ME1510
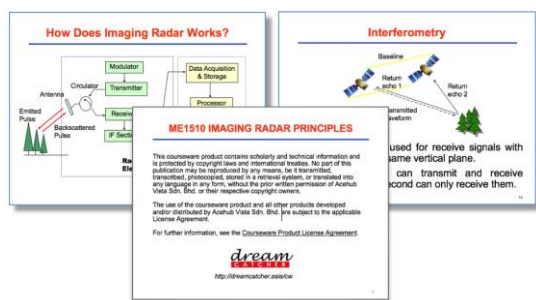
Imaging Radar Principles Courseware

dream CATCHER

~Complete Resources for Lecturers~

KEYSIGHT TECHNOLOGIES
Solutions Partner
Extending our solutions to meet your needs

Teaching slides	Training kit
• Editable Microsoft® PowerPoint® slides • Covers 45 hours of teaching	• Imaging radar system hardware kit • Lab sheets and model answers • Problem-based assignments • Covers 15 hours of labs

Target university subject	Target year of study	Prerequisite(s)
Advanced Radar Systems Synthetic Aperture Radar	Final year undergraduate and postgraduate	Radar Principles and Systems

The ME1510 serves as a ready-to-teach package in the area of imaging radars including real aperture radar and Synthetic Aperture Radar (SAR) as well as advanced imaging radar concepts such as interferometric and polarimetric SARs. This is a resource for lecturers consisting of teaching slides, training kits, lab sheets, and problem-based assignments.

Learning Outcomes

Students would be able to:

➢ Explain principles of basic imaging radar operations
➢ Explain and analyze SAR systems
➢ Distinguish various SAR operation modes

➢ Apply advanced SAR signal processing techniques
➢ Evaluate SAR radar signals using industrial grade software tools

Benefits of the ME1510 courseware

➢ The imaging radar system hardware kit consists of a radar transceiver module with imaging radar processor, single polarization horn antenna, and linear scanning platform, allowing students to understand various working principles and techniques used in today's imaging radar systems.
➢ Students are able to measure, record, and analyze the return echo from the target. Both indoor and outdoor imaging experiments can be performed by using the same imaging radar hardware kit.
➢ Raw data are recorded and accessed by the students. Students are able to conduct post-processing and further analysis of the raw data after the experiment.
➢ Lab sheets are specially designed to enable students to perform various types of imaging radar signal measurements. Each lab exercise highlights the basic radar operation, its working principles, and methods to analyze and interpret the radar received signals.
➢ Detailed explanations of radar imaging are included in the teaching slides and assignments, allowing students to further exploit and develop various imaging radar signal processing techniques using the hardware kit and Keysight SystemVue.

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Teaching Slides

More than 300 editable Microsoft Power Point teaching slides, covering 45 hours of teaching for one full semester are provided. The slides cover the following topics:

- Microwave Remote Sensing and Radar Basics
- Synthetic Aperture Radar (SAR) Principal
- SAR Signal Processing
- Advanced SAR Techniques
- SAR Applications and Case Studies

Training Kit

The radar system hardware kit is used to demonstrate various working principles and operations of imaging radar.

Hardware kit

Embedded Imaging Radar Module
The imaging radar module consists of a C-band RF transceiver and a radar processor. The radar processor consists of a data acquisition unit and high-speed single board computer for raw data digitizing as well as SAR signal processing. A PC-based GUI software is also provided, allowing user to configure the radar for various operations.

Embedded Imaging Radar Module

Linear Scanning Platform
A linear scanner is provided as the moving platform for the imaging radar system. This enables the radar training kit to perform translational scanning mechanism for imaging radar operation.

Horn Antenna and Corner Reflectors
A C-band horn antenna is employed to perform monostatic radar configuration. Two types of corner reflectors i.e. trihedral corner reflector and dihedral corner reflector are included as external man-made targets for radar measurements.

