



Escuela Superior de Ingenieros (US)

Aeronautical Engineering Studies in the University of Seville

Damián Rivas Rivas
Aerospace Engineering
Group of Aerospace Vehicles





Location



School of Engineering

Laboratories



Escuela Superior de Ingenieros (US)

The Engineering School





ESCUELA SUPERIOR DE INGENIEROS

4 main programs:

- Industrial engineering (mech., electr.)**
- Telecommunication engineering**
- Quemical engineering**
- Aeronautical engineering**





AERONAUTICAL ENGINEERING PROGRAM

5-year program (similar to ETSIA's)

Started in 2002/03

Multidisciplinary:

- Aircraft Design**
- Space Vehicles**
- Air Navigation**
- Air Transport**
- Airport Design**





Especialities (Options)

- Aircraft and Space Vehicles**
- Aeronautical Manufacturing**
- Air Transport Infrastructures**

(3rd, 4th, 5th years)





R&D at ESI(US)

Group of Elasticity and Strength of Materials

Group of Robotics, Vision and Control

Group of Aerospace Vehicles



Group of Elasticity and Strength of Materials

School of Engineering
University of Seville

<http://www.esi.us.es /AICIA>



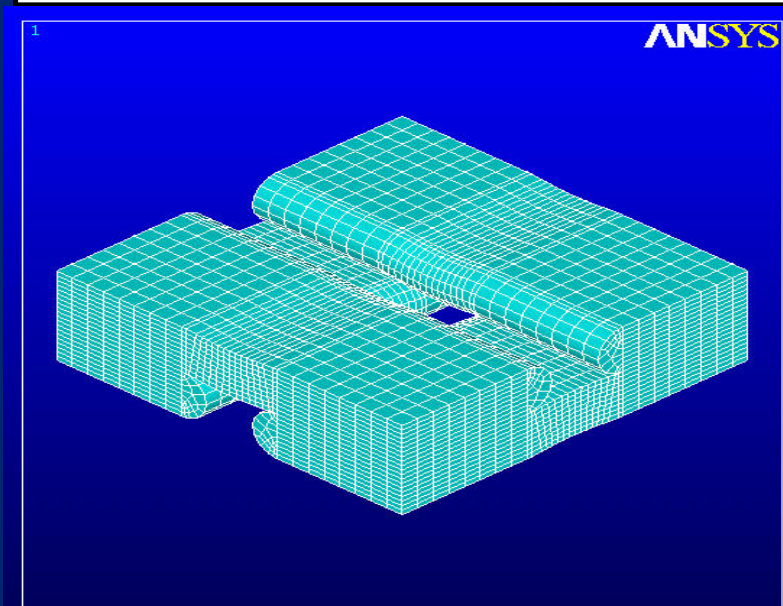
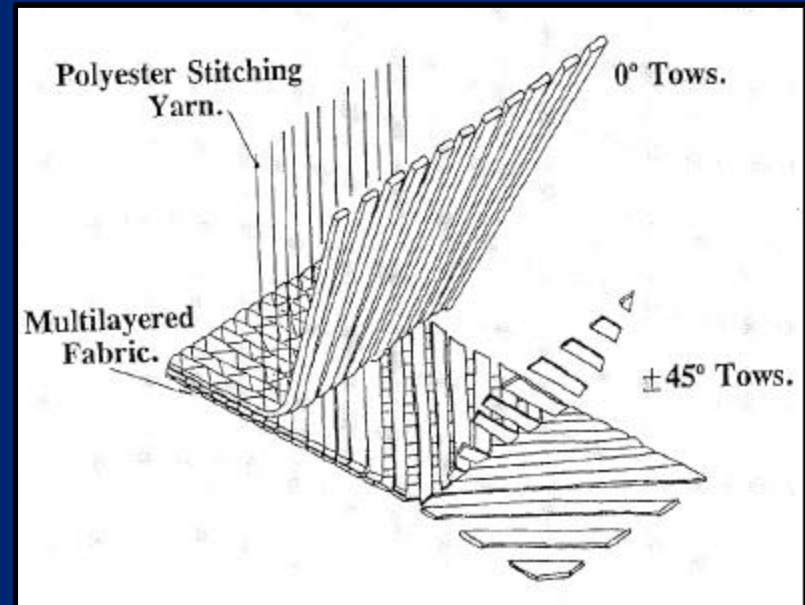
Research

COMPOSITE MATERIAL



FALCOM PROJECT

- European Project for the study, characterization and future applications of **non-crimp fabrics**
-
- 20 partners involving Aerospace industries, Research Centers and Universities
- The role of AICIA in the Project is to perform a meso-mechanical finite element model to predict the properties and damage mechanism of the material



Research Projects. ALCAS

Advanced Low Cost Aircraft Structures

Objective:

- the design of an aircraft wing in composite materials

Purposes:

- Saving weight
- Decreasing fabrication costs
- Saving in maintenance

Participants:

~ 70 European entities, leaded by AIRBUS and DASSAULT-AVIATION

Countries:

Germany, France, Norway, Spain, Italy, Russia, Holland, Belgium, Portugal, Israel

Laboratory of Elasticity and Strength of Materials



Activity

Mechanical and Physical Tests performance for qualifying, receipting and re-qualifying mechanical, composite or adhesive materials.

