



# Satellite-UAV cooperative missions

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# Contents

- Cooperative missions
- Research areas of AGAI/VGTU
- Conclusions

# Aim

- To present the achievements in the area of Space-UAV cooperative missions of AGAI/VGTU.

# **An unmanned aerial vehicle (UAV) as a part of unmanned aviation systems (UAS)**

Satellite–UAS collaborative missions can be defined as any mission where the satellite and the UAS extend the capabilities of each other.

## Sources on cooperative missions used in presentation

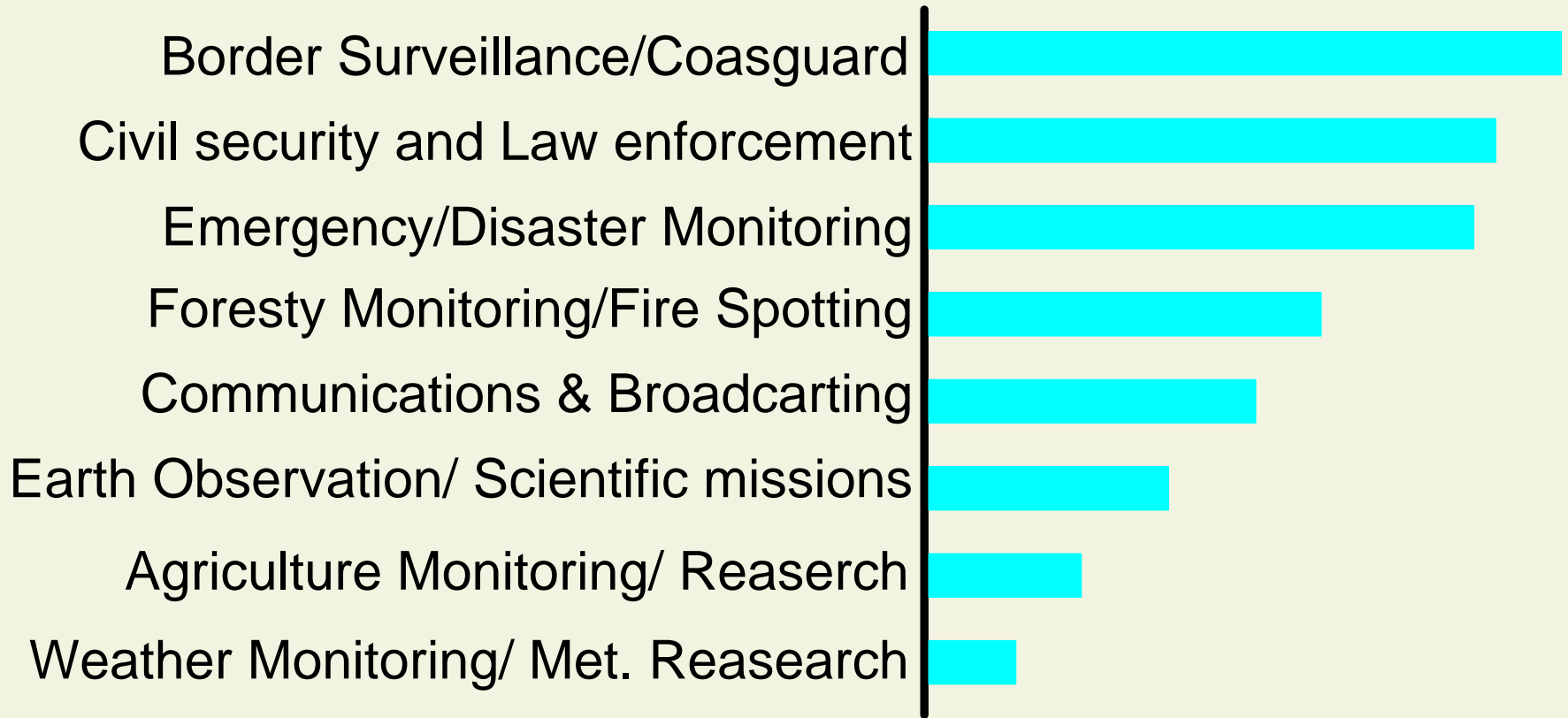
- D.C. Vuilleumier, J.B. Masferrer and J. Cherkaoui in the material of the Workshop on Unmanned Aerial Systems (UAS) and Satellite Services “SATELLITE-UAV COOPERATIVE MISSIONS: STATUS AND OUTLOOK” (ESTEC (Noordwijk), 27-28 May, 2009).
- “Enabling Americas Next Generation of Aviation Vehicles”- 2004 NASA ICNS Conference and Workshop, April 26-30,2004].
- Aviation Authorities of many countries (USA, UK, France, EUROCONTROL/JAA, Canada, Australia, Asian States, South America, etc.) issued regulations for UAV’s.
- ICAO guidance materials for UAS Specifics with respect to existing ICAO SARP’s/Guidance [ICAO CIRCULAR ON UNMANED AIRCRAFT SYSTEMS].

