**Mobili Orlaivių Sekimo Sistema (ADS-B TRAC)**

**Short description of the work**

ADS-B TRAC system is designed to receive ADS-B communication packets, that are mandatory in commercial aircraft. They include aircraft ID, GPS coordinates, altitude, velocity, planned trajectory etc. USA government has plans to make ADS-B transponders mandatory in every consumer drone under ~250grams. The ADS-B TRAC started out as a semester project at Electronics Engineering department of Kaunas University of Technology and was developed by students up to fully functional prototype stage.

Our ADS-B TRAC system is able to track aircraft in two methods:

1. ADS-B packet decoding method. Receive and decode ADS-B packets using only one device.
2. Multilateration method. Received ADS-B packets are processed in server and aircraft position based on packet arrival timestamp is calculated. This method requires at least four ADS-B TRAC units for 3D coordinate solution in a passive radar mode.

Our research goal is to assess aircraft tracking speed, resolution and precision using these two methods and explore possibility using this technology for high speed tracking of consumer drones and other types of aircraft in distance limited areas up to several km. range.

**Portable Aircraft Tracking System (ADS-B TRAC)**

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ADS-B TRAC sistema yra skirta priimti ir apdoroti ADS-B komunikacijos paketus, kuriuos privalomai siunčia visi komerciniai orlaiviai. Šie paketai apima orlaivio ID, GPS koordinates, aukštį, greitį, planuojamą trajektoriją ir t.t. JAV vyriausybė planuoja ADS-B siųstuvus padaryti privalomais kiekviename asmeniniame drone, sveriančiame iki ~250 gramų. ADS-B TRAC prasidėjo kaip semestro projektas Kauno technologijos universiteto Elektronikos inžinerijos katedroje ir buvo studentų išvystytas iki visiškai funkcionalaus prototipo etapo. Mūsų ADS-B TRAC sistema gali sekti orlaivius dviem būdais:

1. ADS-B paketų dekodavimo būdu. Gali priimti ir dekoduoti ADS-B paketus naudojant tik vieną ADS-B TRAC įrenginį.
2. Multilateracijos būdu. Priimti ADS-B paketai apdorojami serveryje, o orlaivio pozicija apskaičiuojama pagal paketo priėmimo momento laiko žymą. Šis metodas reikalauja mažiausiai keturių ADS-B TRAC įrenginių 3D koordinatėms gauti pasyvaus radaro režimu.

Mūsų tyrimo tikslas yra įvertinti orlaivių sekimo greitį, raišką ir tikslumą naudojant šiuos du metodus ir išnagrinėti galimybę naudoti šią technologiją asmeninių dronų ir kitų orlaivių aukšto greičio sekimui iki kelių kilometrų atstumu.

The following hardware and software solutions were developed by our team and implemented in the ADS-B TRAC modules:

1. ADS-B packet detector circuit operating at 1.09 GHz frequency range
2. Altera FPGA and high speed ADC based signal capture and decoding using cross-correlation operation
3. ESP32 microcontroller data packets aquisition and storage to microSD card, data representation on a color display and transmittion to an online database over WiFi connection
4. Initial ADS-B packet processing and precise timestamping in ADS-B TRAC unit implementing global GPS time base synchronization
5. Algorithm for multilateration position solution was selected and implemented in the server computer for aircraft visualisation in PC software.
6. Portable battery powered module modular solution in water resistant IP66 grade case. The modular solution allows to work in different frequency ranges if necessary.

**Novelty of the work**

Functional multilateration method based portable ADS-B TRAC solution prototype implementing FPGA and microcontroller with ability of precise time stamping of received data packets using GPS global time.

**Technical or other problems that are solved with the work**

Portable ADS-B tracking system ADS-B TRAC can find its use as a local solution for drones equipped with ADS-B transponders tracking and in those cases when any aircraft does not transmit global coordinate in the ADS-B message.

**The benefits and value to the potential users**

Integrated modular portable solution ADS-B TRAC with ability to track, process and time stamp the arriving ADS-B packets and to store the data in Internet server for analysis, visualisation and long-term storage. The prototype solution is offered in a water resistant case with ability to operate autonomously up to two hours and from 12-15V external power supply.

**What is the novelty of your work? (up to 120 words) | Darbo naujumas? (iki 120 žodžių)**

The novelty of the work is based on the embedded solution of the tracking system which possesses a flexible ability to discriminate required signals or patterns in the selected frequency band, assign a unique high resolution time stamp to the decoded packet using the GNSS synchronized or local time reference.

**Level of technological readiness**

**TRL 6-7** technology demonstrated in relevant environment with a near future plan to be demonstrated in operational environment

**Are you planning to develop (creating a Start-up / Spin-off company, licensing, etc.) this idea? | Ar planuojate plėtoti šią idėją (kurti startuolį / Spin-off'ą, licencijuoti ir pan.)?**

**Ne**