Scope

✍ Aeronautic Industry



Accreditations, Certifications and Approvals

- ✍ 1998 SACESA approved AICIA-GERM for reception and re-qualification tests of pre-pregs and adhesives according to CASA 1205-04G.
- ✍ 2000 Certified by ENAC according to UNE-EN ISO/IEC 17025:2000 for metallic, composite and adhesives tests (Certificate Nº 248/LE553)
- ✍ 2002 EADS-CASA MTAD approved AICIA-GERM for metals test performance · Supplier Nº10465 and Quality Sistem A-2.
- ✍ 2003 EADS-CASA approved AICIA-GERM for Fatigue, Hardness and Conductivity Tests.
- ✍ 2003 EQA certificated AICIA-GERM in ISO 9001:2000 and EN 9100 (Aerospace sector).
- ✍ 2003 Approved by Sikorsky for mechanical test performance in metals.
- ✍ 2003 Bombardier approval in progress
- ✍ 2004 Approved by Boeing for mechanical tests performance in metals.



Laboratory of Elasticity and Strength Materials



Customers:

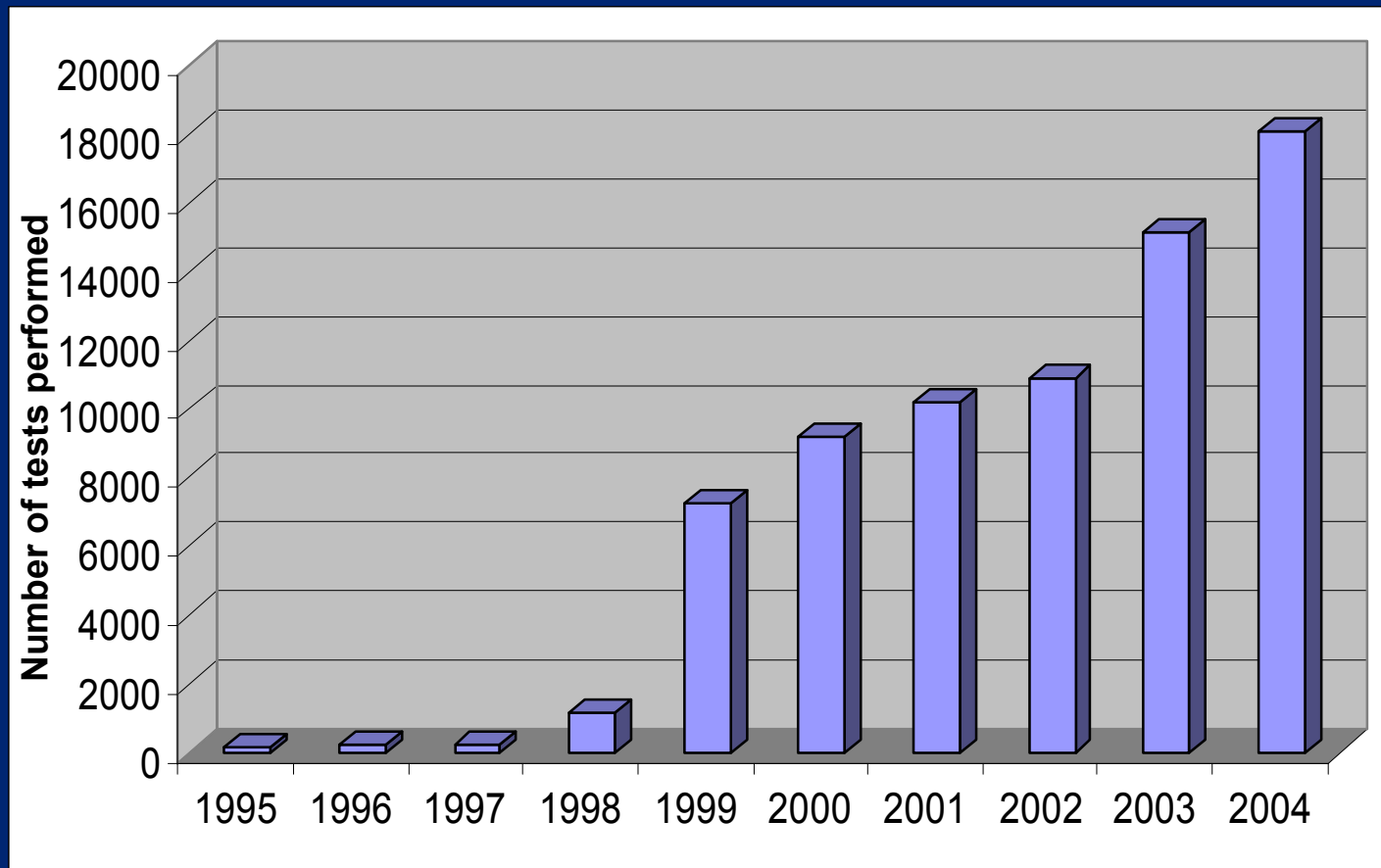
-  **AIRBUS I+D (Getafe)**
-  **AIRGRUP (Seville)**
-  **ARIES COMPLEX (Madrid)**
-  **CASTLE AERO**
-  **COMPOSYSTEM (Madrid)**
-  **EADS_CASA Factory of Puerto de Santamaría**
-  **EADS_CASA Factory of Tablada**
-  **EADS_CASA Space Division**
-  **INTERNACIONAL DE COMPOSITES (Toledo)**
-  **MACPUAR COMPONENTES MECANICOS (Sevilla)**
-  **MACPUARSA (Sevilla)**
-  **MECANIZACIONES AERONÁUTICAS S.A. (Logroño)**
-  **MEUPE (Seville)**
-  **SACESA (Seville)**
-  **SK10**



