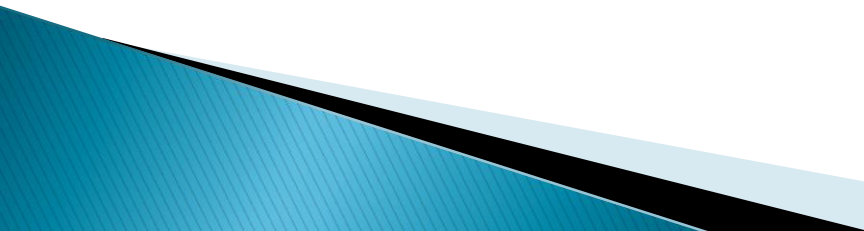


Experimental Studies on the Definition of ADS-B Mode 4 Characteristics on PTERO UAS and Jabiru-450 GA Piloted Aircraft

Lytkino (Kaluga region) landing site
June 16-17, 2014

Goal of the Experimental Studies

- ▶ definition of MGTR-4 coverage area (range) on “air-to-ground” and “air-to-air” channel;
 - ▶ definition of stability, position fairness and integrity of displayed ADS-B information;
 - ▶ possibility to apply small-size mobile ground ADS-B sets (MMNK) for the surveillance of flights of both piloted and unmanned aircraft;
 - ▶ possibility of UA surveillance from board a piloted aircraft and use of a pilot’s tablet prototype to display the air picture and log in (recording) ADS-B data;
 - ▶ check of stability, fairness and efficiency of ADS-B mode 4 data display.
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Objects of Studies

- ▶ Jabiru-450 piloted aircraft with ADS-B mode 4 airborne set including :
 - Pulsar radio station,
 - VHF antenna,
 - GPS/GLONASS satellite navigation antenna,
 - SONY mod.SGP321 pilot's tablet prototype,
 - Independent power supply source for Pulsar radio station;
- ▶ PTERO unmanned aircraft (UA) with ADS-B mode 4 airborne set including:
 - MGTR-4 small-size transponder,
 - VHF antenna,
 - GPS/GLONASS satellite navigation antenna;
- ▶ Zemlya-1 ground mobile set installed on Barguzin car chassis;
- ▶ Zemlya-2 (MMNK) small-size ground mobile set including :
 - Pulsar M radio station,
 - VHF antenna,
 - GPS/GLONASS satellite navigation antenna,
 - SONY PSG power supply source источник питания

Jabiru-450 piloted aircraft



AV-17 VHF antenna



GPS/GLONASS satellite navigation antenna

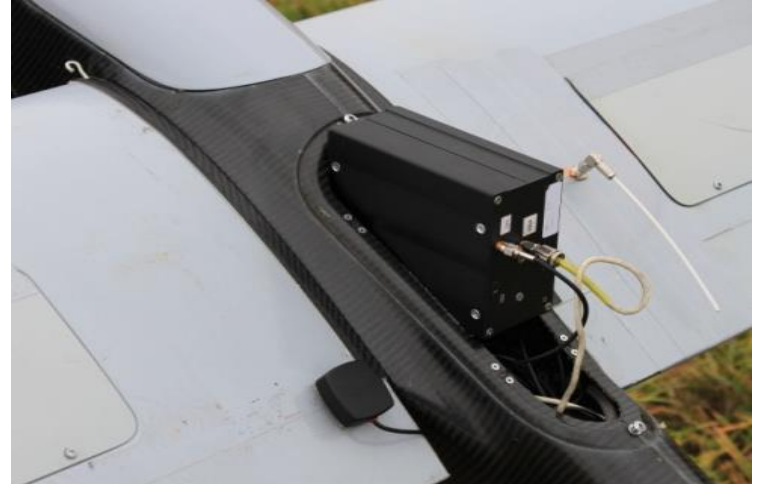
SONY pilot's tablet prototype



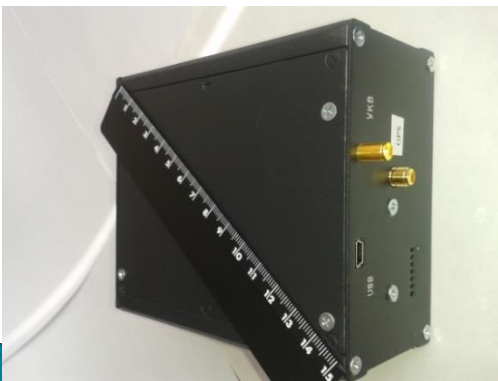
Pulsar radio station position (behind the passenger seat back)