## Strengths of one system can balance weakness of the other system:

Characteristic	Satellite	UAS
Areas Coverage	Better	Worse
Resolution (e.g. atmospheric effects on resolution)	Worse	Better
Availability (when and where required)	Worse	Better
Flexibility (to change mission parameters, type of payload ...)	Worse	Better
Real Time (direct use of data and response time of the system)	Worse	Better
“Pre-conflict” data availability	Better	Worse
Maintainability and upgrade of the system and payload	Worse	Better
Data/Service Cost to Users	Better	Worse
Heterogeneity of quality for the service	Better	Worse

D.C. Vuilleumier, J.B. Masferrer and J. Cherkaoui “SATELLITE-UAV COOPERATIVE MISSIONS: STATUS AND OUTLOOK”, 2009.

## UAS missions requiring satellite services are provided in the following priority sequence:

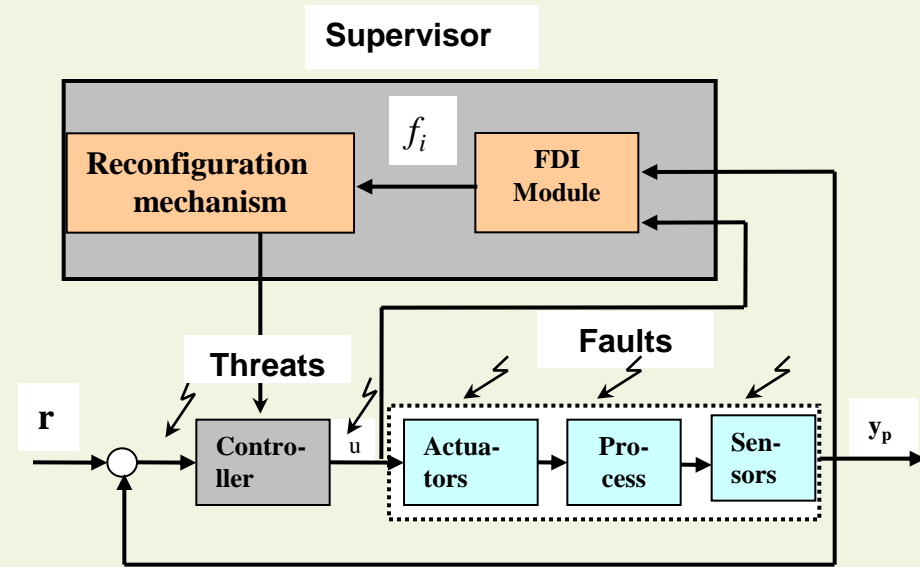
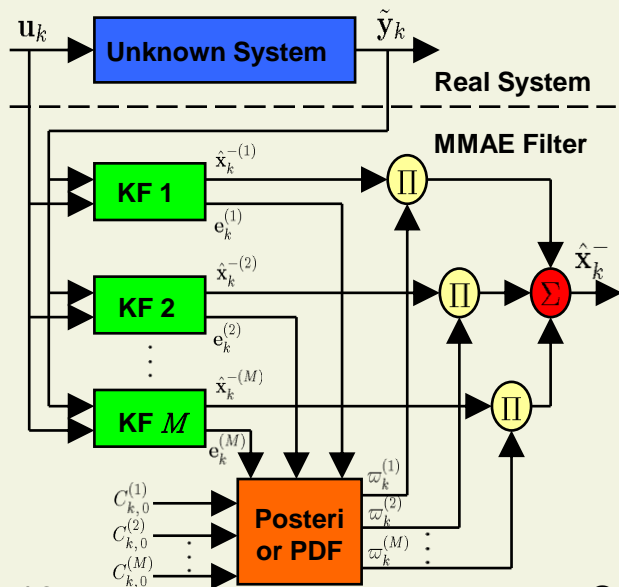


D.C. Vuilleumier, J.B. Masferrer and J. Cherkaoui "SATELLITE-UAV COOPERATIVE MISSIONS: STATUS AND OUTLOOK", 2009.



