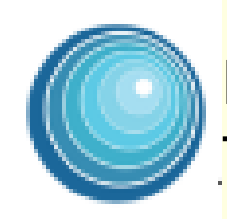

Povolzhskiy State University of Telecommunication and Information(PSUTI)

SPACE RADAR TECHNOLOGIES OF THE EARTH REMOTE SENSING FOR DETECTING SUBSURFACE STRUCTURES AND WATER RESERVES

Goryachkin O.V.

Introduction

Radar systems applications

- 1) Mapping and monitoring of extended objects;
- 2) Interferometry;
- 3) Navigation;
- 4) Foliage and Ground Penetration;
- 5) Environment monitoring.

Introduction

Radar systems for water monitoring

The space radar image of Samara, the border water reservoirs and humidification zones, the SAR image was obtained by SIR-C-X-SAR PCA, (USA, 1994), processed in the PGUTI.

Introduction

Radar systems for detecting subsurface structure

The penetration depth of a radio wave into the ground is determined by the following known formula

$$h = \frac{\lambda}{2\pi} \frac{\sqrt{\varepsilon_r}}{\varepsilon_i}$$

where is ε_r - the real part of the permittivity of the soil, ε_i - the imaginary part of the permittivity of the soil.

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Introduction

Radar systems for detecting subsurface structure

Sub-surface radar images of the water channel, humidification and emergency filtration zones obtained by the aviation SAR "MARS" (Ukraine, IRE, 1990).

Space radar satellite classification by main character

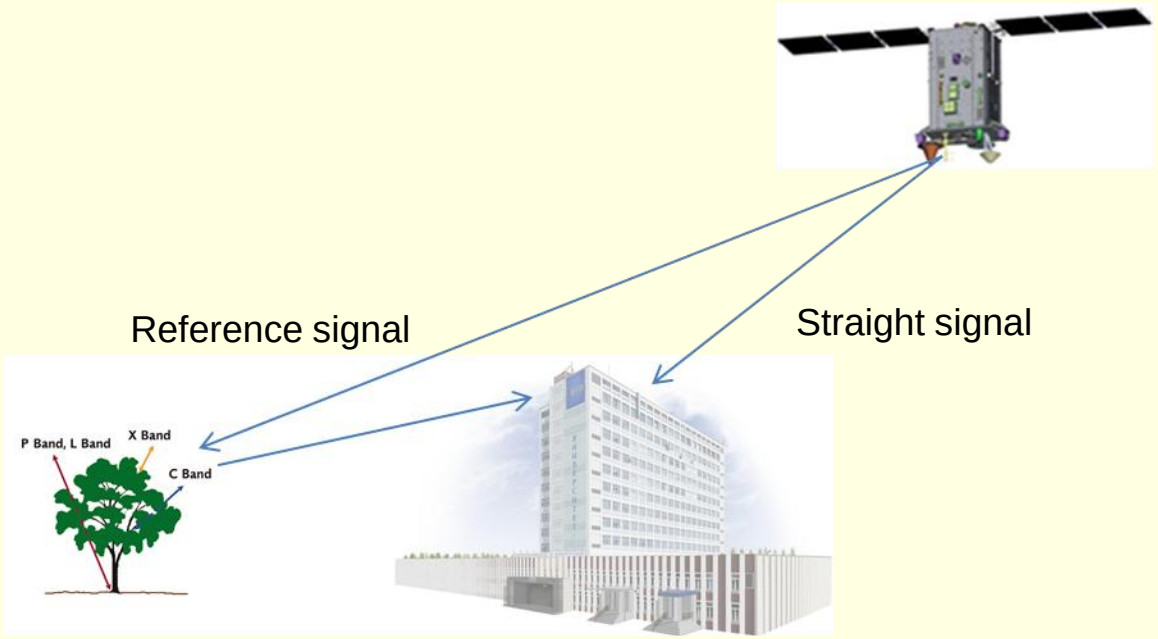
TerraSAR-X 2, .

TerraSAR-L, Alos-2

BiRLK «Aist-2D», Biomass

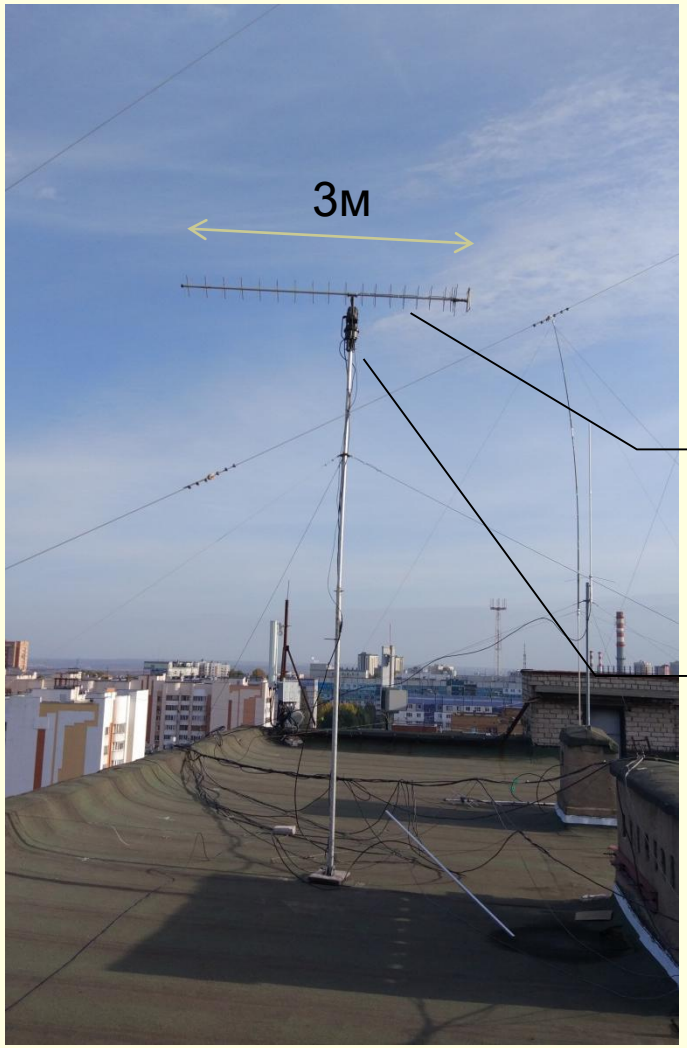
Frequency band	Ultra-high spatial resolution, <0.5m	High spatial resolution, 0.5-3m	Middle spatial resolution, 3-10m	Low spatial resolution, >10m
X – Band (3 cm)	Window of possibility №1	TerraSAR-X, SAR-Lupe, Tandem-X (Germany), COSMO Skymed (Italy), VEGA (USA), Migs (Japan), TechSAR (Israel)	TerraSAR , SAR-Lupe, Tandem-X (Germany), COSMO Skymed (Italy), VEGA (USA), Migs (Japan), TechSAR (Israel)	TerraSAR, SAR-Lupe, Tandem-X (Germany), COSMO Skymed (Italy), VEGA (USA), Migs (Japan), TechSAR (Israel)
C – Band (5 cm)	Not able by radio regulation		RADARSAT 1-2 (Canada),	ERS 1-2, ENVISAT (ESA), RADARSAT 1-2 (Canada),
L – Band (23cm)			Window of possibility №2	Adeos (Japan),
P – Band(70 cm)			Window of possibility №3	
VHF – Band (180 cm)				

Model of experiment with BiRLK «Aist-2D»



- Spatial resolution BiRLK to 5m;
- Wight swap to 20 km from ground station PSUTI

Straight channel antenna by ground station of BiRLK (P Band)