PTERO UA with MGTR-4 transponder



MGTR-4 small-size transponder (certification stage)



Specifications:

- Transmitter power (Wt) – 4
- Operation mode – pulse
- Modulation type – GFSK (TDMA)
- Data rate (Baud) – 19200
- Two-channel tunable receiver
- Frequency range (MHz) – 118.0-136.975
- Operating frequency (MHz) – 136.945
- Frequency step (kHz) – 25
- Sensibility (dBm) – 100
- Dimensions (mm) – 110x70x40
- Mass with batteries (g) – not exceeding 300

Done according to ICAO, EUROCAE, ETSI standards

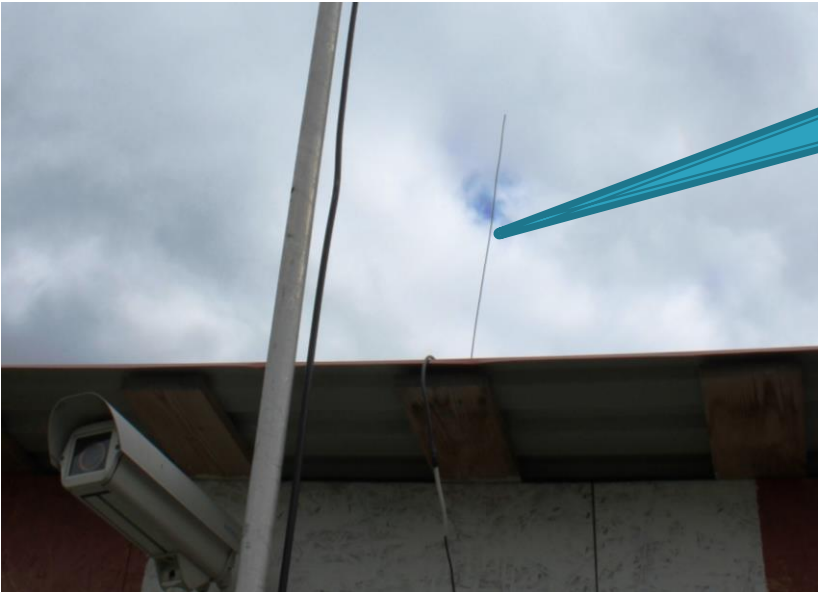
PTERO UA mobile control station



PTERO UA control box



ADS-B small-size ground mobile set (MMNK)



VHF rod antenna

Display unit (lap-top)



Pulsar M transponder

Power unit of Pulsar M transponder

ADS-B information on MMNK display

PTERO UA (22503) mark

Jabiru-450 aircraft (0326) mark

Ground control station mark

Log with aircraft call-sign and exceedence (ΔH)

Позывной	Код ICAO	Высота
0326	1048708	0.0
	-1	0.0
22503	1048675	0.0

Detailed information about aircraft

Выбранный объект	
Позывной	22503
Широта	54.781517028808594
Долгота	37.09024429321289
Путевой угол	72.24609
Расстояние	4.471766
Скорость	124.084 км/ч
Код ICAO	1048675
Время пакета	11:44:29.944
Геометрическая высота	582.16797 м
Геометрическая ...	0.0 м
Барометрическая высота	0.0 м/м
Барометрическая ...	0.0 м/м
Смещение высоты	-624.83997 м
Индикатор поворота	0
Точность:	
передачи координат	240
источника координат	10
измерения скорости	0