## Security analysis for aircraft integrated diagnostics systems

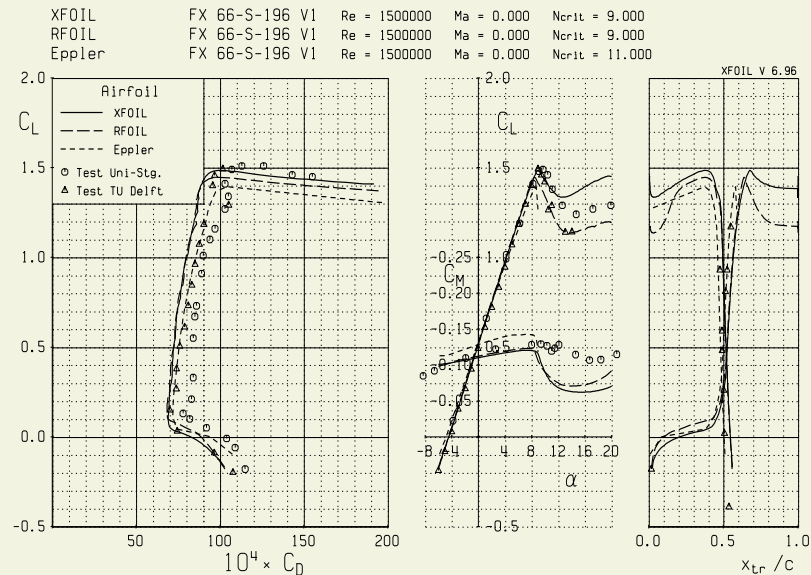
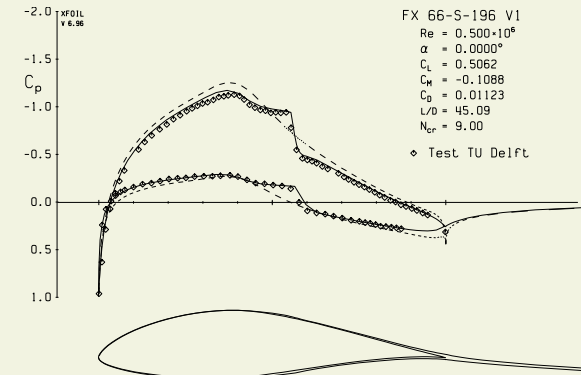
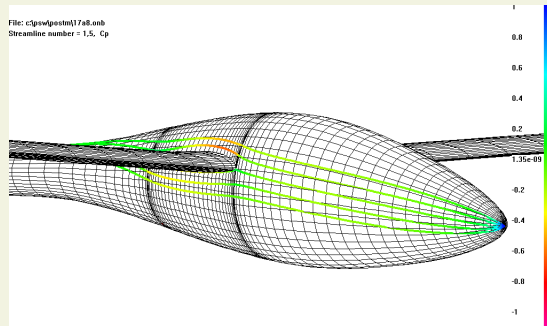
- Aircraft health management integrated system
- Fault detection and isolation techniques