Antenna

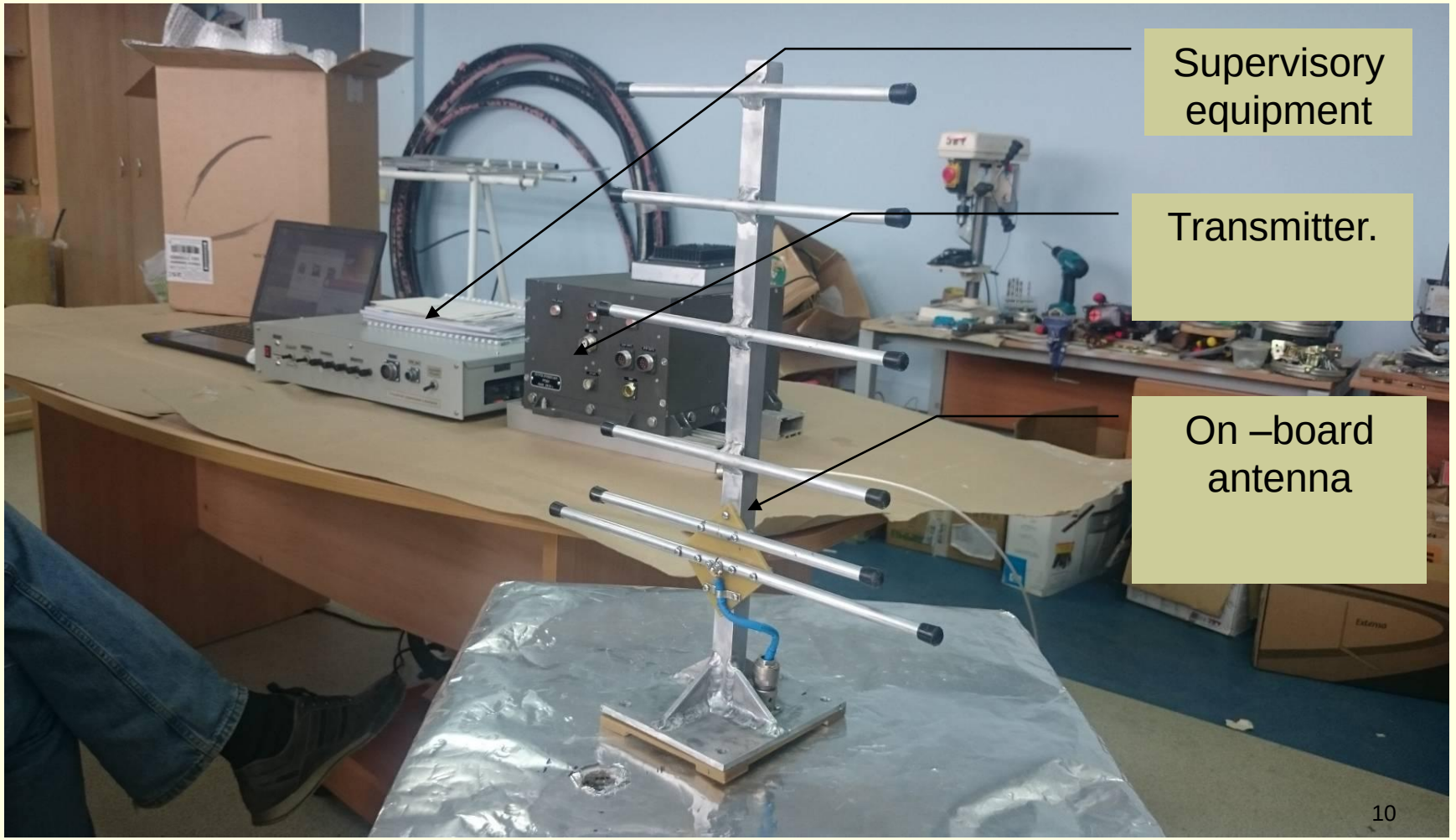
Two – dimension rotation equipment

Reference channel antenna by ground station of BiRLK (P Band)

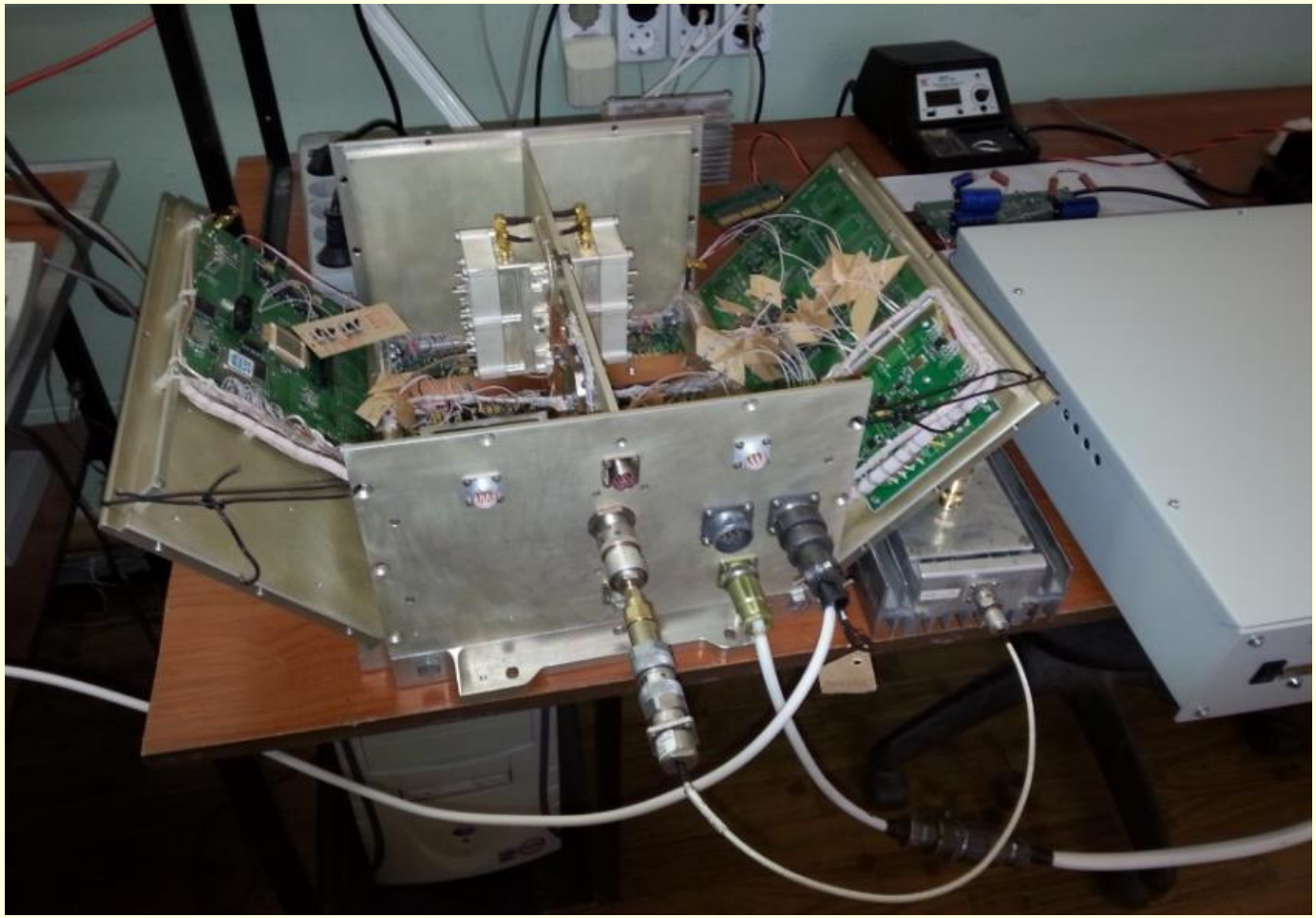
Antenna

Two – dimension rotation equipment

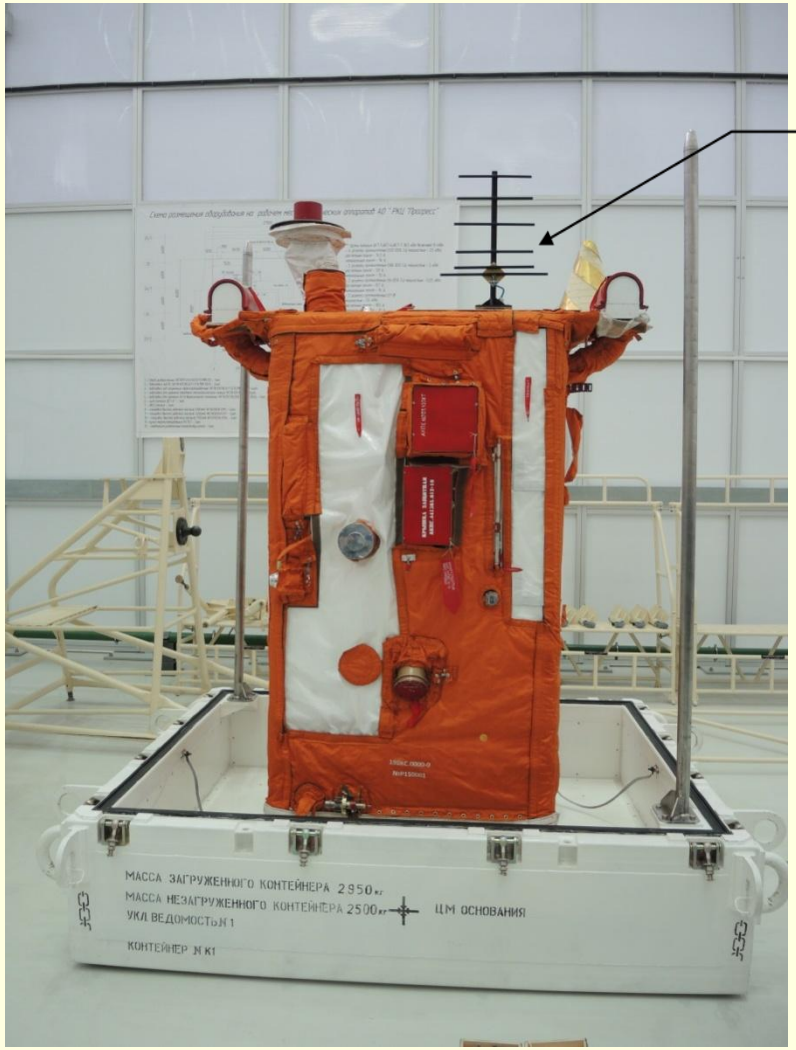
On-board equipment of small satellite «Aist-2D»