Laboratory of Elasticity and Strength of Materials

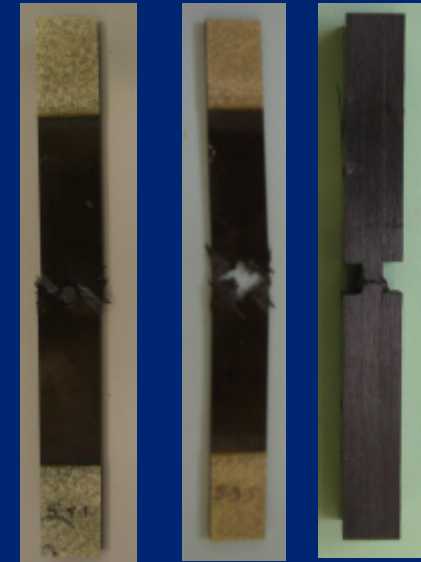
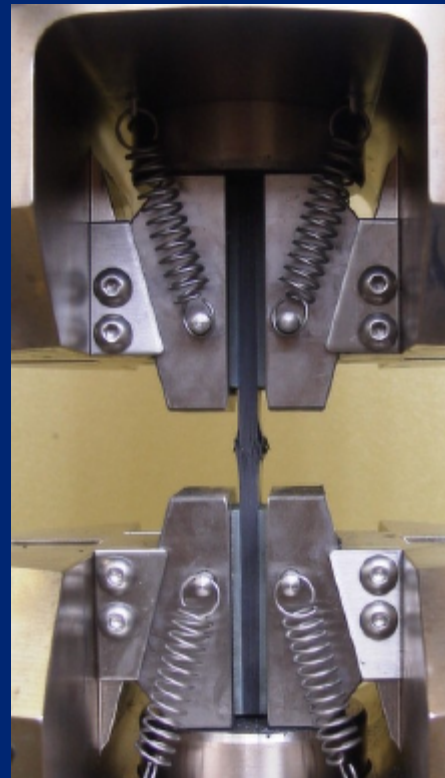


Number of tests

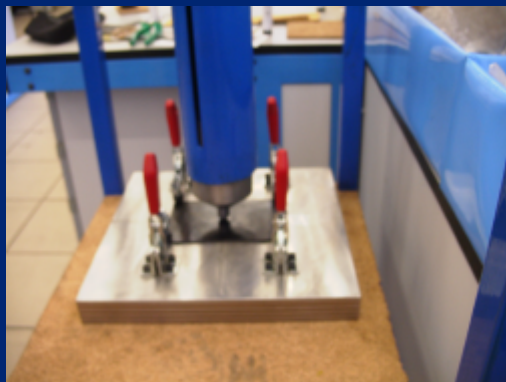


EXPERIMENTAL WORKS



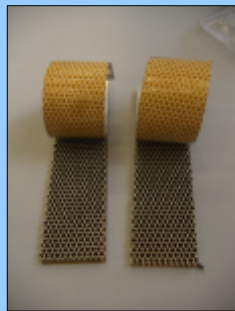
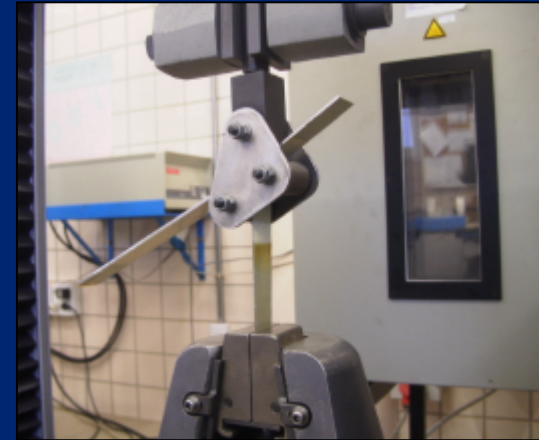
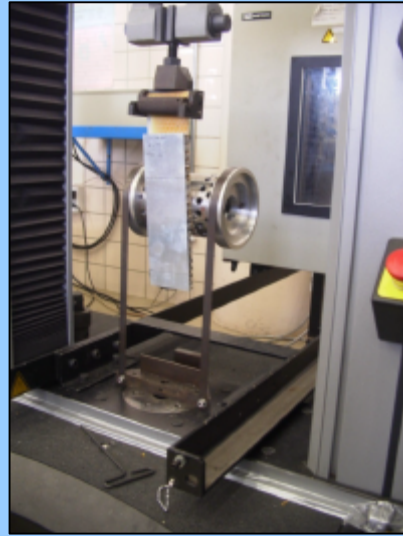


