

SAR EXTENSION

A synthetic aperture radar is a radar which produces radar images of higher resolution than normal radars through the shooting of a series of radar images of the same target but from spatially displaced positions. The radar source is traditionally an FMCW radar. In reality these images are created by side-lobe radars of aircrafts. SkyRadar's SAR add-on extends the FMCW radar through a controlled linear axis and imaging logic - making it work like a side-lobe radar.

The iSAR solution uses the same imaging logic but builds on a fixed source and a rotating target (placed on SkyRadar's target positioning system).

The system operates with the SkyRadar FreeScopes Software which provides many scopes (A-Scopes, B-Scopes, PPI), control interfaces and filters. The module allows for highest flexibility in the learning process, while

providing high-resolution at close distance with an electromagnetic emission of a small fraction of that of a mobile phone.

Description

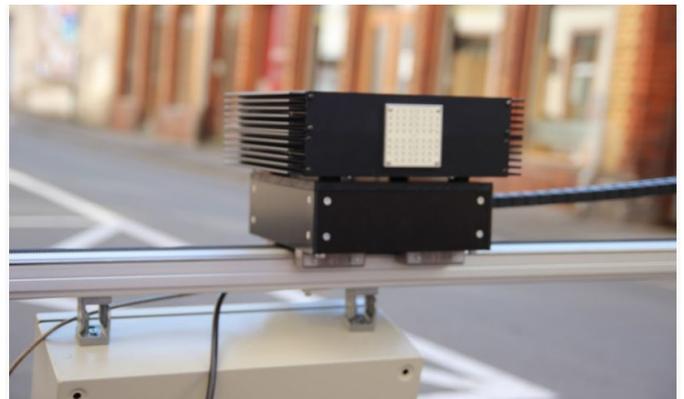
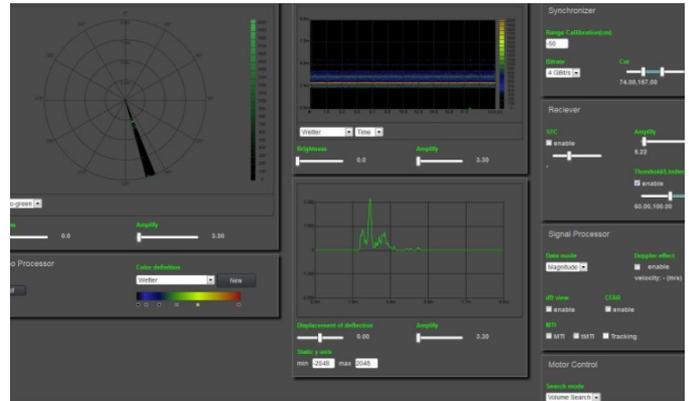
The SAR Module is an extension of the FMCW base module. A step-motor-controlled linear axis allows movement of the transceiver and antenna and thus produces radar images with defined time-stamps and positions for SAR operations. SAR aggregates the data in a time-multiplex approach. SAR allows producing resolutions which go far beyond results of a normal antenna.

To run iSAR, the system requires the Mobile Target Positioning System to rotate the target.

Features

- Operating Modes (enabled in the hardware)
 - FMCW
- Scopes (enabled through FreeScopes)

- B-Scope (time-scale), displaying the SAR image
- A-Scope
- Amplification
 - Amplification of raw signal (IQ signal) at receiver
 - Amplification of filtered signal in the scopes
- Filters and Signal Treatment
 - Sensitivity Time Control (STC)
 - Signal Threshold and Limiter
 - Range Calibration and Extension
 - Cutting out sections of the signal range
 - Hamming
 - Hanning
 - Blackman
 - Blackmanharris
 - Signal Threshold and Limiter
 - Range Calibration and Extension
 - Cutting out sections of the signal range
 - Moving Target Detection and Indication
 - and more



SkyRadar FMCW Base Module placed on the SAR extension

Topics

The FMCW Base Module can be applied to experiment on the following subjects (selection):

- Experiments on Synthetic Aperture Radars
- Calibrating a radar setup using amplification, filters and settings

- Experiments on amplification of source as well as of the signals
- Clutter processing e.g., through Sensitive Time Control (STC)
- for iSAR only: Radar Cross Section (RCS) analysis allowing for an understanding of the varying detectability of objects based on material, absolute and relative size, reflection angle, distance and strength of the signal.
- Allows analyzing performance and false alarm tolerances through adjustment of the sensitivity.
- Adjustable decision threshold allowing for experiments on background noise.
- And much more.