Transmitter on assembly table



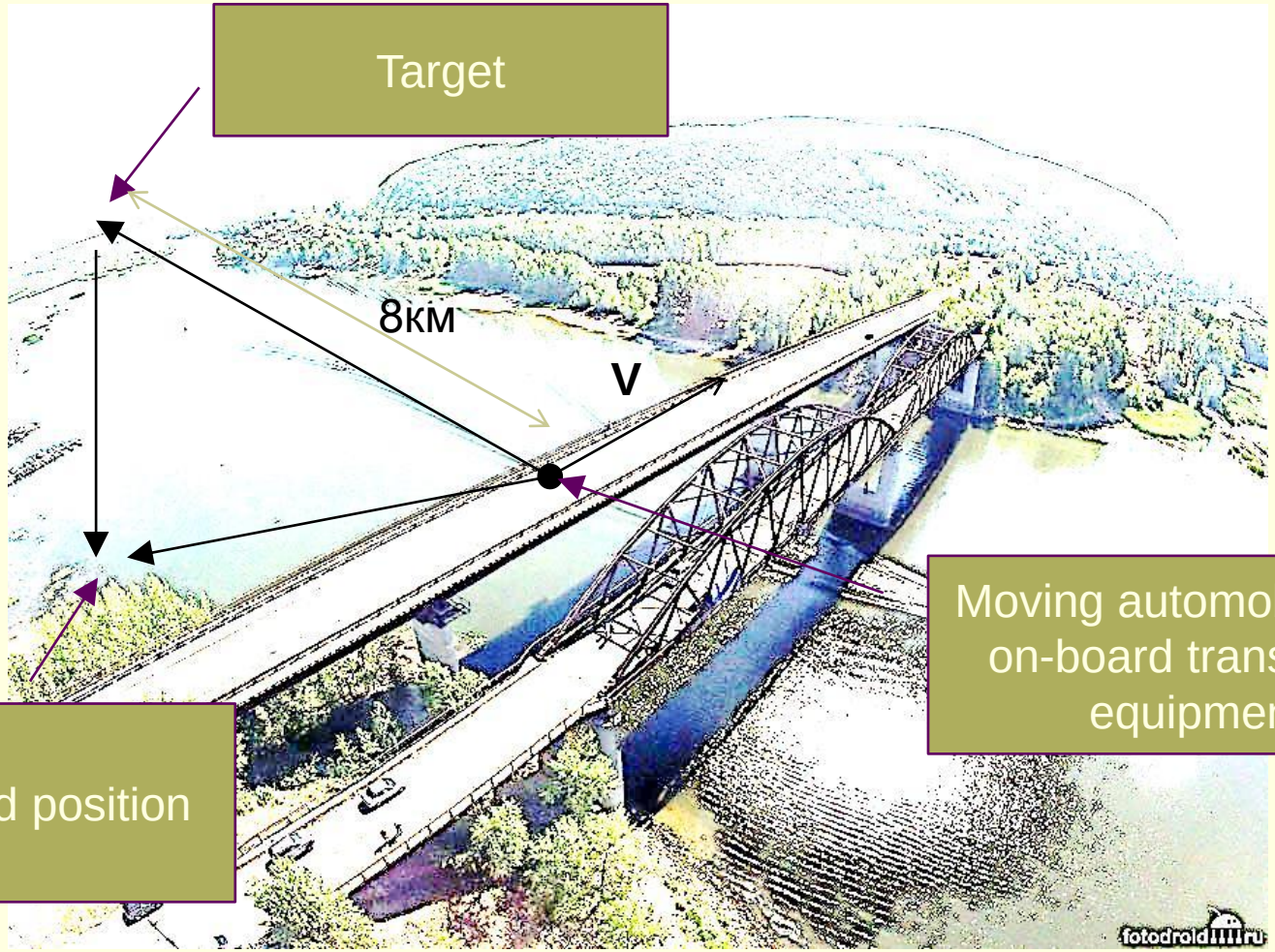
Small Satellite «Aist-2D» in cosmodrom «Vostochny»