Material : Carbon Panels by Fiber Placement



Material : Carbon Panels by Fiber Placement

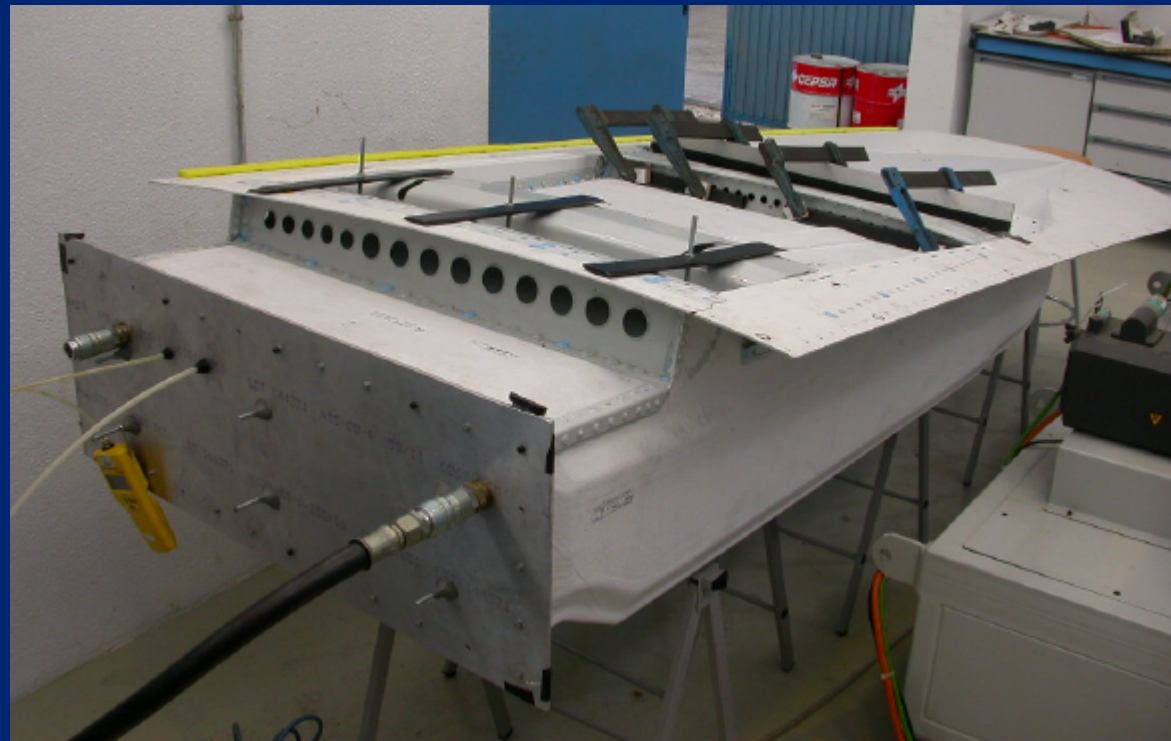
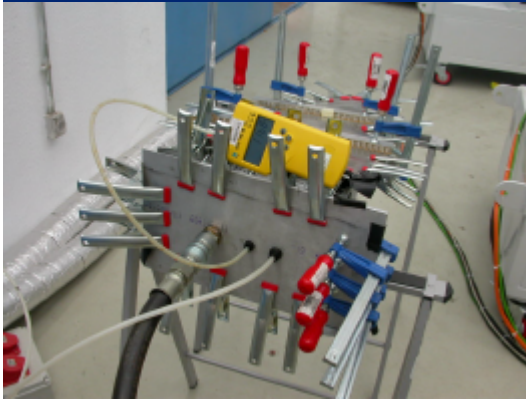
Adhesive Tests



Damage Tolerance



Test in Cooling Ducts



Facility Test

✍ Vibratory



Vibration test. Supplemental Cooling Airbus A380

Facility Test

✈ Endurance (Pressure and Temperature)



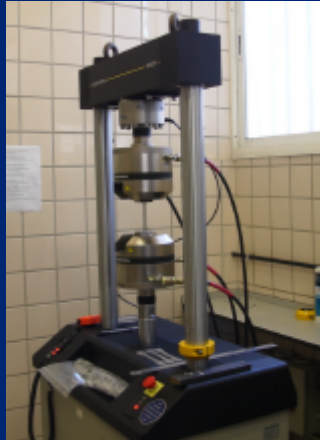
Mechanism fatigue test. AGU NACA Airbus A380



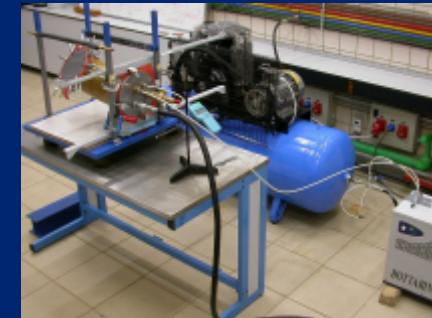
Pressure fatigue test.

TEST FOR AIRBUS A380

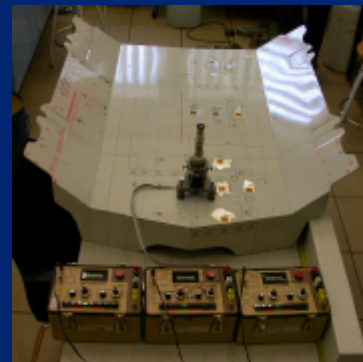
Metálicos



System



Composites



Elements

Unmanned Aerial Vehicles

COMETS. Real time coordination and control of multiple heterogeneous unmanned aerial vehicles.

**EUROPEAN COMMISSION.
INFORMATION SOCIETY TECHNOLOGIES**

IST PROGRAMME, 2001- 34304, 2002-2005.

**7 partners from Spain, France, Germany, Sweden
and Portugal.**

Scientific and Technical Coordination of the project.

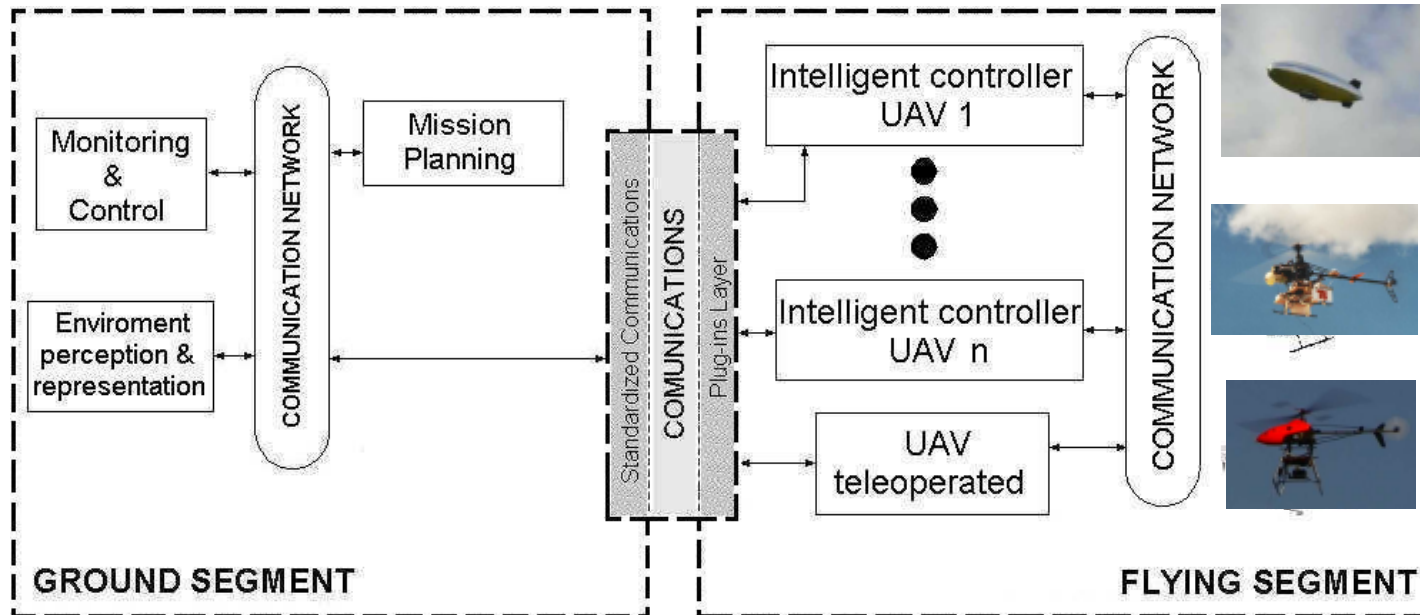
COMETS activities:

