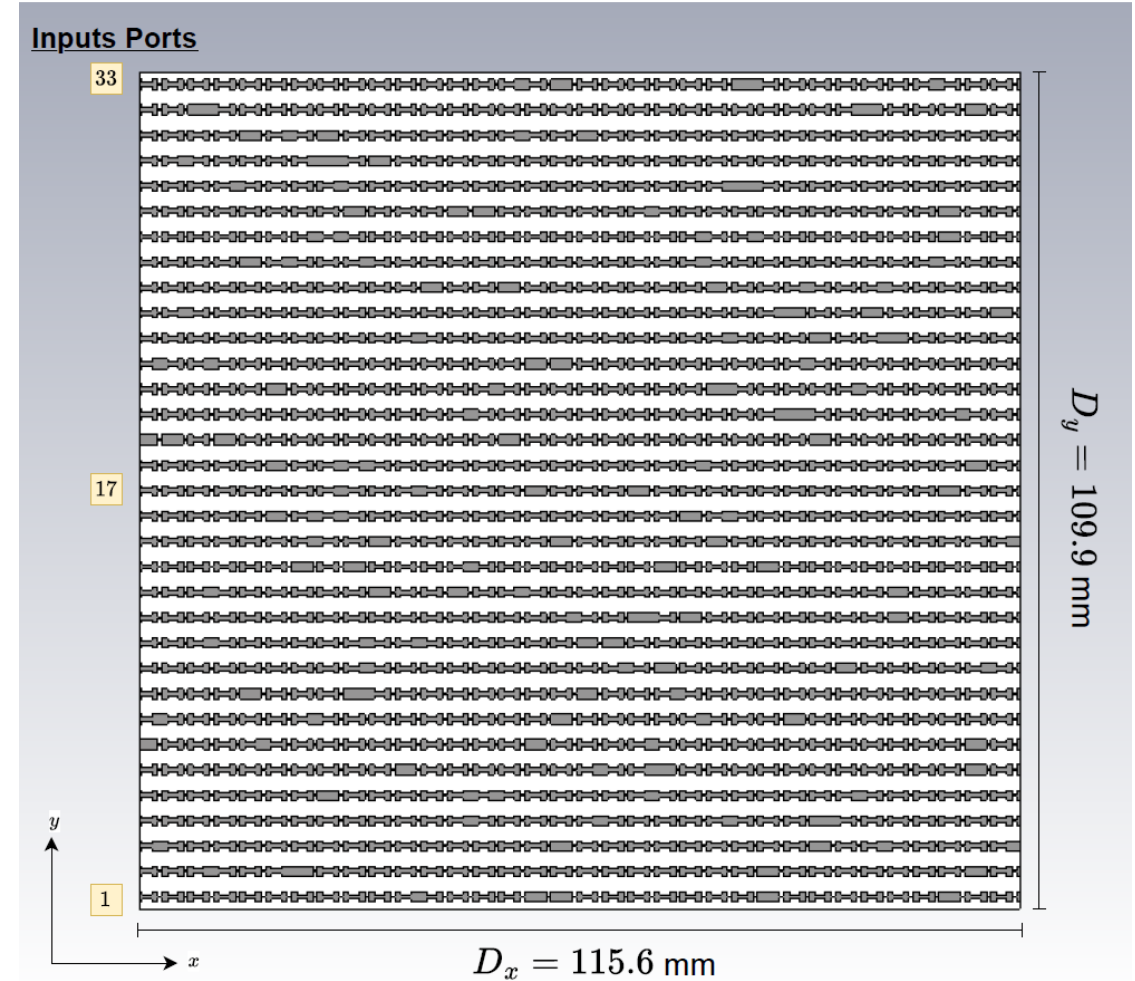
Master's Degree – Thesis: Compressive Sensing Algorithm Implementation