Antenna of BiRLK

THE GROUND BASED EXSPERIMENT WITH BISTATIC RADAR SYSTEM FOR SMALL SATELLITE «AIST-2D» P- BAND FREQUENCY

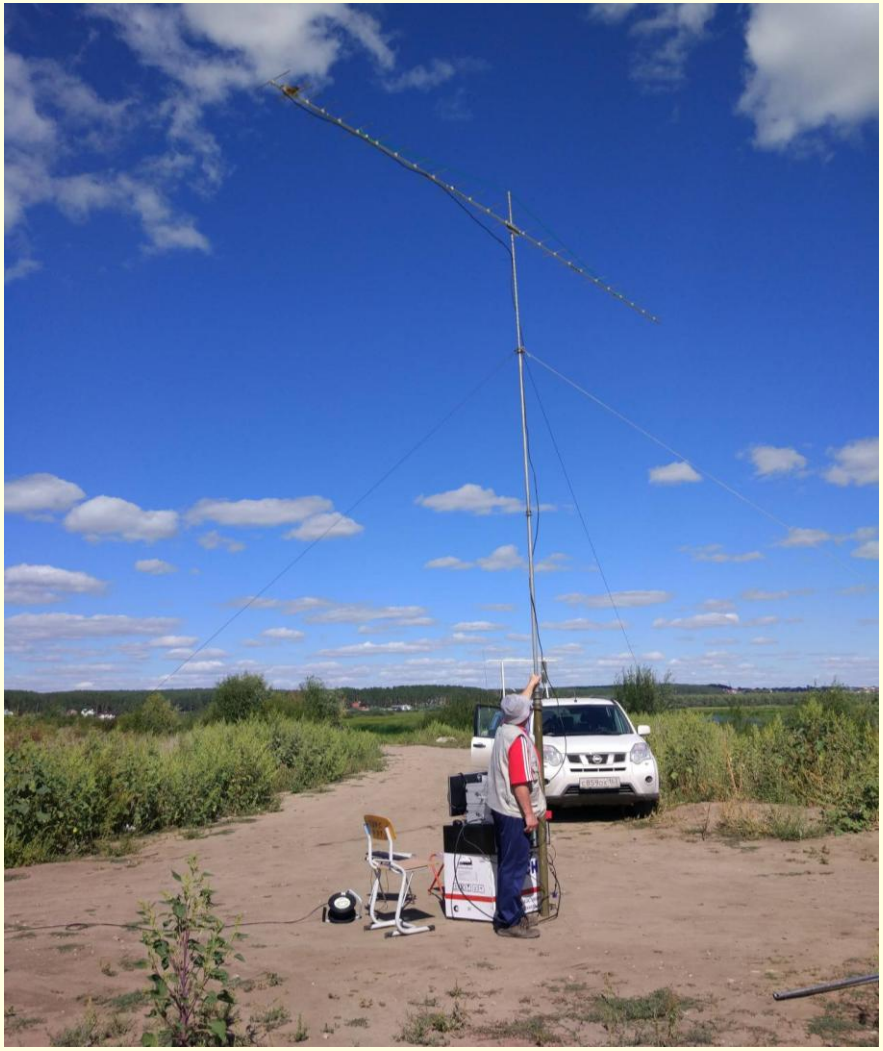
Geometry of experiment



Receiver equipment in outdoor condition

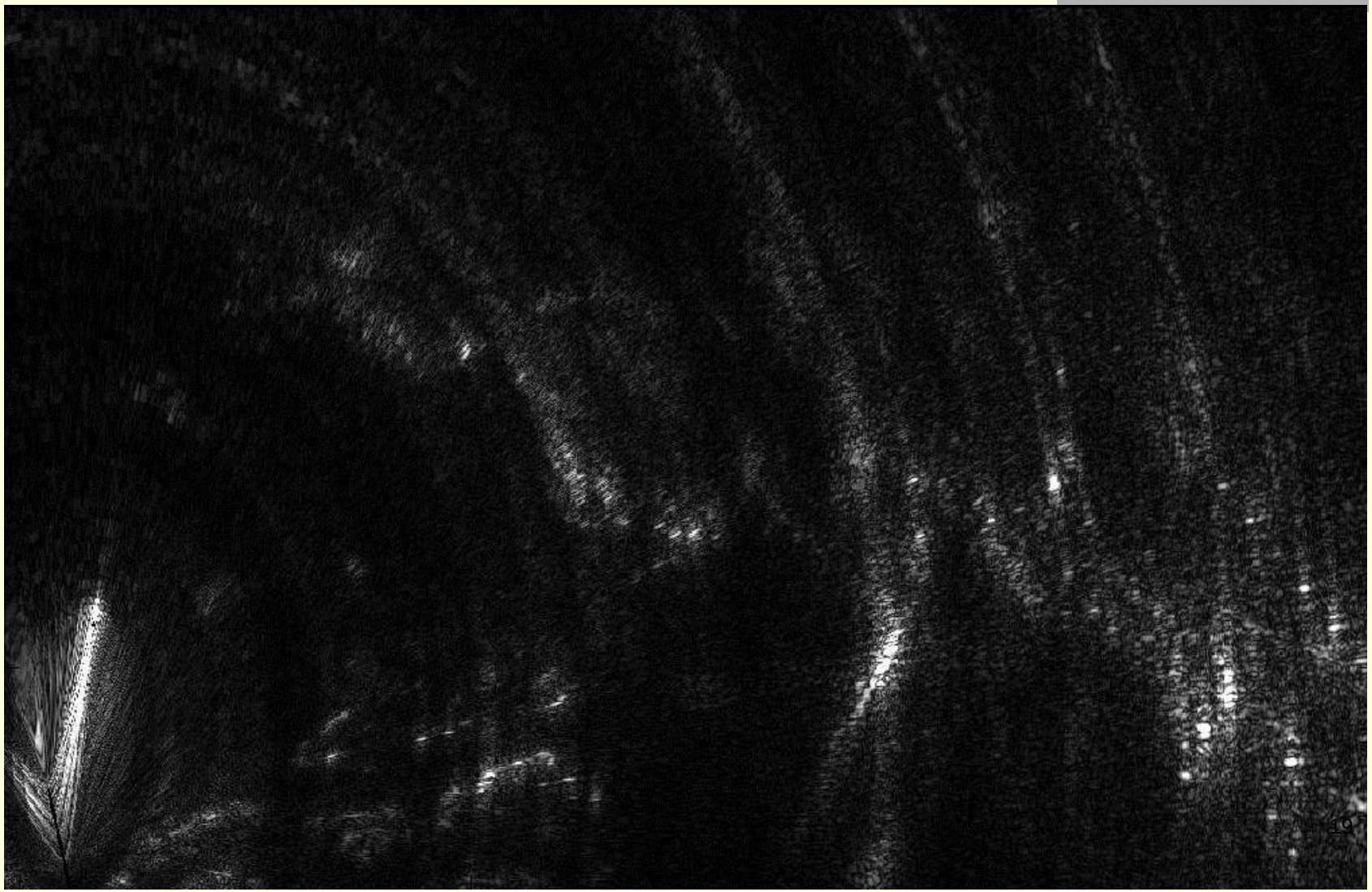
Transmitter equipment settled up on automobile

Reference channel antenna

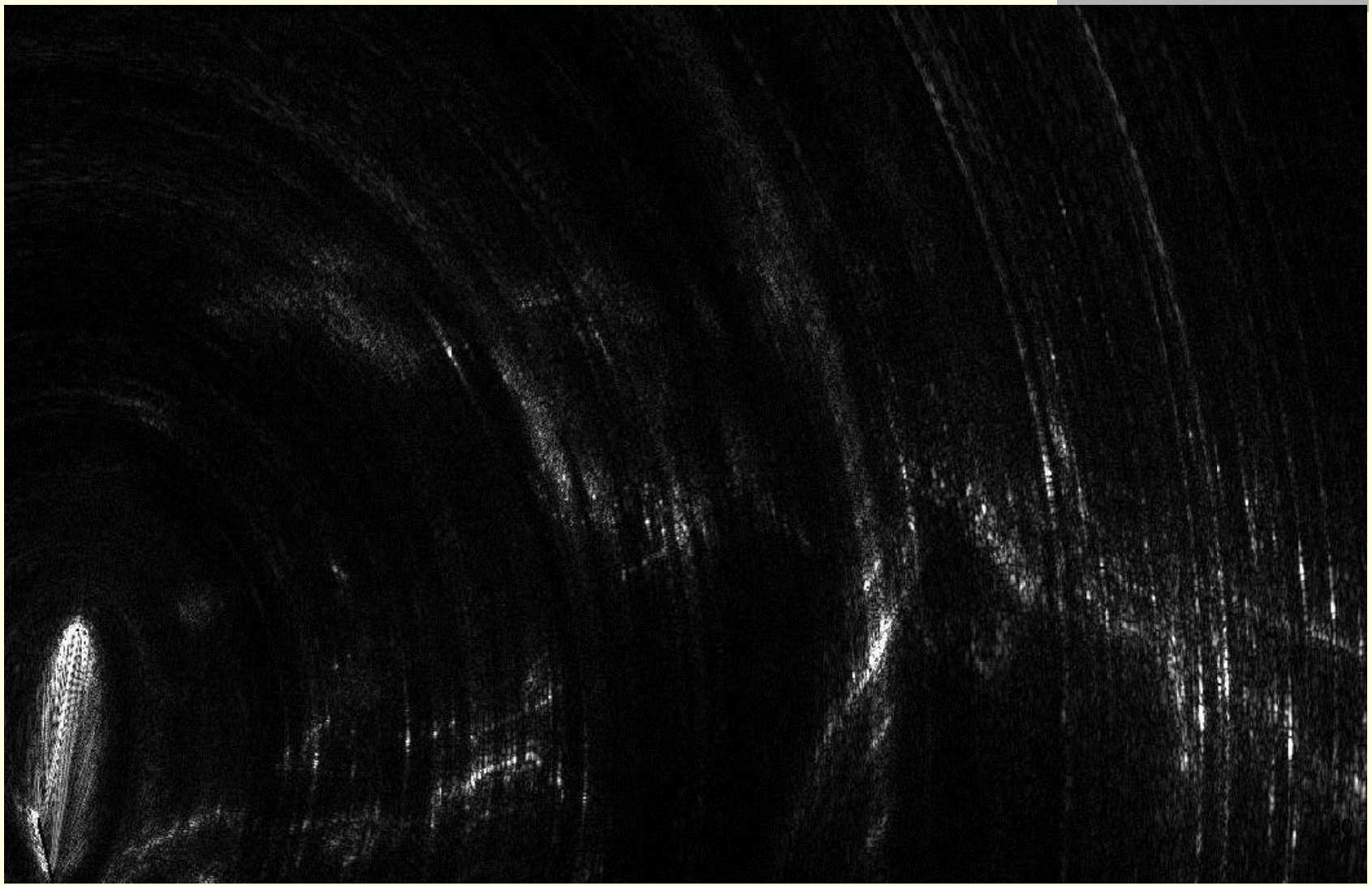


Location of experiment

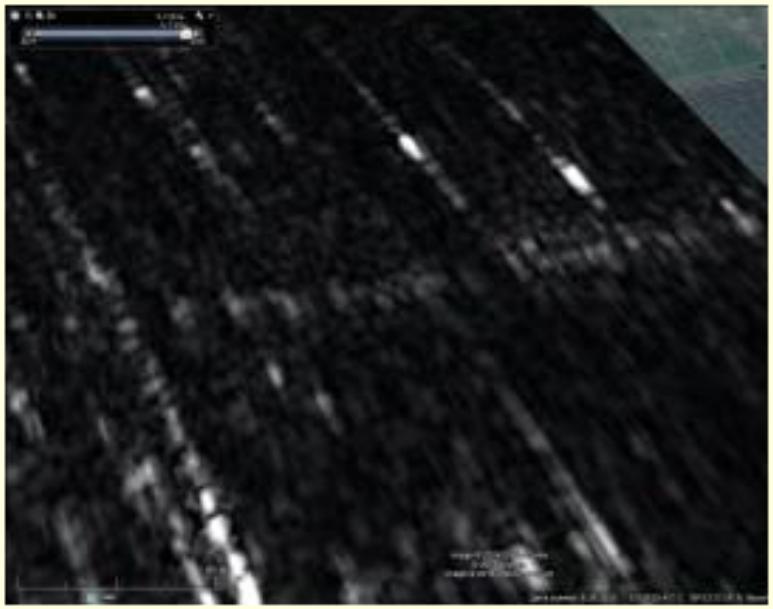
Radar image, step of pixel- 5M, frequency band – 5MHz