- **Architecture.**
- **Control centre: Mission planning & monitoring, simulation, teleoperation.**
- **Distributed control: autonomous flying systems.**
- **Distributed sensing techniques and real-time image processing capabilities.**
- **Experimentation: Forest fire application.**



Coordination of multiple heterogeneous UAVs

The COMETS system



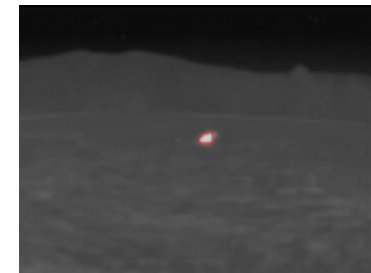
Multi-UAV systems: provide information from different points of view

Blimp: panoramic views

Autonomous helicopter and teleoperated helicopter: detailed views

Unmanned Aerial Vehicles

- Application to fire detection.
 - Visual detection: Colour, Smoke
 - Infrared detection



Alarm !!



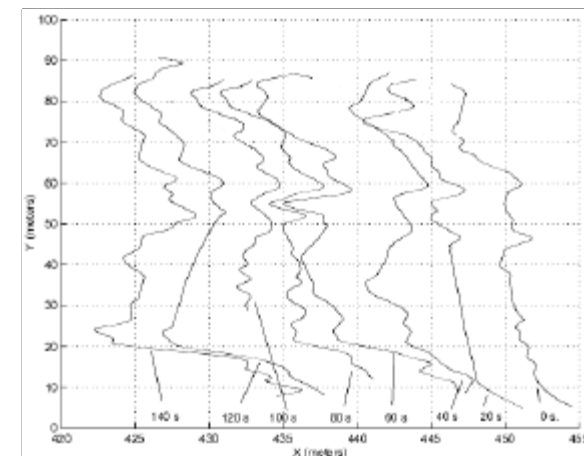
False alarm



Localisation: Position of alarms transmitted to CC

Alarm tracking: Uncertainties in alarm position iteratively reduced

- Application to fire monitoring.



Unmanned Aerial Vehicles: Autonomous Helicopter prototypes



Unmanned Aerial Vehicles

CROMAT. Coordination of Aerial and Ground Unmanned Vehicles.

SPANISH NATIONAL R&D&I Programme. DPI 2002-2005.

Coordination of the National project (3 Universities).

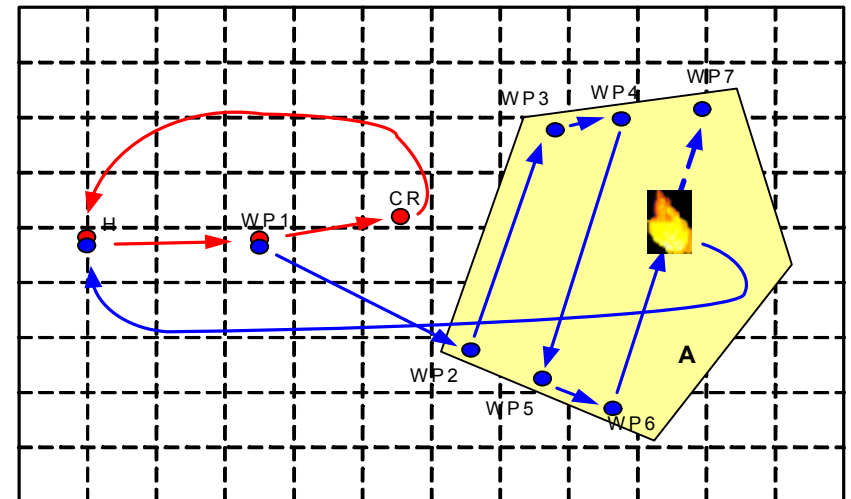
Integrated System Autonomous helicopter- Autonomous tractor-trailer vehicle.



UAV-UGV cooperation



CROMAT project



CROMAT experiments

Seville, March 2005

Unmanned Aerial Vehicles

HELINSPEC.

PLADIT, Junta de Andalucía, 2004-2005.

Autonomous helicopters for inspection.

Infrared inspection



- Tele-robotic techniques.
- Computer vision and image processing
- Experiments: Thermal inspection of buildings.

Airplane Testing.