- Security method for measurement data transfer

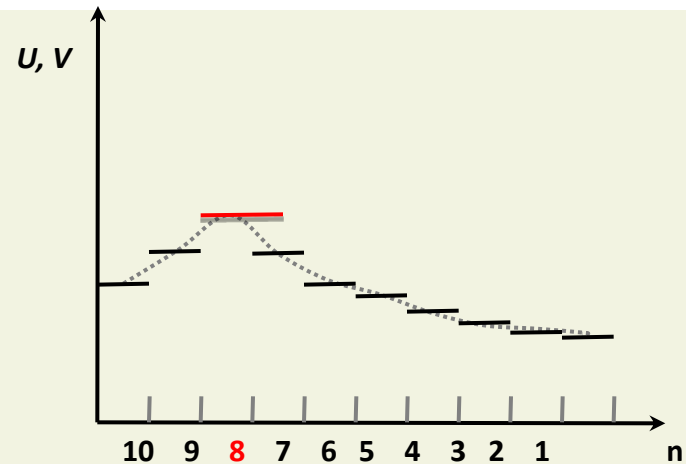
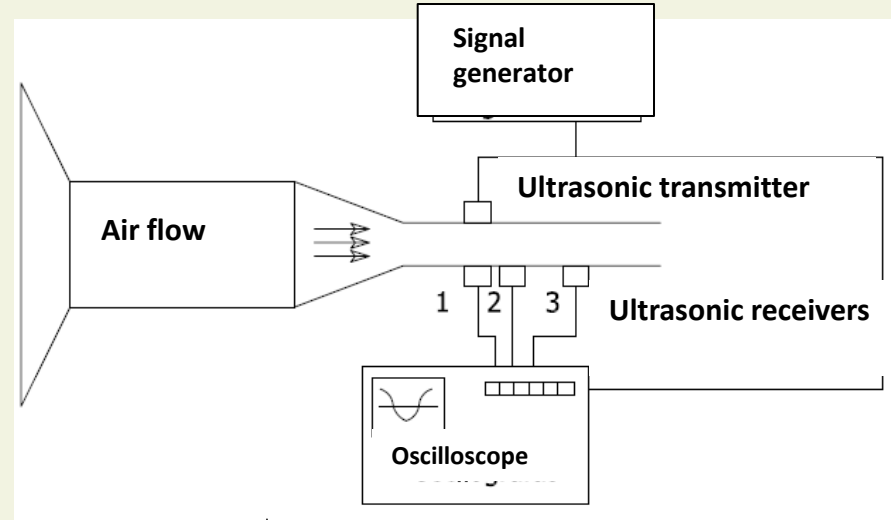
## Aerodynamic design of high performance UAV

- UAV airfoils characteristics (Eppler-program, XFOIL, RFOIL, MSES)
- UAV stability and control (VLA, VLAERO)
- UAV wing and plane 3-D configuration (PSW, KK-Aero)
- Computational Fluid Dynamics (CFD) analysis (Fluent)



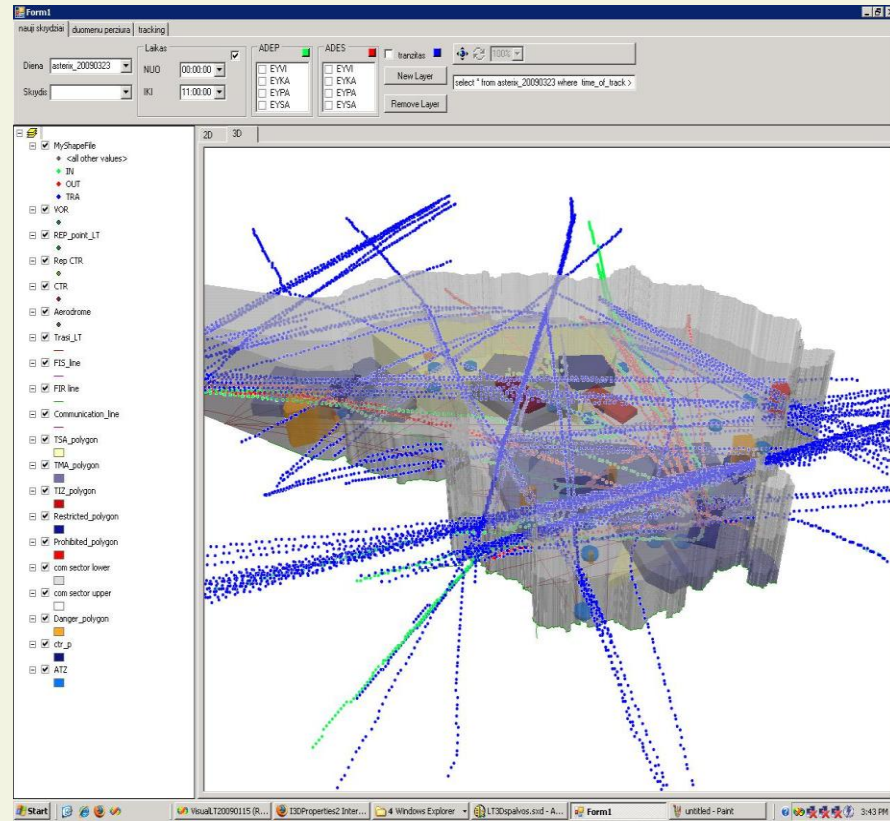
## Ultrasonic flow rate measurement methods