PTERO UA (22503) display on SONY pilot's tablet prototype via ADS-B channel

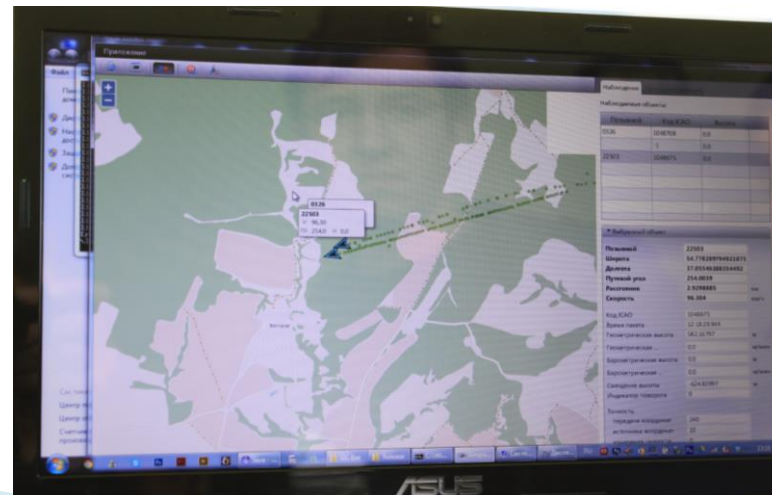
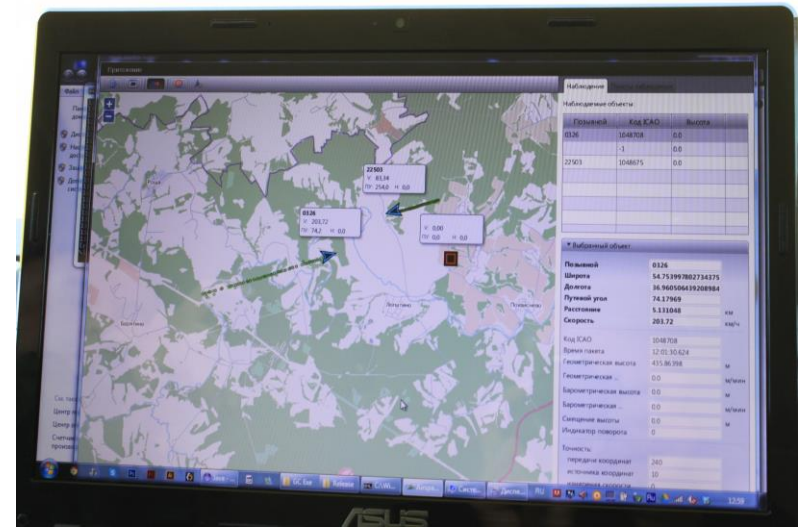
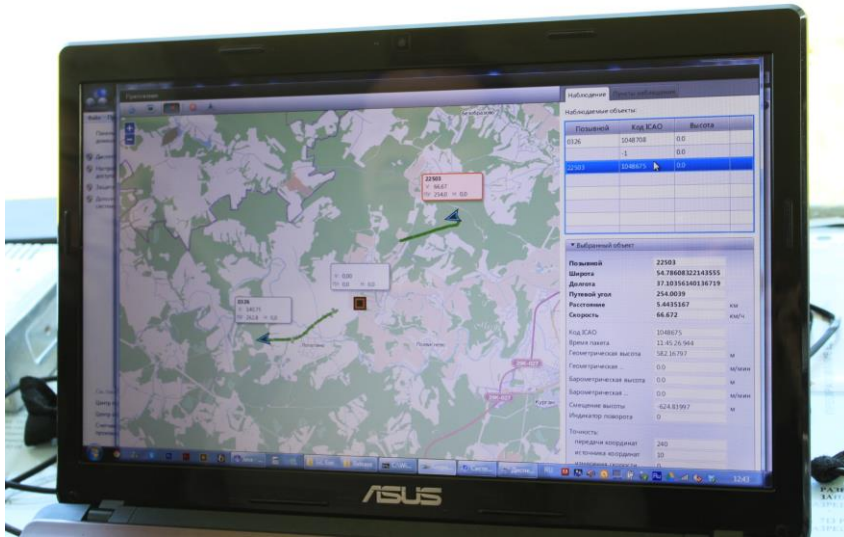