Radar image, step of pixel- 5M, frequency band – 30MHz

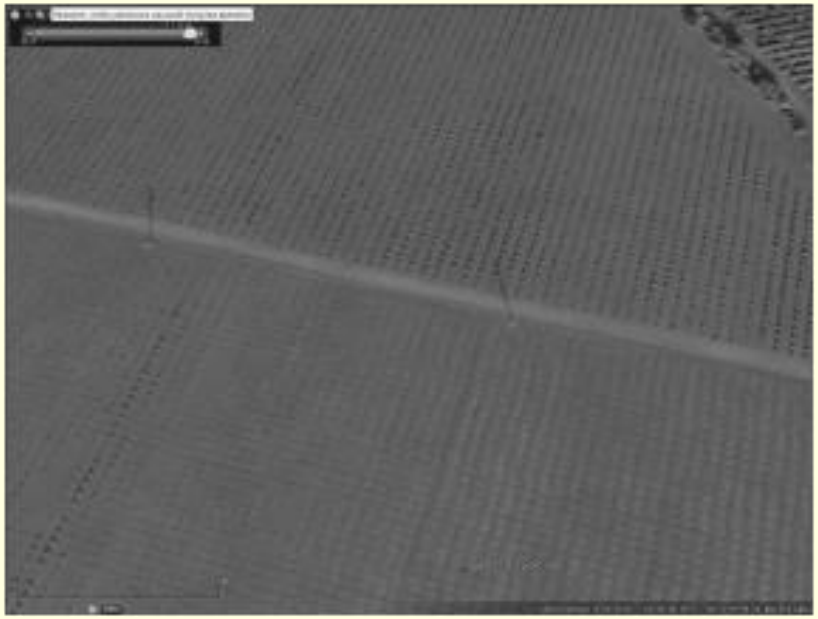


Radar image, step of pixel- 5M, frequency band – 30MHz



Forest landing RADAR (right), optical equipment (left), bandwidth 30 MHz, radiation mode CHIRP pulses step 5 m pixel.

Radar image, step of pixel- 5M, frequency band – 30MHz



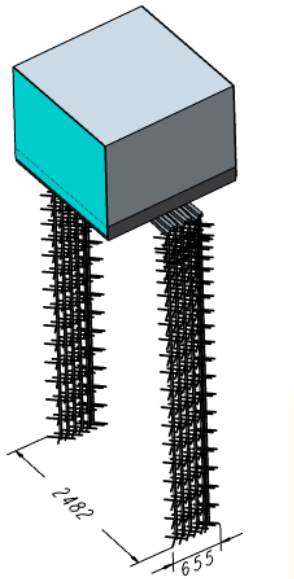
Power line. RDAR(right), optical equipment (left), bandwidth 30 MHz, radiation mode CHIRP pulses step 5 m pixel.

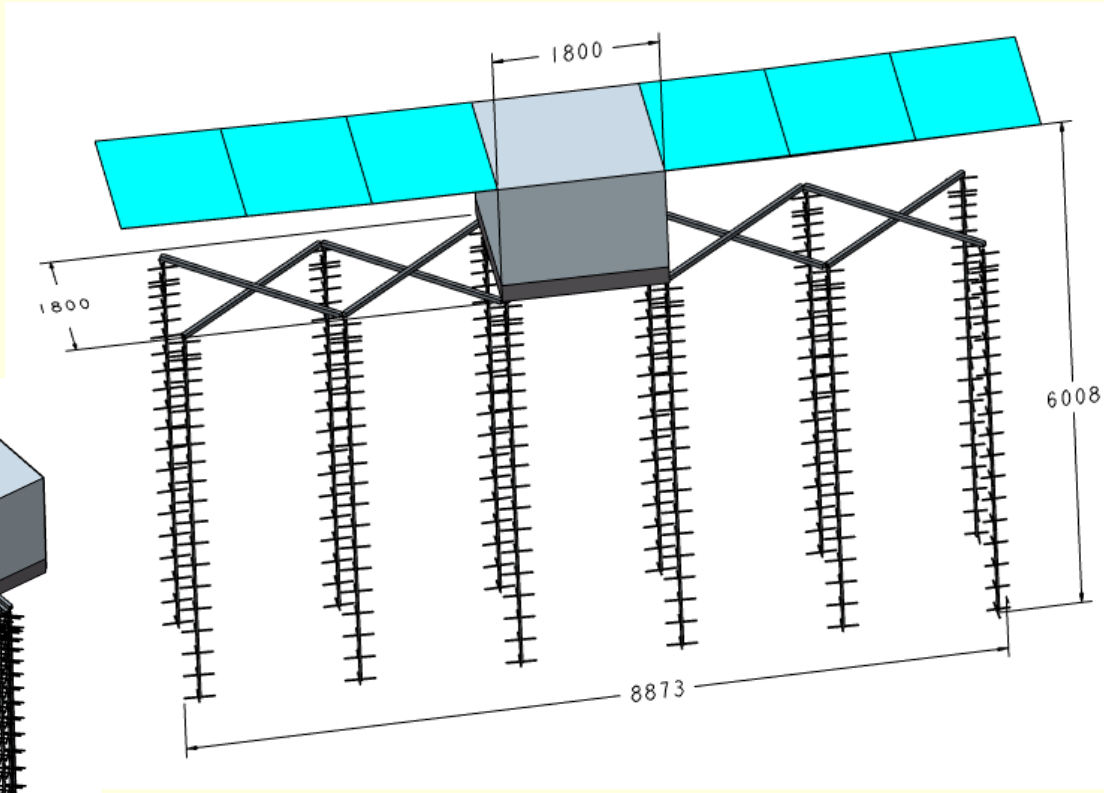
Future trends of BiRLK «AIST-2D»