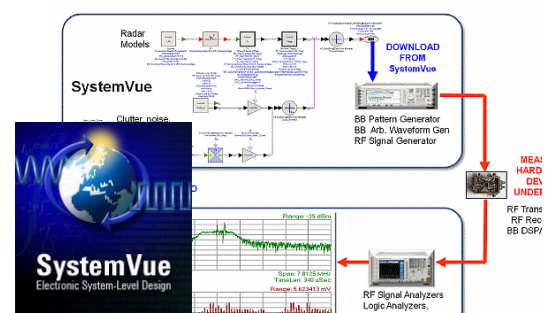Horn Antenna and Linear Scanning Platform
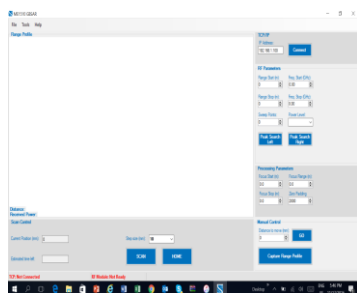
Software GUI

Corner Reflectors and Sample SAR Image
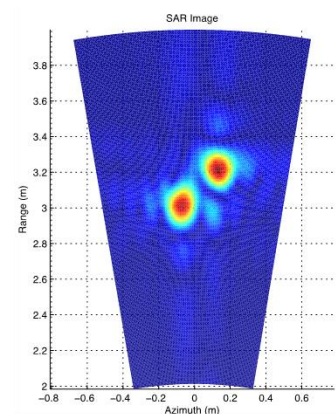
Keysight SystemVue EDA Software for Radar System Simulation

SystemVue is a dedicated electronic design automation (EDA) environment for electronic system-level (ESL) design. It is used in this courseware to perform radar system simulation and radar signal analysis.

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Accessories

The following accessories are provided with the training kit.

Item	Quantity
Power adapter, 24 Vdc, 15 A	1
RF cable (1.5 m)	1
Trihedral corner reflector	2
Tripod for reflector	2

Lab Sheets

The training kit includes five lab sheets in editable Microsoft Word format. Each lab sheet requires 3 hours to complete. Model answers are provided with all lab sheets. The required instruments for the lab sheets are listed below.

Lab Sheet	Required Items[1]	
	Hardware Kit	Keysight SystemVue
1. Familiarization with Imaging Radar Training Kit	√	
2. Basic Operation of Side-Looking Airborne Radar and Range Compression	√	√ [2]
3. Range-Doppler Processing and Azimuth Compression	√	√ [2]
4. Interferometric Synthetic Aperture Radar	√	
5. SAR Signal Generation and Processing using SystemVue		√

[1] All labs require the use of the Imaging Radar System Hardware Kit (Embedded Imaging Radar Module and Linear Scanning Platform). A computer is also required to run the experiments (purchased separately).

[2] SystemVue is only needed in the last section of the lab exercise to perform simulation and analysis (available by May 2016).

Problem-based assignments

The problem-based assignments below allow students to enhance their problem-solving skills.

1. Design of a Synthetic Aperture Radar System
2. SAR Signal Processing and Simulation

Instruments

The recommended instruments and software from Keysight Technologies, to be purchased separately, are listed below.

Instrument / Software	Model
SystemVue Software[1]	W1461BP SystemVue Comms Architect
	W1905EP SystemVue Radar Model Library

[1] The Keysight EEsof EDA University Support Program provides software for educational purposes at deeply discounted prices. Please go to http://Keysight.com/find/eesof-university or contact your local Keysight EEsof EDA field engineer for details.

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Training Kit Specifications

RF

Carrier frequency, f_c	4.3 GHz
Operating bandwidth	$f_c \pm 500$ MHz
Transmitter power	0 dBm (typical)
Antenna frequency range	$f_c \pm 500$ MHz
Antenna type	Horn

Performance

Signal type	Step frequency continuous wave
Range resolution	0.15 m
Azimuth resolution	0.15 m @ 3 m
Azimuth step size	10 cm per step
Synthetic length	1 m

General

Input voltage	220-240Vac, 50Hz
EMC designed to	CISPR11:1990/EN55011:1991
	IEC801-2:1984/EN50082-1:1992
	IEC61010-1:1990+A1
Warranty	1 year

Ordering Information

Description	Package	Product Number
Teaching Slides	1 user license	ME1510-100
Training Kit	1 set	ME1510-200
Teaching Slides + Training Kit	1 user license + 1 set	ME1510-300

Training courses related to subject matter are available on request. Visit dreamcatcher.asia for details.

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