Projects funded by EADS-CASA:

- **Ground automatic testing of airplanes (2000-2001).**
- **Testing Automation in the Aeronautic Industries CATS I and II (2002-2003).**
- **Distributed automatic system, 2004-2005.**
- **A400M Testing system, 2005-2006.**

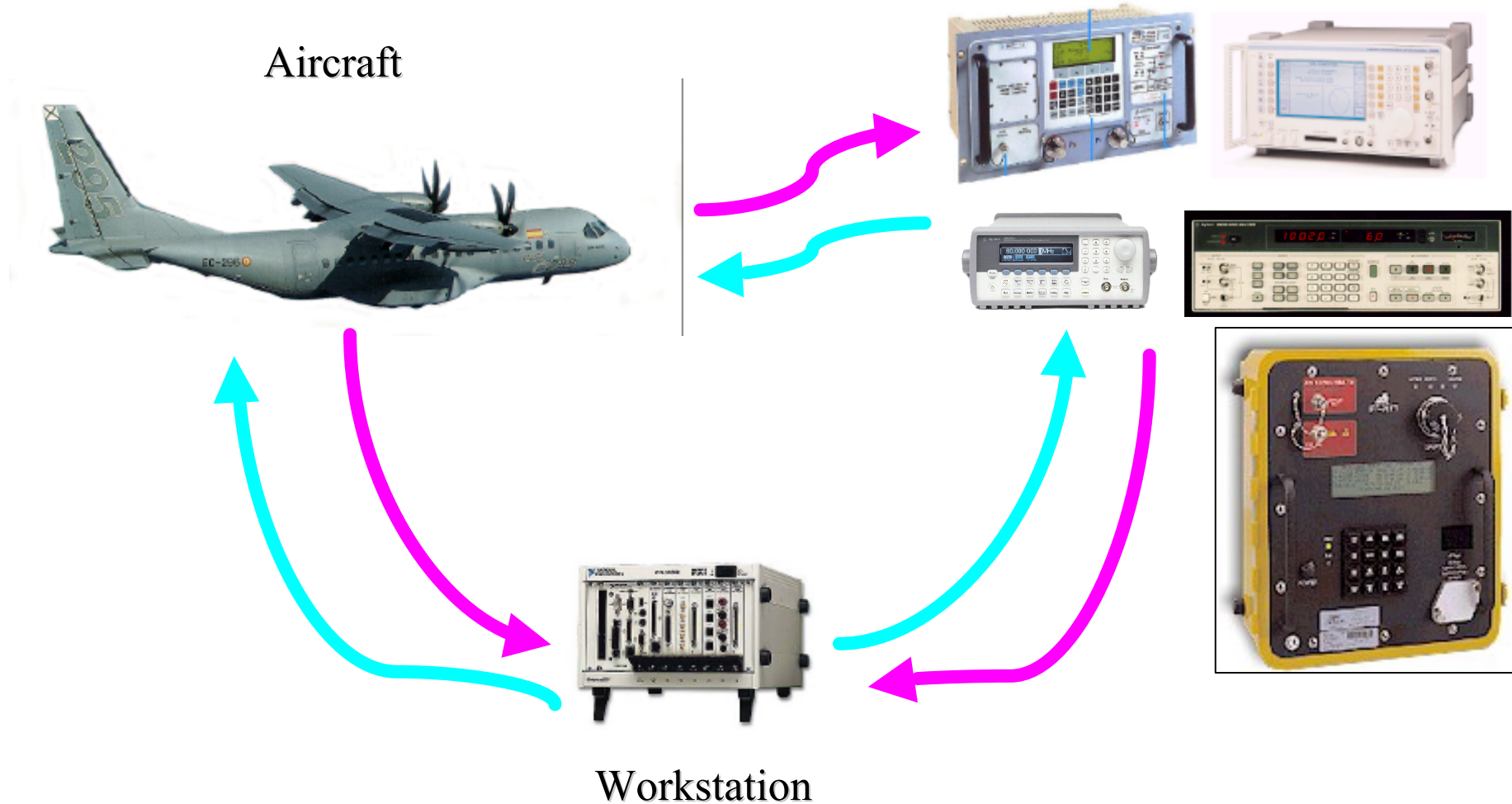
Design and development of computer-based ground tests edition, execution, management and result analysis system

Functions

- **System access management**
- **Tests generation and edition**
- **Tests execution**
- **Data recording**
- **Data analysis**
- **Reports generation**