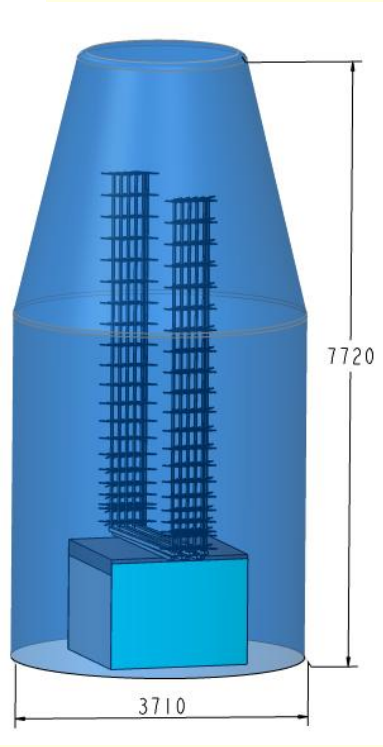
1. Monostatic radar system of P band

Small satellite with P-band radar

Embedded antenna

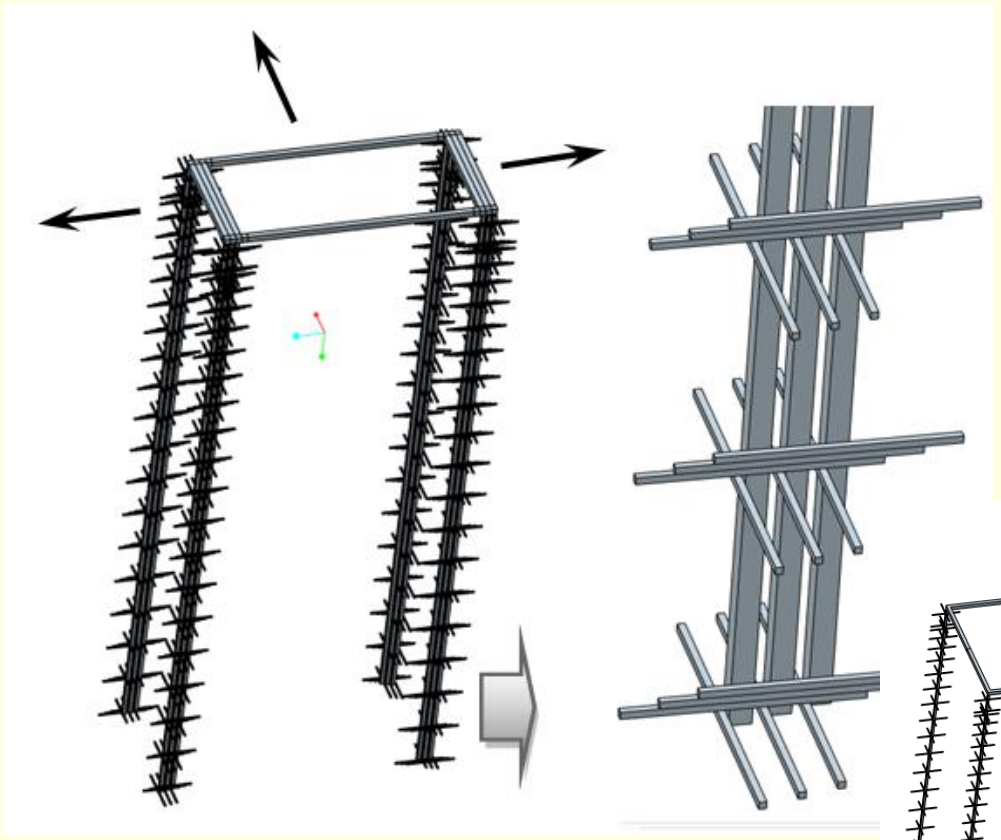


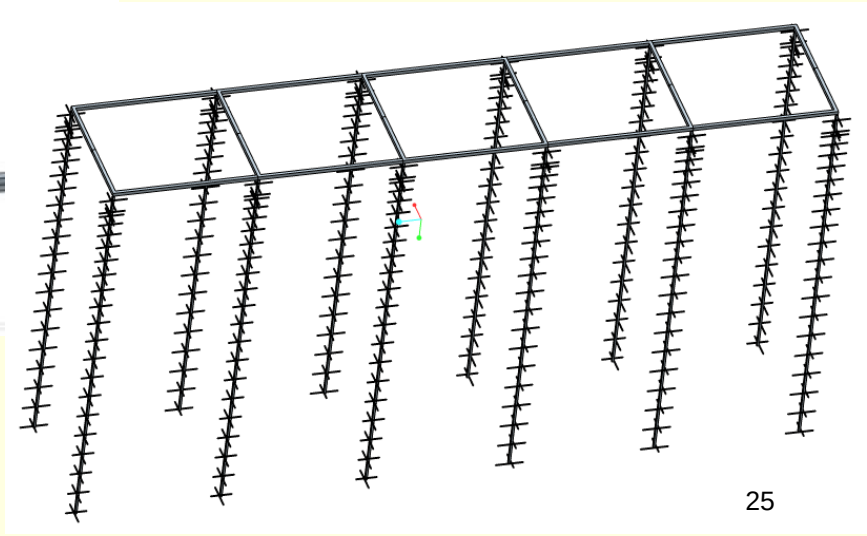




Antenna deployed

P-band antenna for small satellite

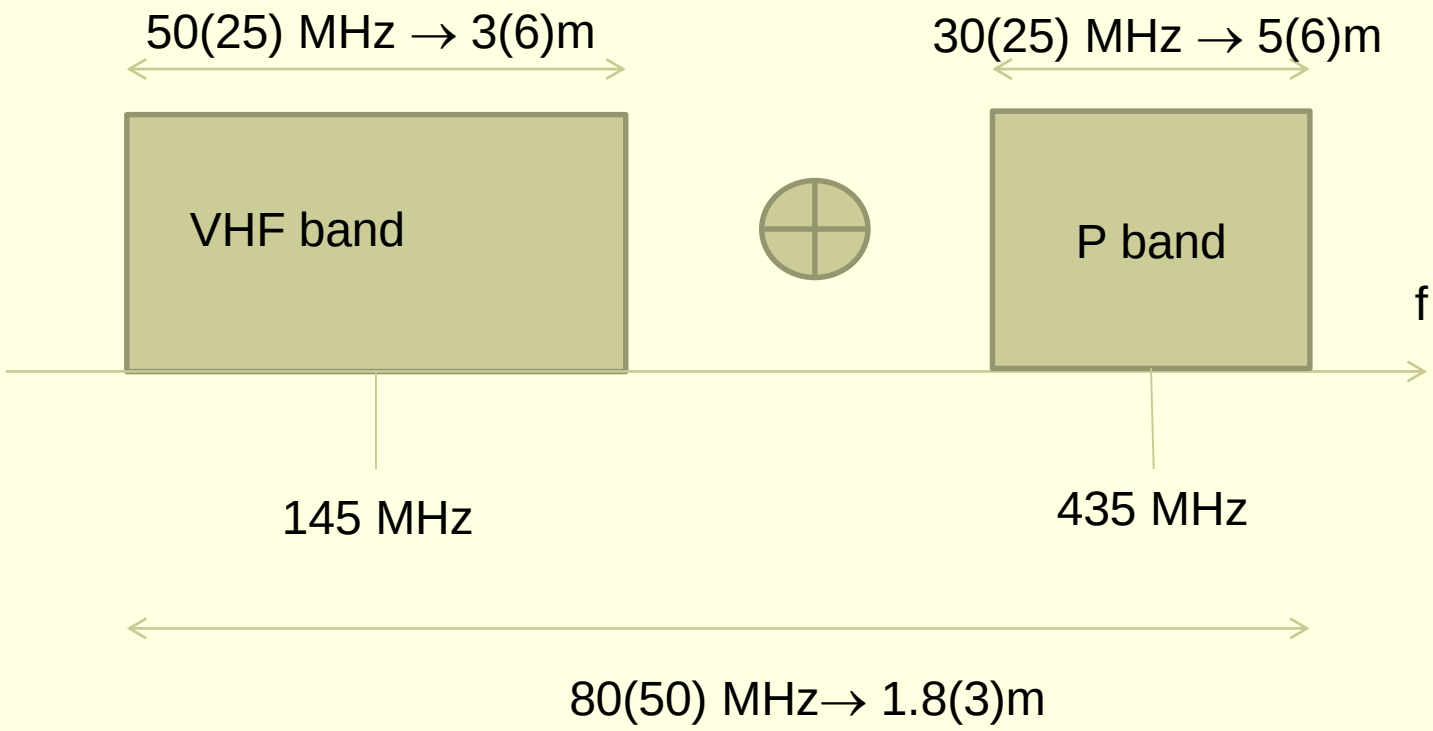




Future trends of BiRLK «AIST-2D»

2. Super resolution radar system P-VHF Band

Main idea


50(25) MHz → 3(6)m
30(25) MHz → 5(6)m
VHF band
P band
f
145 MHz
435 MHz
80(50) MHz→ 1.8(3)m

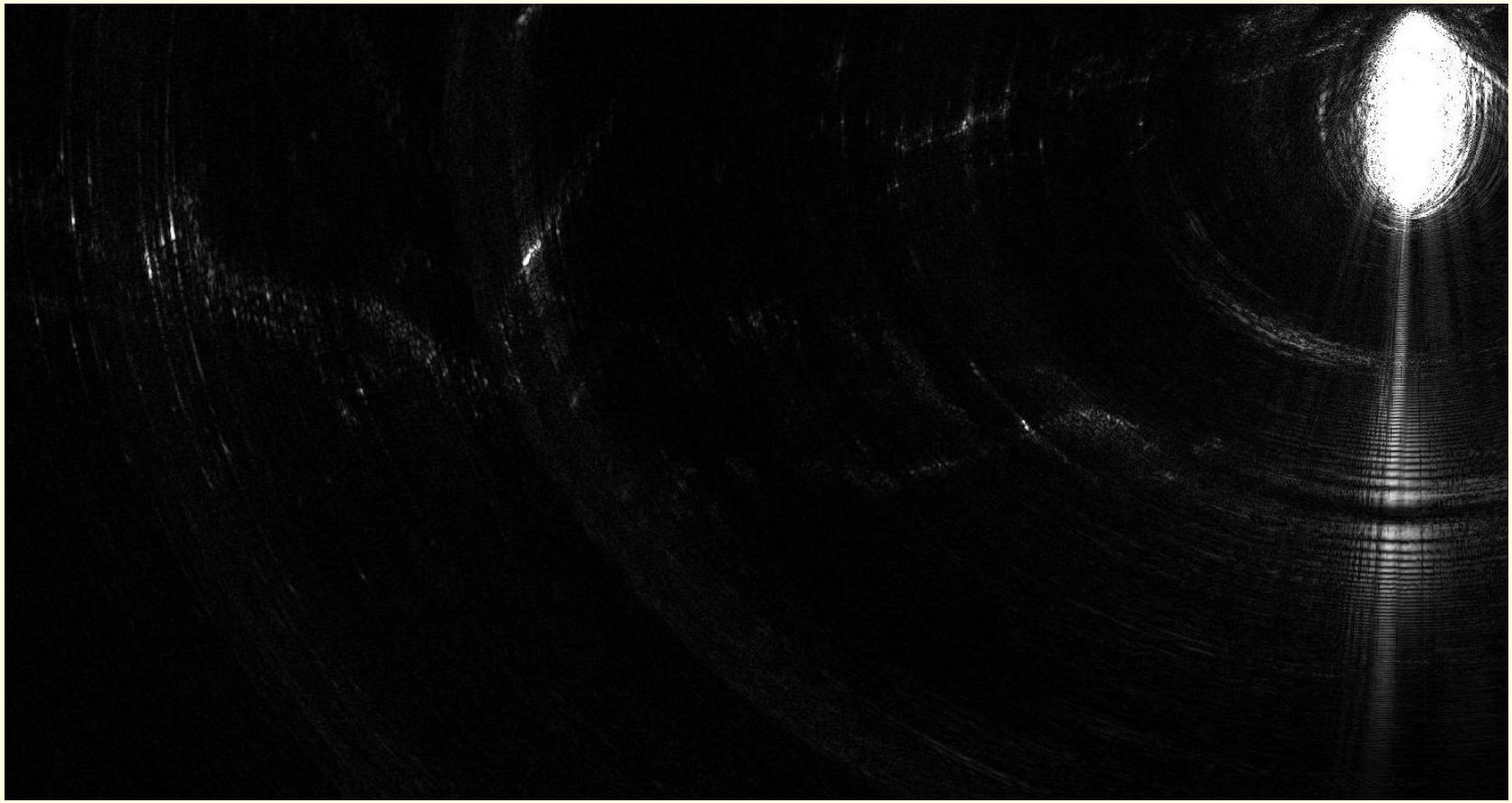
Experiment with bistatic radar system VHF-P bands