- Research on the application of ultrasonic waves in the gas flow



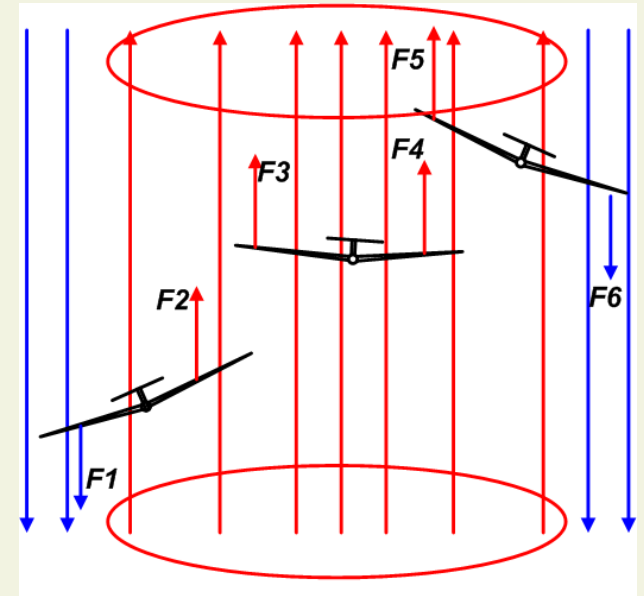
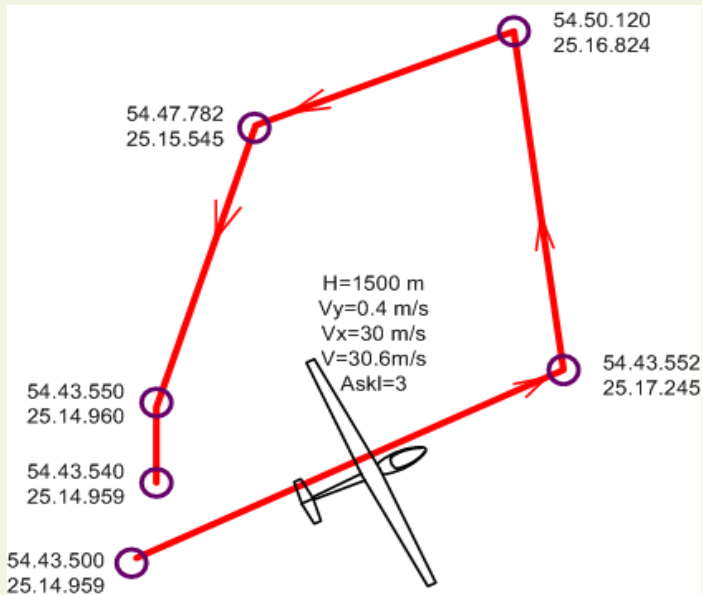
## 3D flight trajectory presentation

- Analysis of manned aircraft flows in airspace
- Modelling of UAVs and manned aircraft flows in airspace
- Aircraft flow visualization in three-dimensional airspace