Ptero UA mark via ADS-B channel

Current range values

Mark of Jabiru-450 aircraft own position

PTERO UA (22503) and Jabiru-450 aircraft (0326) joint flights



ADS-B data displayed on the pilot's tablet during joint flights with PTERO UA



A snapshot from a camera installed on Jabiru-450 wing



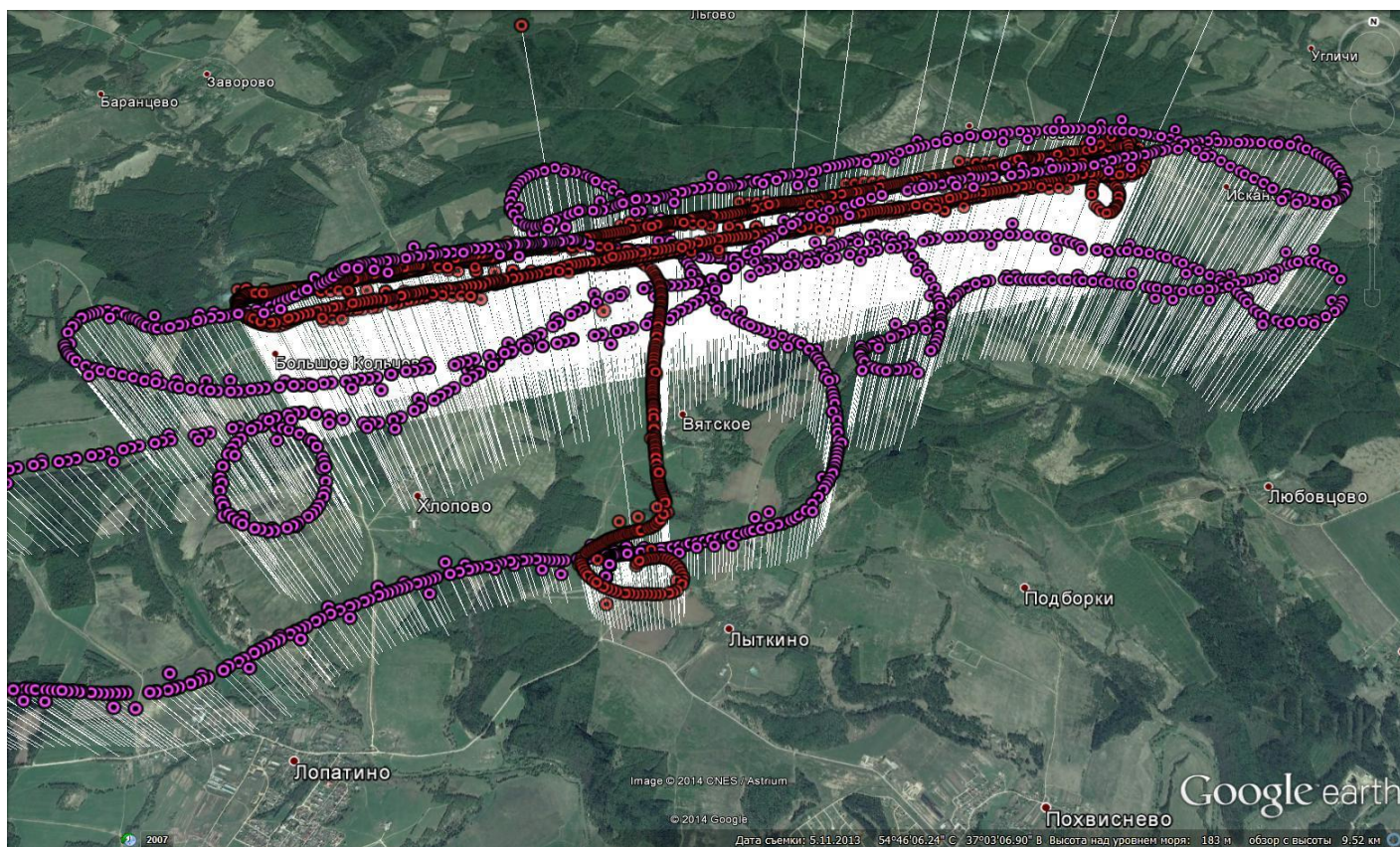
Ptero UA



PTERO UA landing



Tracks of PTERO UA (red) and Jabiru-450 piloted aircraft (crimson) flights on the results of the decoding of parameters (log-files)



Conclusions

- Sets of ADS-B onboard equipment installed on piloted and unmanned aircraft are functionally operative. Data exchange on “air-to-ground” and “air-to-air” datalinks with the aim of air surveillance is provided.
 - Acquired results proved the validity of taken design solutions in MGTR-4 and MMNK creation as well as transmittance management of ADS-B information to be displayed on pilot’s tablet prototype using Bluetooth technologies.
 - Positive results of the experimental studies confirmed the possibility of simultaneous airspace use both by piloted and unmanned aviation.
 - Acquired results may serve as a basis of future researches and developments.
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