Transmitted P and VHF band antenna system

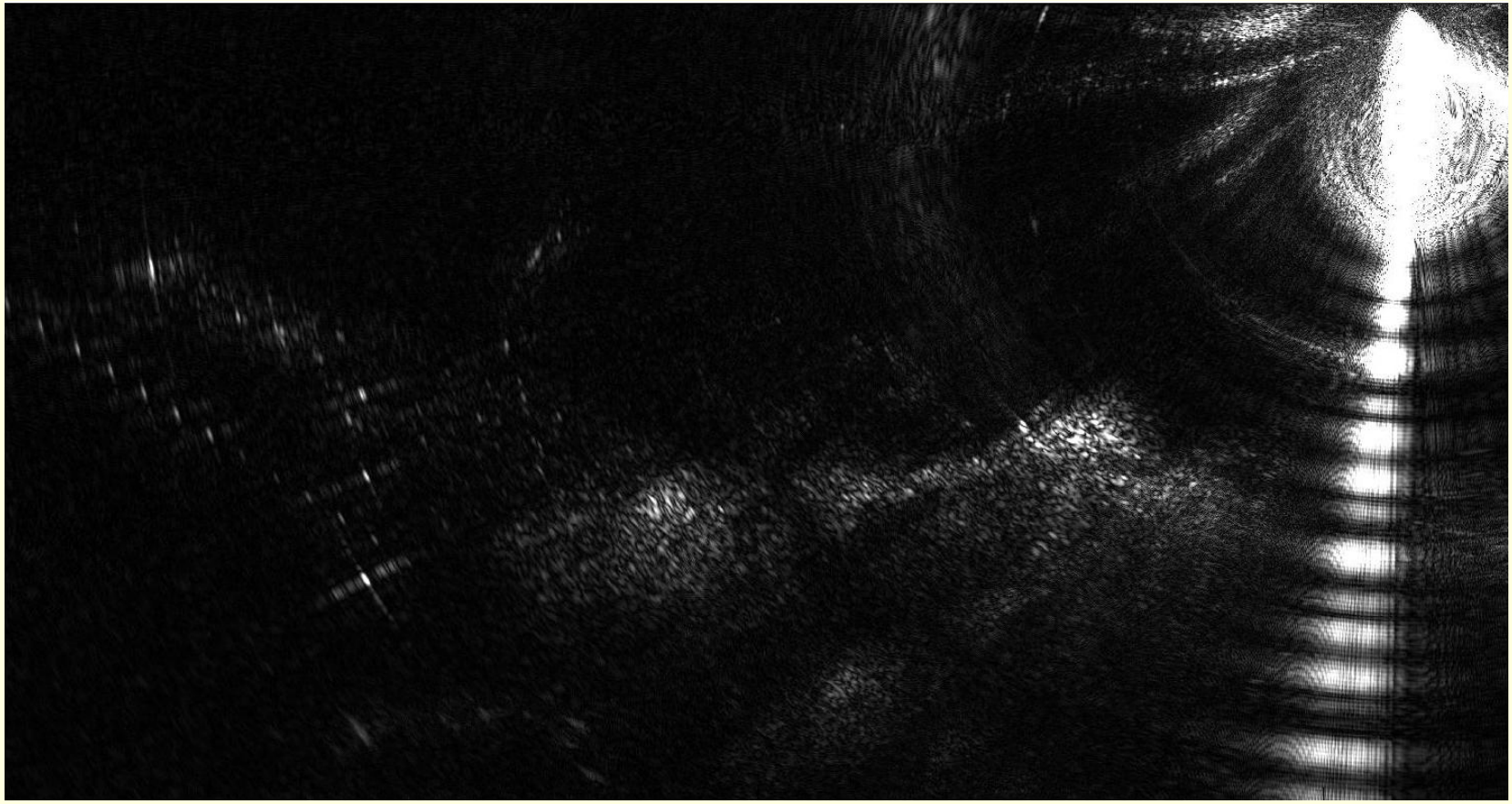
Received P and VHF band antenna system

Experiment location

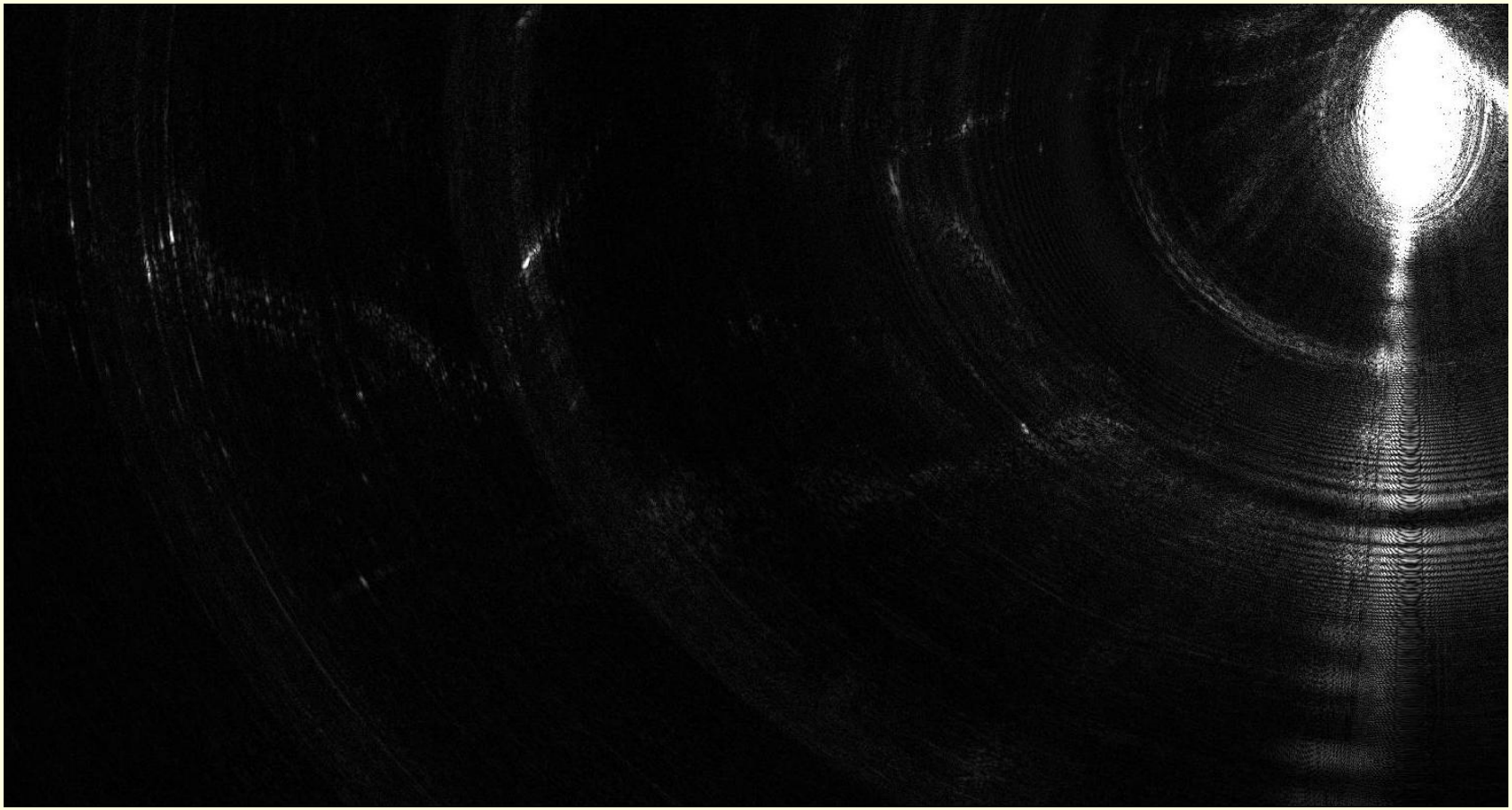
P-band radar image, step of pixel – 1.5 M