## Research on artificial neural networks for UAV control

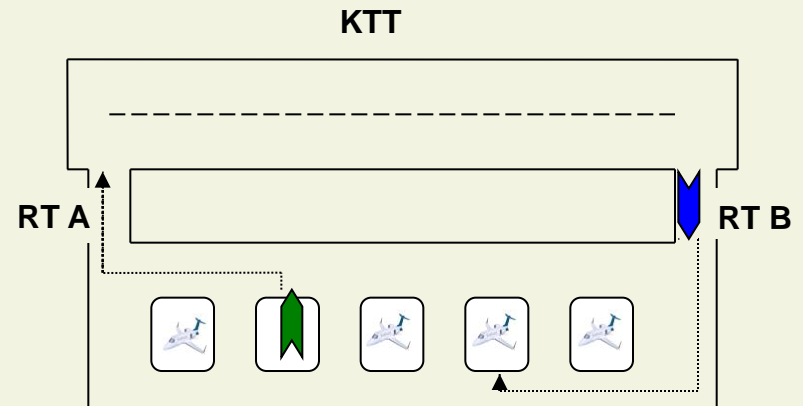
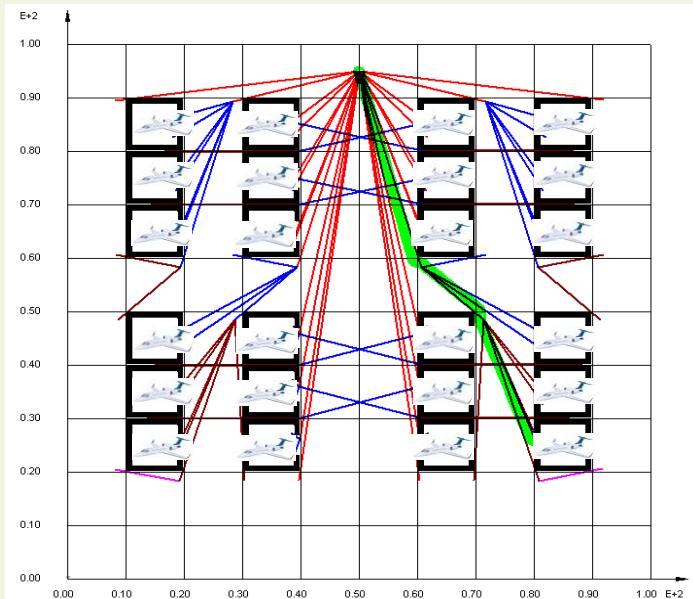
- Rising air flow identification research using artificial neural networks



- Modelling of artificial neural network applications for UAV control algorithms

## Research on flight control procedures in common airspace for manned and unmanned aircraft

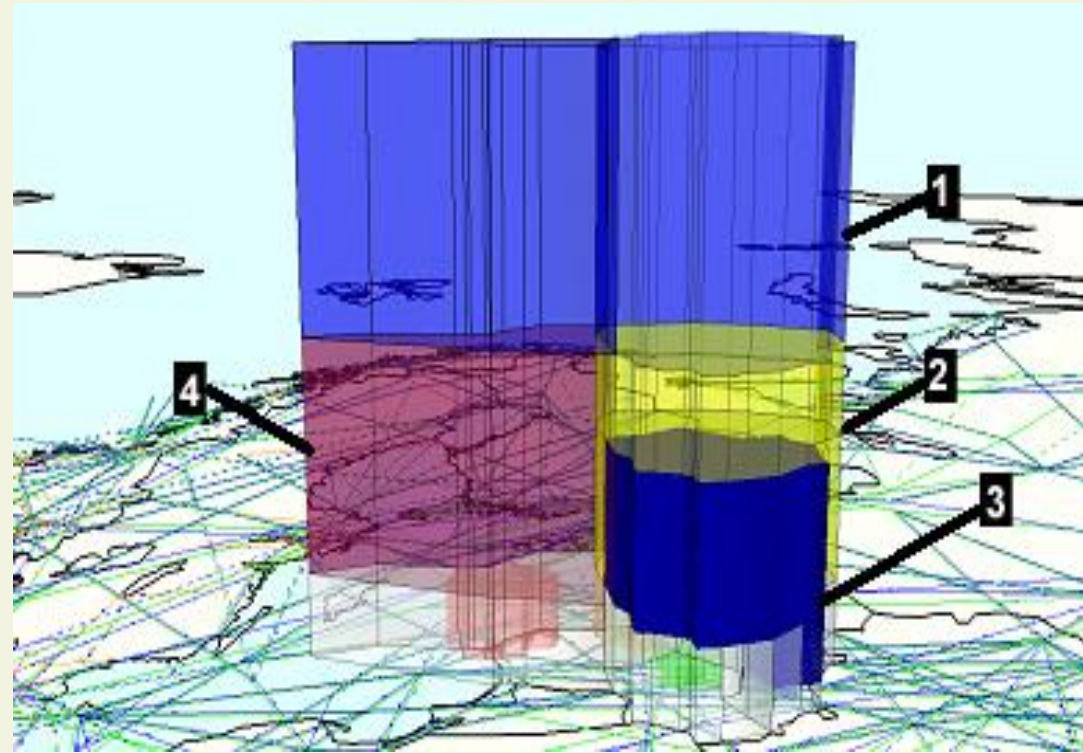
- Research on interaction of manned aircraft and UAVs in common airspace
- Aircraft flow simulation using coloured Petri network



