Tomasz Rogalski

In-Flight Tests in Students Projects

EWADE & READ 2018
EWADE 2018 - 14th European Workshop on Aircraft Design Education
Brno University of Technology, Czech Republic
7th to 9th November 2018

EWADE Session
08.11.2018, 14:10 to 15:50
Origins of Flight Tests...

Aviation, science, education, flying laboratories for in-flight tests existed at Mythic Age already.

- Aviation
  - Myth
- Science
  - Concept
- Flying Laboratory
  - Wings
- Education
  - Lesson learned
There are lots of flying laboratories used in science and education activities in the World at present:

- aircraft
- balloons
- rockets
- helicopters
- and many others
There are lots of flying laboratories used in science and education activities in the World at present

- Cranfield University
- Delft University of Technology
- Technical University of Munich
- Technical University of Pensylvania
- and many others
Why Do They Use Flying Laboratories?

- Efficiency
- Real experiment condition
- Attractiveness
- Real facilities and devices
- Other...
What Fields Can We Use it On?

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<th>Aircraft on-board Equipment</th>
<th>Flight Aerospace Control Systems</th>
<th>Flight Instrument</th>
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<td>Durability and Diagnostics of Aerospace Devices</td>
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<td>other</td>
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Where in Education Can We Use it to Conduct In-Flight Tests?

- Regular student lessons
- Student projects
- Diploma projects
- Doctoral student research
- Other student activity
Scope of the Presentation

Not to

• present structure of flying laboratories
• present their development process
• answer the question: how, when, where, who developed them.

To

• give specific samples of usage flying laboratories in flight tests in education
• present possibilities their applications
• familiarization with flying laboratories

AND

• to down some myths
Some Myths Should be Downed

- In-flight tests are always very expensive
- Flying laboratory is always very sophisticated facility
- In-flight tests require staff having extraordinary skill
- There is no possibility to involve them into standard student courses
Let’s Start from the General Structure …

**Platform**
- Sensors
- Recorders
- Radiolink
- Control systems

**Airborne part**

**Ground control Station**
- Health monitoring
- Data visualization
- Radiolink
- Data recorders
- Post-flight data processing
Optionally Piloted Vehicle

- MTOW 495kg
- Max. Airspeed (Vne) 270 km/h
- Min. Speed 65 km/h
- 2 seats
Optionally Piloted Vehicle

Research and education

• flight tests of control laws for ultralight aircraft
• tests of heavier onboard equipment
• activities for 4 students at the same time – two person on board the aircraft and two persons in the car (ground station)
• relatively low operating costs

Limits

• only two students on board
### Title
- Aircraft handling qualities assessment in selected flight phases

### Author
- Student of Aviation Faculty

### Objectives
- In-flight test maneuvers preparation
- In-flight experiments and data analyzes

### Content
- Handling characteristic during typical flight phases (horizontal flight, coordinated turn).
- Static and dynamic stability tests.
- Aircraft characteristics during landing at different configurations.
Optionally Piloted Vehicle – Diploma Project
Longitudinal Stability Tests

- Pitch angle vs time
- Flight altitude vs time

pilot’s input

K A I S

KATEDRA AWIONIKI I STEROWANIA
Piper Seneca V

- MTOW: 2155 kg
- Never exceed speed: 378 km/h
- 6 seats
Research and education

- flight tests of control laws for general aviation planes
- tests of heavier onboard equipment
- activities for small group of students – six persons on board the aircraft

Limits

- the higher operating cost
- MEP(L) pilots rate required
• Investigation of general aviation aircraft performances

• student of Aviation Faculty

• in-flight test maneuvers preparation
• In-flight experiments and data analyzes

• Max speed at horizontal flight investigation
• Climb rate investigation
• Stall speed investigation.
General Aviation Plane – Diploma Project

Climb Rate Tests

Original recorded data
Gliders

• MTOW: about 500 kg
• Never exceed speed above 200 km/h
• 1 or 2 seats
Research and education
• flight characteristics investigation
• portable devices tests
• low operational costs - cheap in use

Limits
• only one student on board
• non complex devices applied

Symbols pointing airbrakes positions (PW-6)

Portable flight data recorder (Puchacz)
Title
• Investigation of airbrakes efficiency

Author
• student of Aviation Faculty

Objectives
• Investigation of airbrakes efficiency
• In-flight experiments and data analyzes

Content
• Investigation of airbrakes efficiency during flight at different airspeeds
• Tests done for different types of gliders
• Reports about test flights
Gliders – Diploma Project

**Title**
- Investigation of G-force during glider aerobatic flight.

**Author**
- Student of Aviation Faculty

**Objectives**
- Investigation of G-force magnitude
- In-flight experiments and data analyzes

**Content**
- Problem statement
- Equipment development
- In-flight tests done
- Reports about test flights preparation
Investigation of airbrakes efficiency

Gliders – Diploma Project

Results of Flight Tests

G-force during loop maneuver

Airbrakes impact onto sink rate

„Investigation of G-force during glider aerobatic flight”

„Investigation of airbrakes efficiency”
Non Complex RPAS Sets

- Idea
- Non complex platform
- Supplementary devices
Non Complex RPAS Sets

Motorglider Cularis

Penguin

Sky Walker

Diagram showing the connection between Motorglider Cularis, Penguin, and Sky Walker.
Non Complex RPAS Sets

Research and education

• flight tests of control laws for small unmanned aerial vehicles
• identification and verification of a mathematical model of small flying constructions
• tests of small onboard equipment
• flight tests of remotely piloted systems in high-risk situations
• activities for big group of students
• training operators of unmanned aerial vehicles
• very low operating costs

Limits

• strong dependency on weather conditions
• too little space for additional equipment
Courses:
- aircraft control systems
- flight recorders and data analyses
- aviation radio systems
- In-flight tests
- aerodynamics
- ...
Conclusion

For these reasons flying labs are welcome solutions