Region of Successful Detection
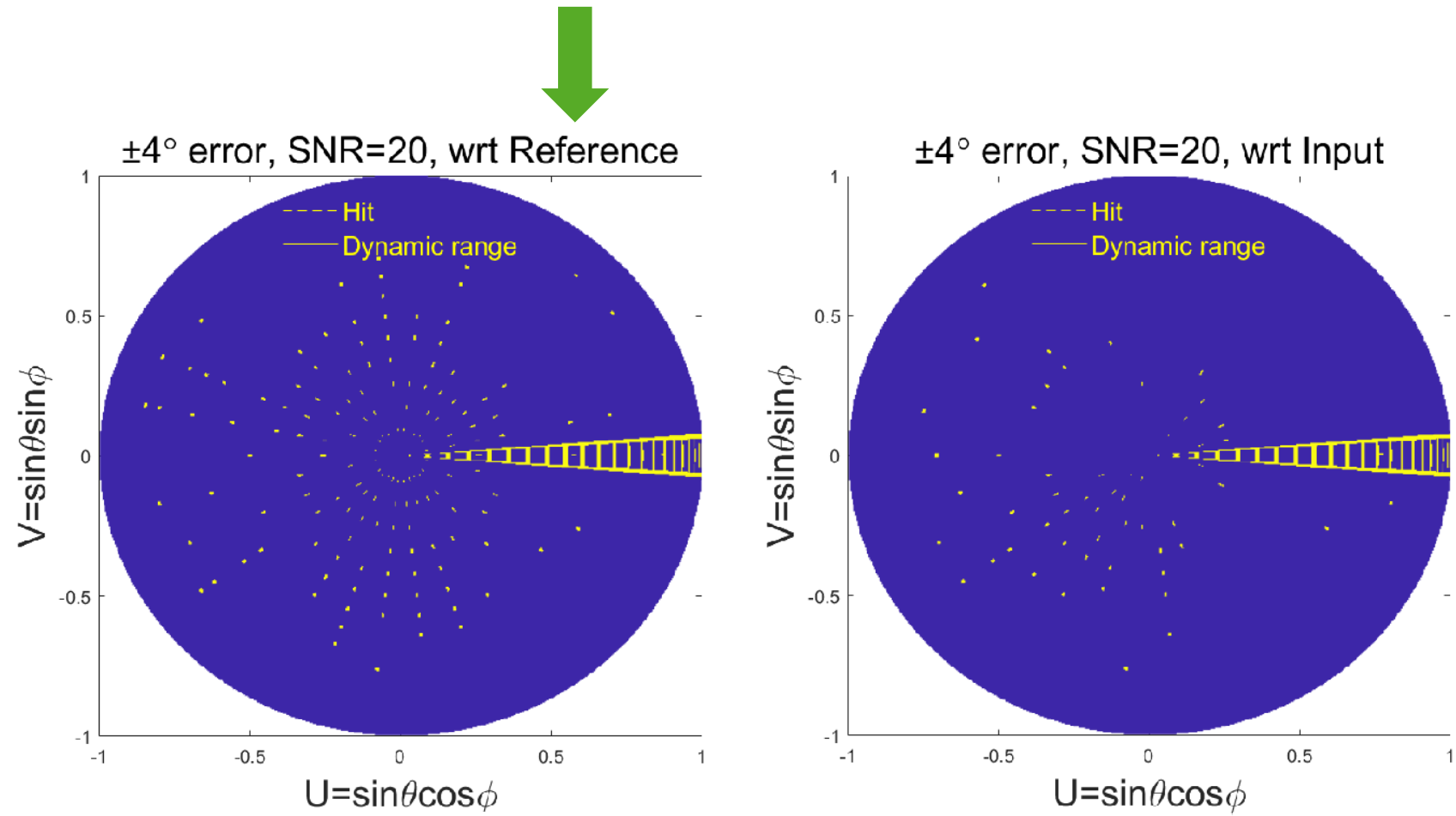
Input (θ, ϕ)	Reference (θ, ϕ)	Estimated (θ, ϕ)
(10, 30)	(5, 18)	(5, 18)
(18, 75)	(15, 84)	(15, 84)
(26, 120)	(22, 122)	(22, 122)
(34, 165)	(30, 170)	(30, 170)
(42, -150)	(39, -150)	(39, -150)
(50, -105)	(43, -107)	(43, -107)
(58, -60)	(49, -61)	(54, -63)
(66, -15)	(54, -18)	(54, -18)

[5] https://github.com/canerkadi/MSc-Thesis

Master's Degree – Research Assistant

Phased-Array System Development

- Continuation of thesis
  - Design of corporate feeding network with phase shifts
  - Component selection: diodes, connector
  - Preparation of fabrication documents