- Development of flight control procedures for manned aircraft and UAVs

# Analysis and experimental research of several scenarios of the Lithuanian airspace models

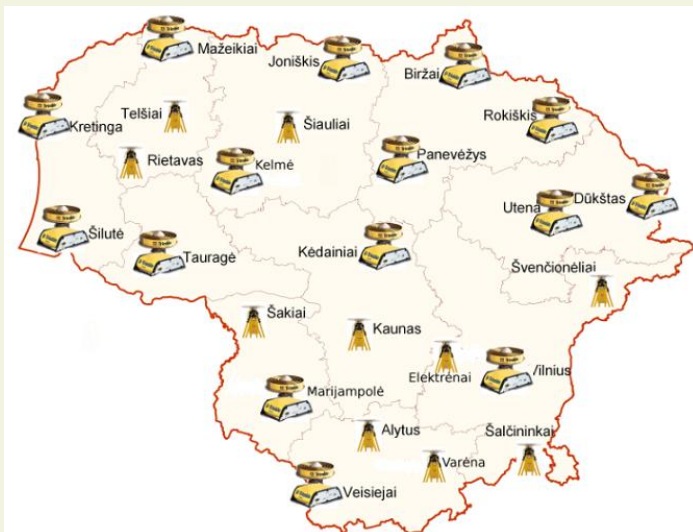
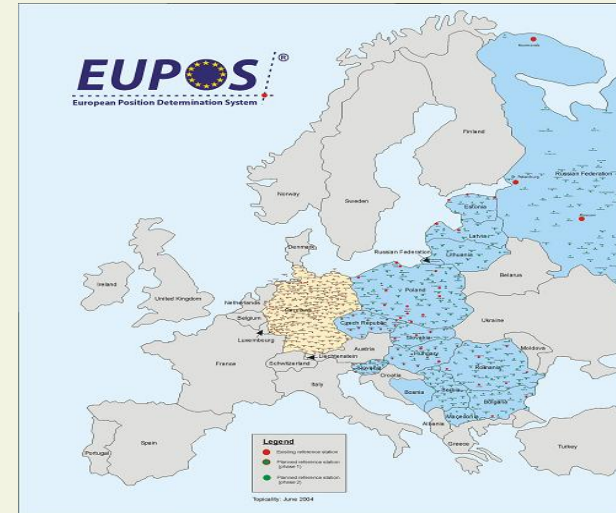
- Research and analysis on the demand for air navigation services in the airspace Lithuania
- Airspace segmentation modeling



Reorganization of Lithuanian Airspace

## LitPOS – a service for precise positioning in real time

- LitPOS (Lithuanian Position Determination System) – the state network of permanent reference GNSS stations is operational from July 2007. It provides data both for the real-time and post-processing applications.