Airplane testing system

Interface / Measurement / Actuation devices



Airplane testing system

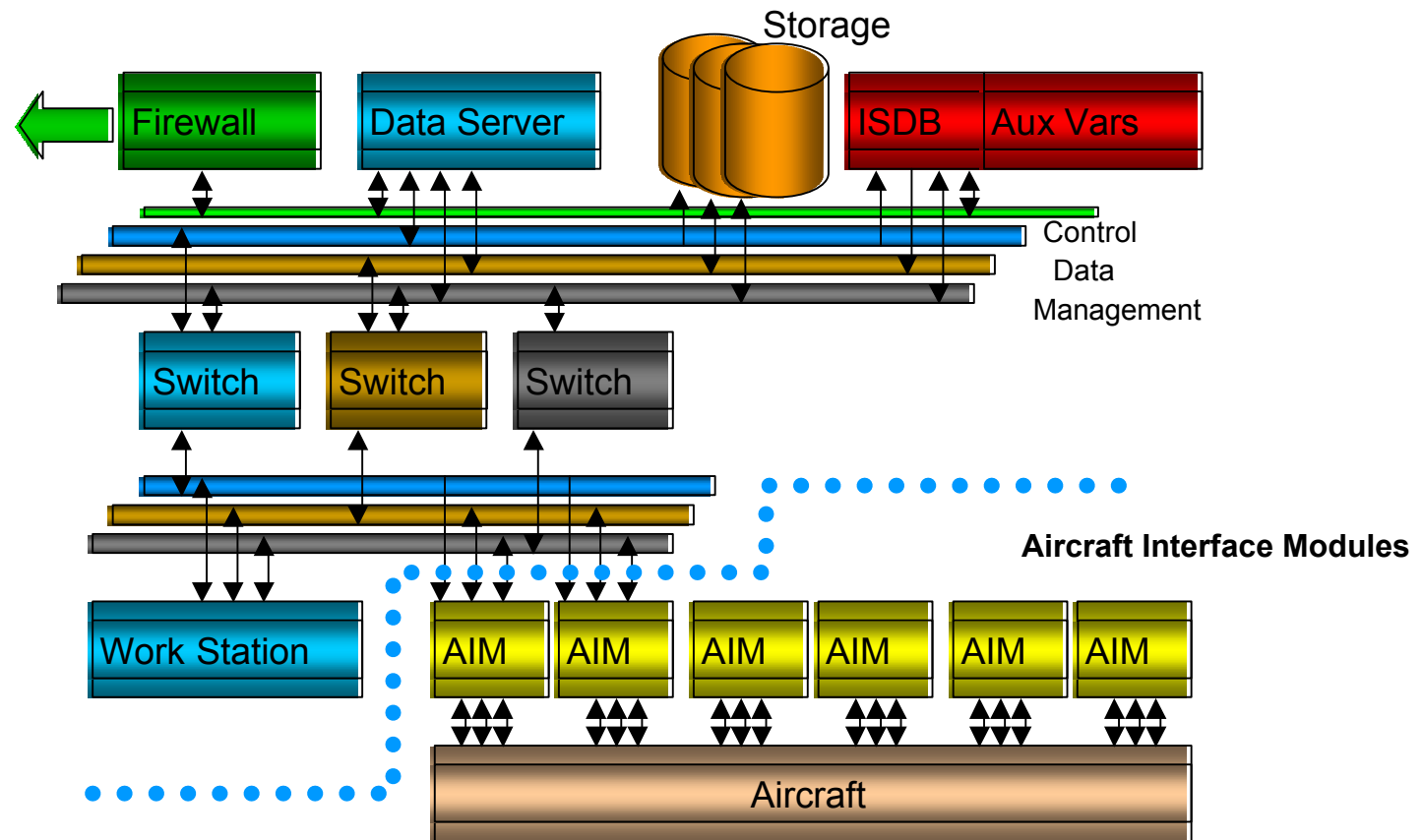
- Work Station: industrial PXI PC
- Interconnection capabilities:
 - Digital inputs and outputs
 - Analog inputs and outputs
 - Serial RS232 / RS485
 - Ethernet
 - ARINC 429 bus
 - MIL-STD 1553 bus
 - AFDX bus
 - CAN bus

Software system:

- Modular system, very easy to use and upgrade
- Specific language created for test edition and execution (flexibility)



Airplane testing: Architecture

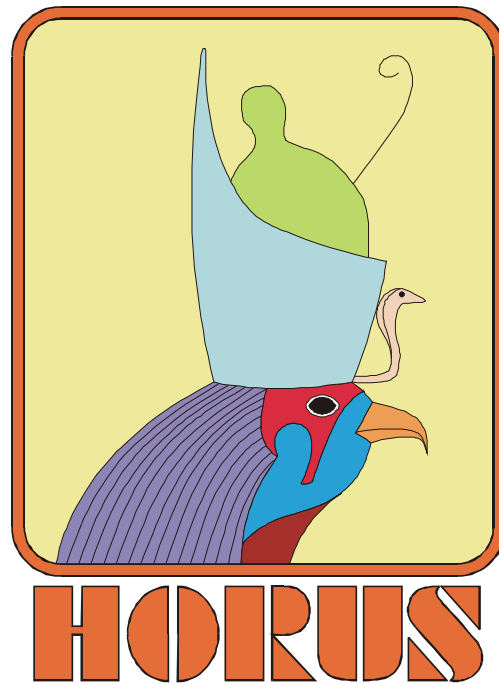


GROUP OF AEROSPACE VEHICLES

(Department of Aerospace Engineering)



1. PROJECT HORUS



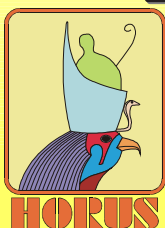


Proyecto HORUS: Helicóptero de Observación Recreo y Usos Similares

Proyecto de cooperación docente y tecnológico entre la Universidad Politécnica de Madrid y la Universidad de Sevilla, cuya finalidad es la construcción, en un marco fundamentalmente académico, de un pequeño helicóptero ultraligero monoplaza de demostración tecnológica.

Dado su carácter interuniversitario, se tiene previsto la fabricación de dos ejemplares del helicóptero, de modo que las tareas de diseño, integración montaje y pruebas del HORUS se puedan llevar a cabo simultáneamente en Madrid y Sevilla.

En el desarrollo del HORUS, los alumnos incorporados al proyecto en la actualidad, y los que se incorporarán en cursos venideros, juegan un papel fundamental en las tareas de diseño, fabricación y ensayos.