- Wireless LAN connection SAR/iSAR server



Parts (Basic Configuration)

The SAR Module consists of:

- one (1) linear axis (2050 mm) driven by a stepper motor
- one (1) control unit providing
 - drive control and visualization system

One (1) SAR and iSAR management server

- rack server
- Intel® Celeron® Quad-Core J1900 SoC (2.0 GHz)
- 1 x Intel SSD S3520 150GB SATA-3 3,5 Zoll (Capacity: 150 GB)
- management software licence
- One (1) cable set

Prerequisites

- Computer with latest HTML5 enabled browser. Current versions of Chrome, Firefox, MS Internet explorer, Opera and Safari are able to read HTML5.
- SkyRadar FreeScopes (comes free with the FMCW Base Unit)
- FMCW Base
- only for iSAR: Mobile Target Positioning System

The SkyRadar SAR and FMCW Base Module is accessible by an unlimited amount of concurrent users. The broad coverage of solutions useful in ICAO and EuroControl ATCO and ATSEP training programs as well as IATA qualifications make SkyRadar the preferred choice of many aviation academies and IATA TrainAir Plus accredited institutions. Many universities and military academies use the PSR Base Module within their qualification, education, training or research programs.

Detailed Description

SkyRadar's SAR system builds on the FMCW base module. Set on a linear high-precision conveyor, driven by a servo motor and controlled with an industrial drive system, it produces a variable number of radar images which are aggregated in a time-multiplex approach.

Extensions

- [SkyRadar Rotary Tripod](#) (recommended)
- [SkyRadar Parabolic Reflector](#) (recommended)
- [SkyRadar Cloud Server](#) (recommended)
- [SkyRadar Target Tracker](#) (comes free with the base module)
- [SkyRadar Security](#)
- [SkyRadar Target Subsystems](#)
- [Vessel](#)
- [Quadcopter](#)
- [SkyRadar ADS-B Experimenter](#)

General Features

SkyRadar FMCW SAR Hardware Features

Synthetic Aperture Radar (SAR) hardware setup, with servo controlled movement of the antenna on a linear rail.

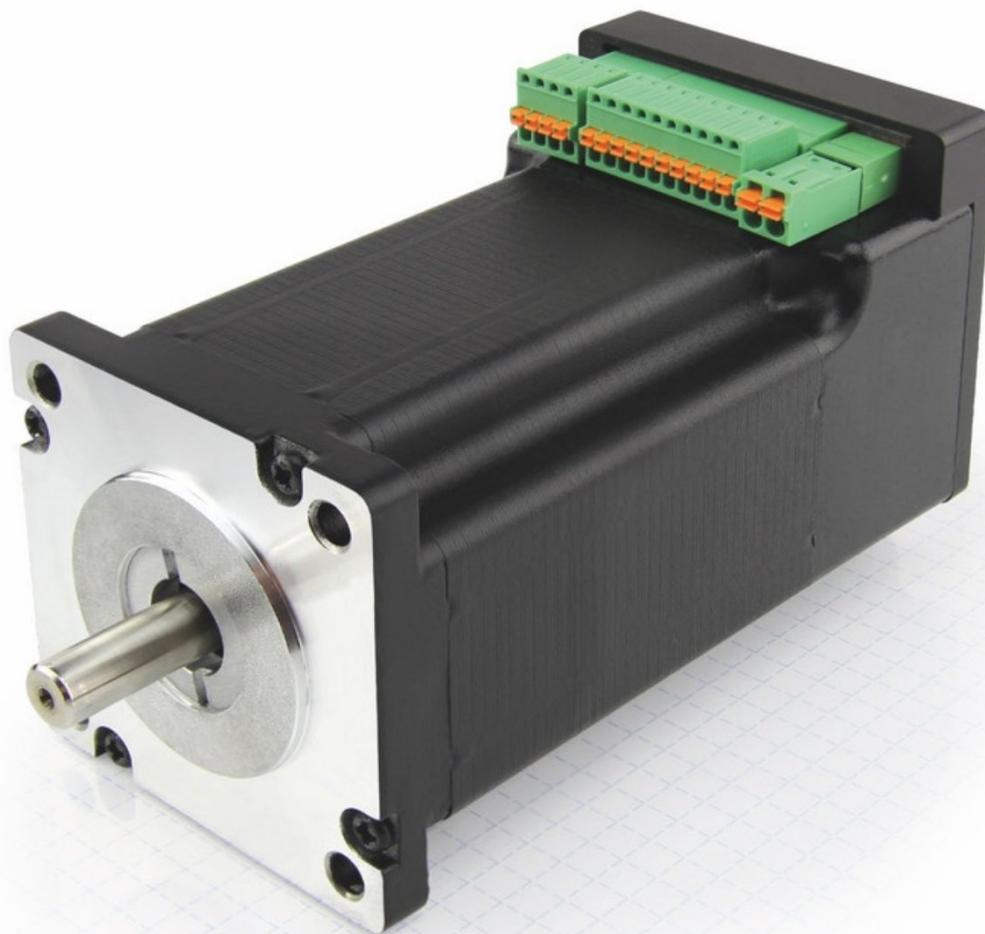
- Synthetic Aperture Radar (SAR) hardware setup, with DC-motor driven the antenna on a 2050 mm linear rail .
- Phased-Array through a 2-segment patch antenna Default operation in at 24 GHz.