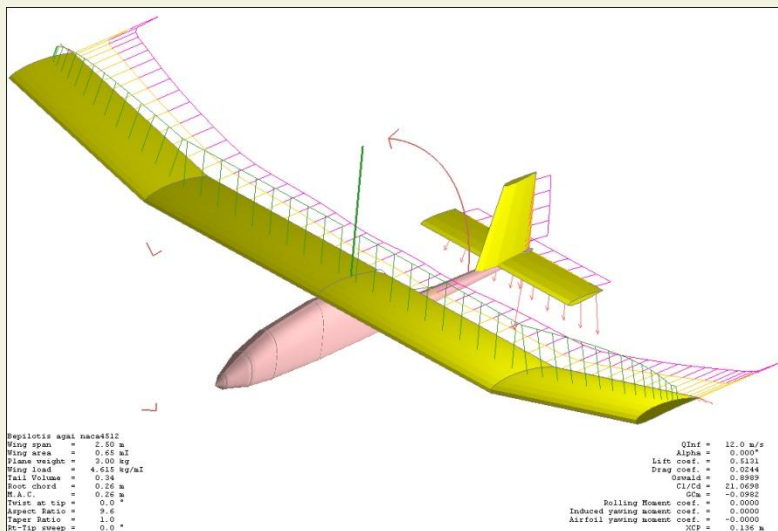
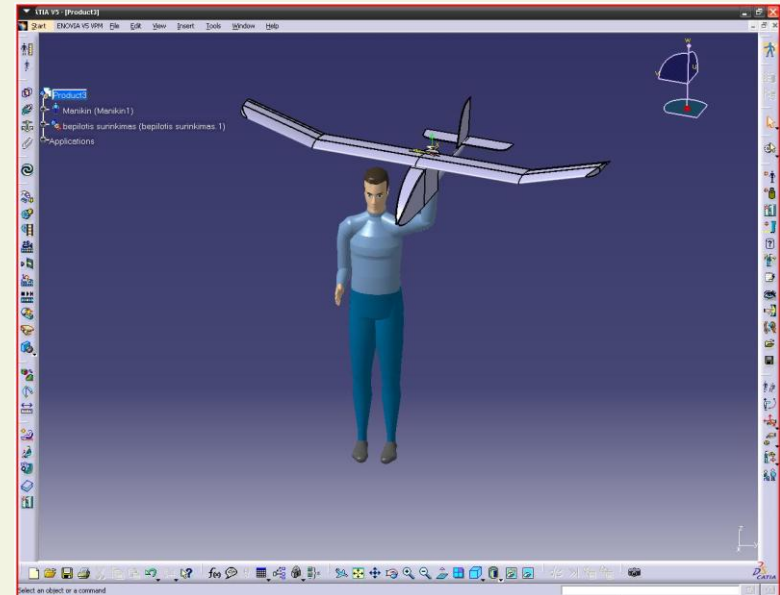


- LitPOS stations cover the all territory of Lithuania. Total number of GNSS stations is 25.
- The integration of some stations of neighbouring countries is foreseen. It is possible on the basis of cooperation in EUPOS® (European Position Determination System ) project.



## Progress of research project in AGAI/VGTU

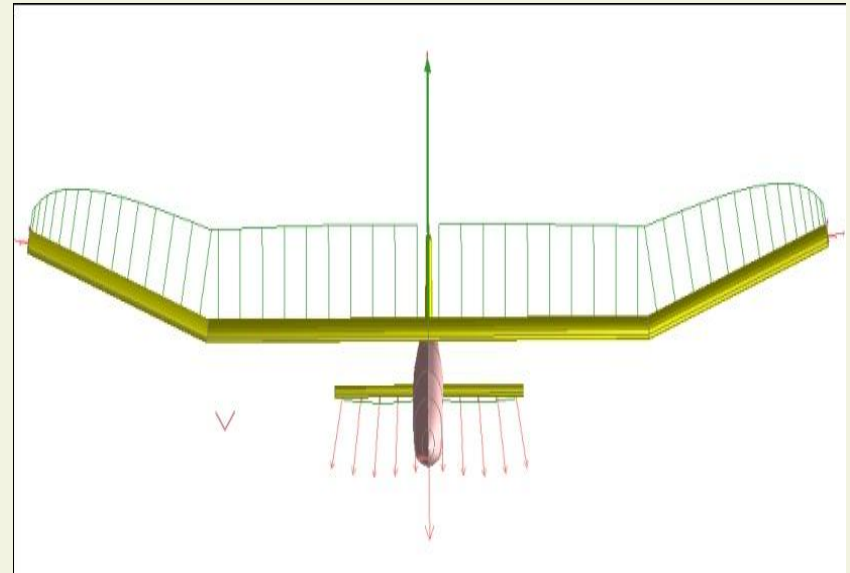
- Since 2001 VGTU has been participating in the project UAV-NET of the programme FP5
- VGTU is a partner of UAV-NET consortium established in 2005



- Self-made construction UAVs are being created to evaluate the results of practical experiments in the field of UAV.

## Progress of research project in AGAI/VGTU

Wing Span	2 m.
Maximum Takeoff Weight	3,2 kg (7,05 Lbs)
Payload	0,7 kg
Flight time	45 min.



# Conclusions

1. Applications of UAS contributes to the development of satellite technologies.
2. Application of UAS–satellite cooperation programme is relevant for Lithuania and the Baltic region.
3. Ongoing research themes of VGTU are capable of solving urgent problems of UAV-satellite systems.

# Thank you for your attention!



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