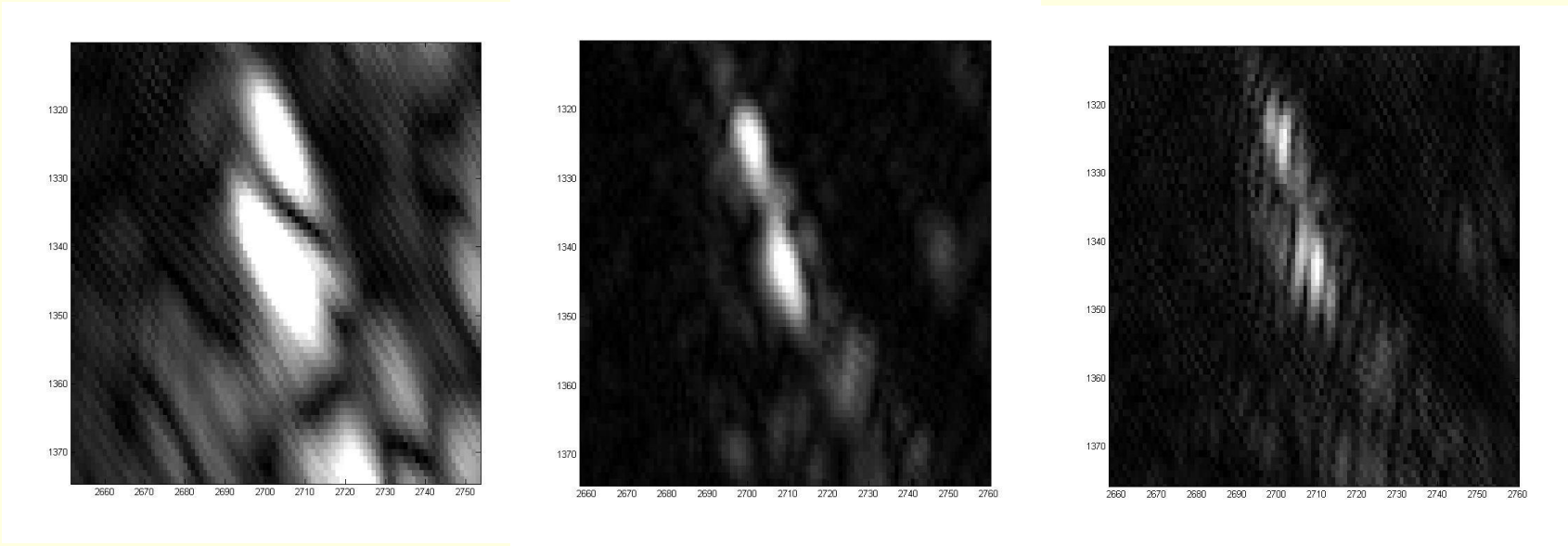
VHF band radar image, step of pixel – 1.5 M



P+VHF band radar image, step of pixel – 1.5 M

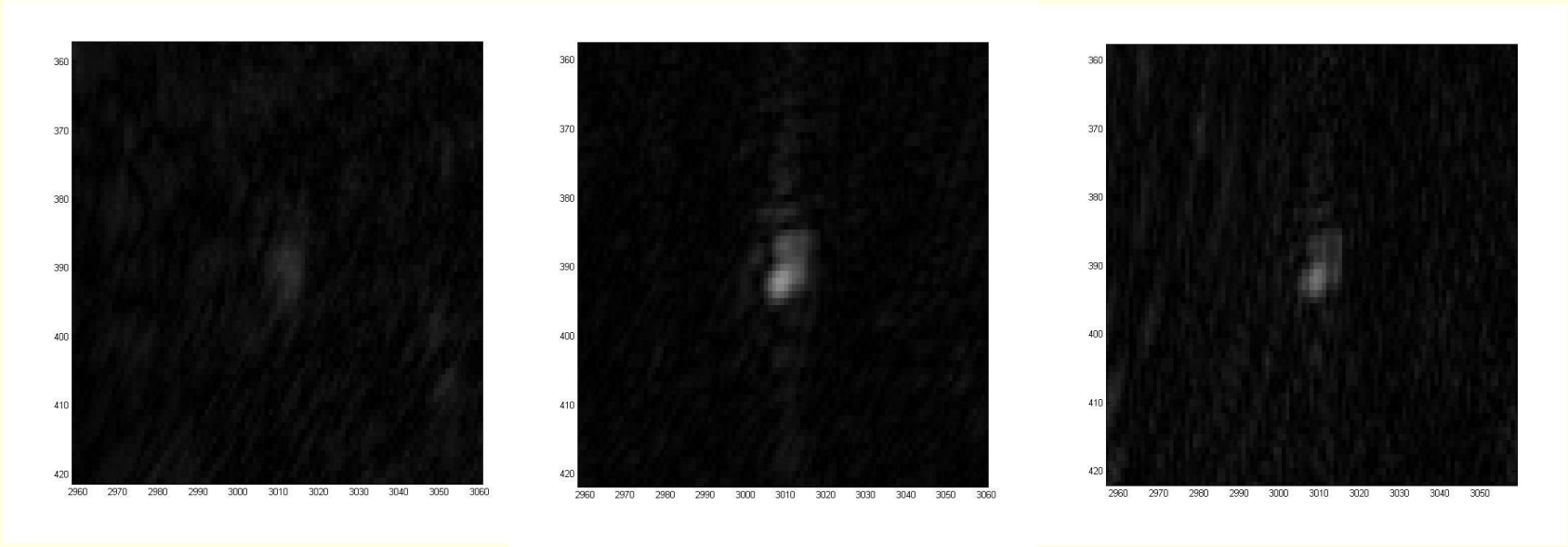


Radar image fragment, step of pixel– 1.5M



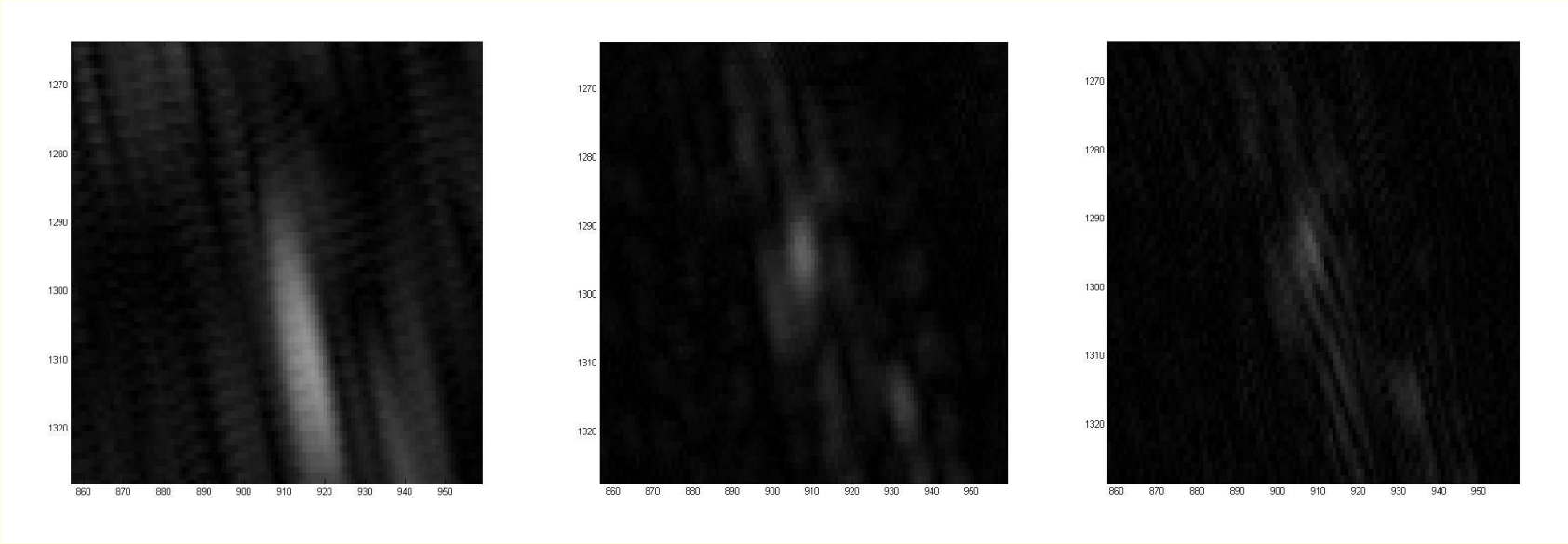
Two buildings on radar image. Left- VHF-band radar image, center- P-band radar image, VHF+P band radar image

Radar image fragment, step of pixel– 1.5M



Some object on radar image. Left- VHF-band radar image, center- P-band radar image, VHF+P band radar image

Radar image fragment, step of pixel– 1.5M



Some object on radar image. Left- VHF-band radar image, center- P-band radar image, VHF+P band radar image

Thank you!