SkyRadar FMCW SAR Software Features

- Wireless communication between Radar element and computers or CloudServer.
- A -Scope, B-Scope with time-scale on the x-axis.
- Very high resolution of the radar image through synthetic aperture image generation.

Stepper Motor

A high precision brushless DC servo motor with integrated controller (stepper) actuates the linear drive.



Operating Voltage	12 V DC - 48 V DC
Peak Current (RMS)	6.3 A
Type Digital Inputs	24V, 5/24 V switchable
Type Analog Input	0-10 V
Type Digital Output	Open-Drain (30 V max.)
Size	56 mm
Interface	USB
Holding Torque	110 Ncm
Rated Current (RMS)	4.2 A
Number of Digital Inputs	6
Number of Analog Inputs	1
Digital Outputs	1
Encoder Resolution	1024 Cycles per Revolution
Weight	0,8 kg

Table : Operative characteristics of the servo motor

Linear Conveyor

The linear conveyor creates the defined and highly precise displacement, allowing the radar to shoot shifted images that will be aggregated into one high resolution images in a subsequent time-multiplex principle.



Length	2,050 mm
Width	315 mm
Height	approx. 850 mm
Required Space	approx. 2,400 mm x 800 mm
Track Gauge	97 mm
Weight	5.6 Kg
Traverse Path	1,700 mm
Feed (1/U)	75,36 mm

Table : Operative characteristics of the linear conveyor

Programmable Logic Controller PLC



An industrial Siemens S7 PLC controls the conveyor displacement.

Type	Siemens SIMATIC S7-1200
CPU	1214C compact CPU
Onboard IO	14 DI, 24V DC; 10 DO Relay 0.5 A; 2 AI 0 - 10V
Power Supply	85 - 264 V AC at 47 - 63 Hz
Memory	75 KB
Licence	SIMATIC S7, STEP 7 BASIC V14 FLOATING LICENSE, E-SW, SW AND DOCU. ON DVD, LICENSE KEY ON USB STICK, 2 LANGUAGES (GE,EN), REFERENCE HW: S7-1200

Table : Operative characteristics of the PLC

Human Machine Interface HMI

The displacement of the linear conveyor is controlled via an industrial Human Machine Interface by the German manufacturer Siemens.

Type	Siemens SIMATIC HMI KTP400 BASIC COLOR PN, BASIC PANEL
Operation	Key and Touch
Display	4 " TFT 65536 colors
Interface	ProfiNet

Table : Operative characteristics of the HMI

Network

The components are connected through industrial Ethernet by the German manufacturer Siemens.



Industrial Ethernet Switch	Siemens SCALANCE XB005 UNMANAGED INDUSTRIAL ETHERNET SWITCH FOR 10/100 MBIT/S; WITH 5 X 10/100MBIT/S TWISTED PAIR PORTS WITH RJ45-SOCKETS; FOR CONFIGURING SMALL STAR AND LINE TOPOGRAPHIES; LED DIAGNOSTICS, IP20, 24 V DC POWER SUPPLY
Connector	Siemens SIMATIC NET INDUSTRIAL ETHERNET TP XP CORD RJ45/RJ45, CAT 6, CROSSED TP CABLE 4X2, PREASSEMBLED WITH 2 RJ45 CONNECTORS, LENGTH 6 M
Licence	Siemens SIMATIC WINCC BASIC V14 ENGINEERING SOFTWARE, FLOATING LICENSES AND DOCUMENTATION ON DVD, FOR CONFIGURATION OF SIMATIC BASIC PANELS

Table : Operative characteristics of the Network