- Tasks due
  - Fabrication and assembly
  - Near-field and pattern measurement
  - Real-world scenario
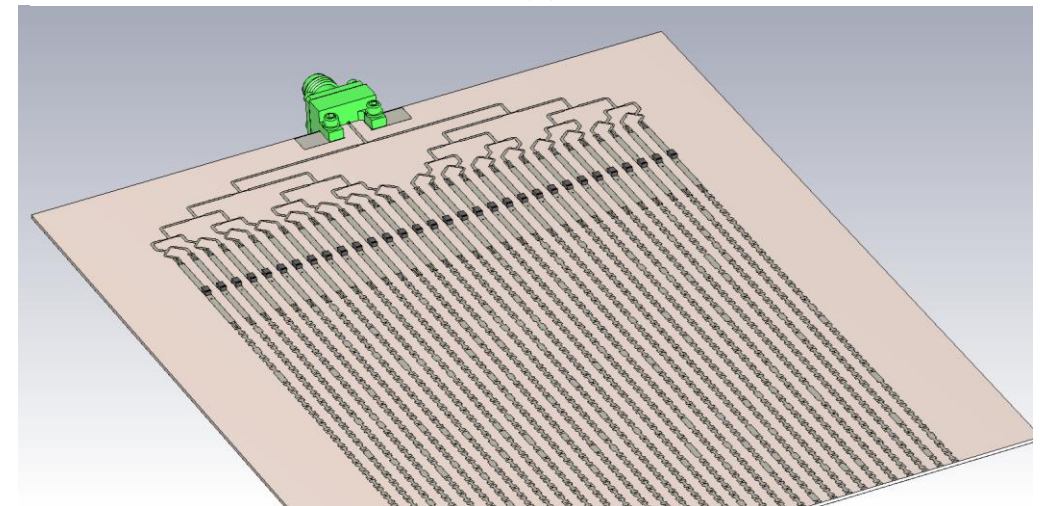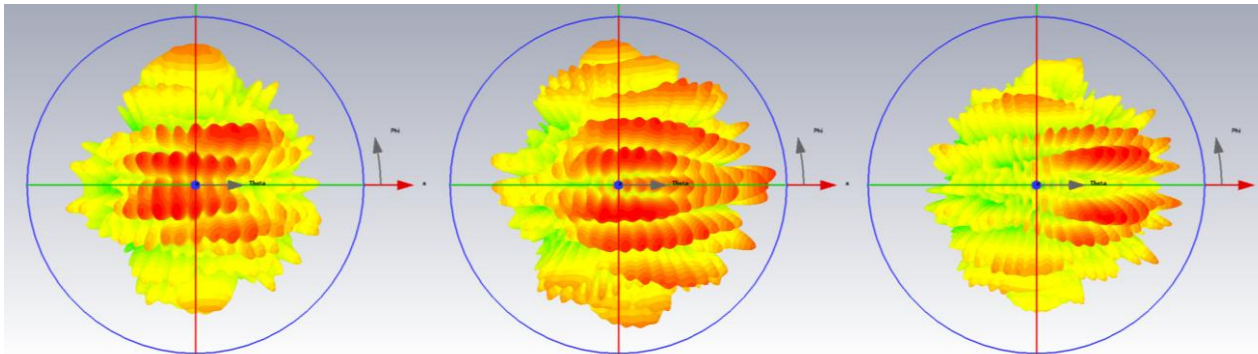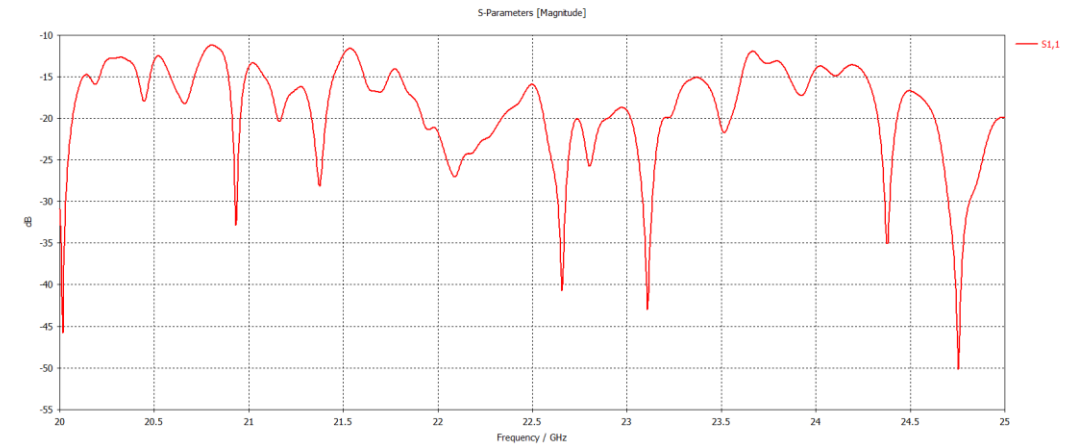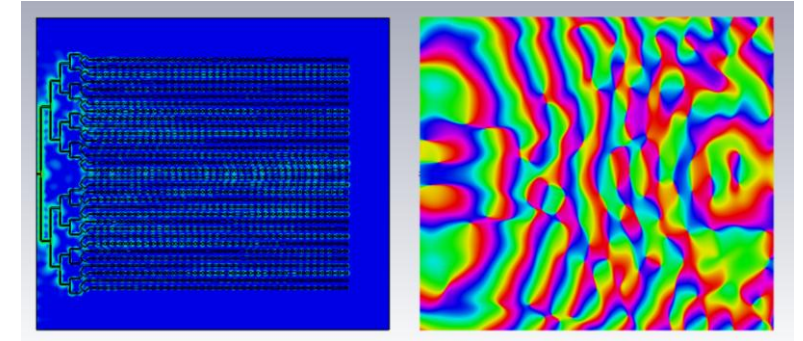
Summary & Skill Set

- ~3 Years of RF/Microwave Engineer + M.Sc. Degree + 9 Months of Research Assistant

- Hardware Development
  – RF/Microwave Circuit Design, PCB Development, LTCC Packaging, Antenna and Array Design, Feeding Network

- System Level
  – RF Communication (Link Budget, Level Plan, etc.), Beamforming, Signal Processing for Radar Applications, ML Methods
  –
- Experience with EM and Circuit Simulation Programs
  – CST Microwave Studio, Cadence AWR MWO, Ansys HFSS, Keysight ADS

- Scripting Skills for EM Modelling, Automation and Testing
  – Python, MATLAB, VBA

- Measurement Equipment
  – Vector Network Analyzer, Spectrum Analyzer, Signal Generator, Probe Station, Power Meter, etc.

- German B2

Thank you!