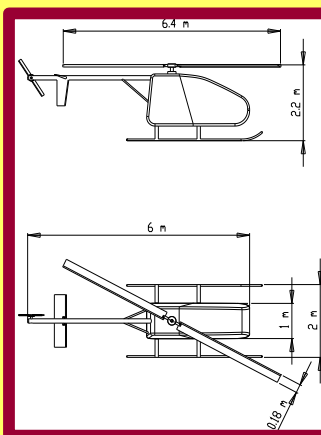


Especificaciones

Masa máxima: 300 kg
Masa en vacío: 150 kg
Combustible: 60 litros

Altura máxima: 2,20 m
Longitud máxima del fuselaje: 6,6 m
Longitud máxima, rotores girando : 7,5 m
Anchura máxima del fuselaje: 1 m
Anchura del tren de aterrizaje: 2 m

Dimensiones Preliminares



Rotor principal

Número de palas : 2
Diámetro: 6,40 m
Cuerda: 0,18 m
Torsión: -10°
Perfil: NACA 23012

Rotor antipar

Número de palas : 2
Diámetro: 1 m
Cuerda : 0,075 m
Torsión nula
Perfil: NACA 0012

Empresas y Organismos Colaboradores



Project HORUS

Groups:

- Structures
- Mechanical Systems
- Automatic Control
- Flight Mechanics

Course 2004-2005: 17 students

Grants: 90.000 euro

Project HORUS

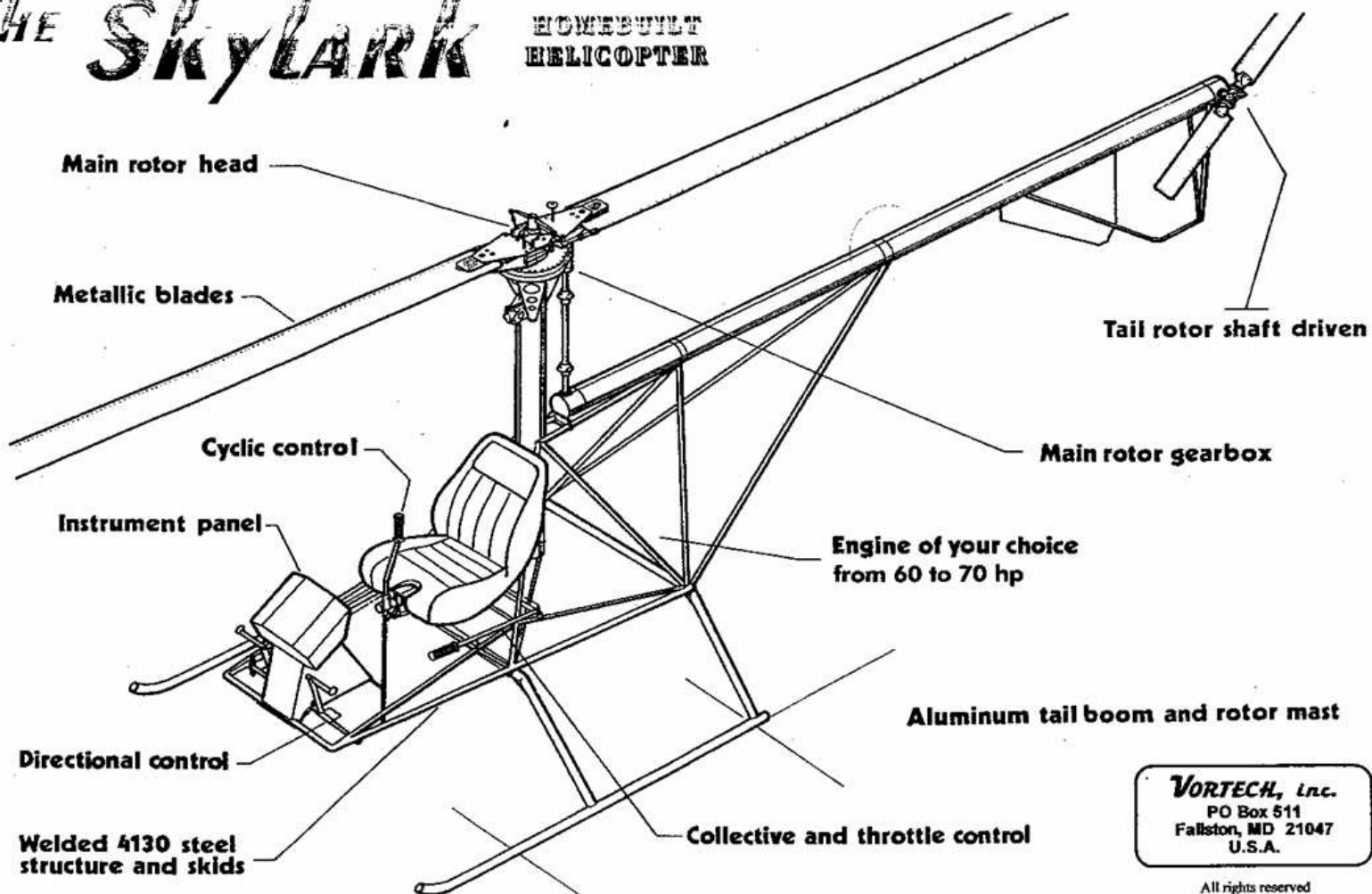
Flight Mechanics

Pacheco, G., Roldán, M., Valenzuela A. y Rivas, D., “Proyecto HORUS. Estimación de Masas y Tensor de Inercia”, Informe MV-01, Mayo 2005.

Pacheco, G., Roldán, M., Valenzuela A. y Rivas, D., “Proyecto HORUS. Actuaciones en Vuelo Axial”, Informe MV-02, Mayo 2005.

The Skylark

HOMEBUILT
HELICOPTER



VORTECH, Inc.
PO Box 511
Fallston, MD 21047
U.S.A.

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2. PROJECT NAW

(Nozzle Array Wing)

Design of a nebulizing system against mosquitos

In collaboration with:

- **Manatee County Mosquito Control District**
(Department of Agriculture, Florida, EE.UU.)
- **Florida A&M University**

Budget: 40.000 \$

Gañán-Calvo, A., López-Herrera, J.M. y Rivas, D., “Nozzle-Array Wings Design”, Engineering Report, no. 1, Manatee County Mosquito Control District, Mayo 2005.

Project NAW

Insecticide flow rate: 1.1 litre/min

Droplet diameter: $d \sim 20\mu\text{m}$

Droplet generation frequency: $N = 4 \times 10^9/\text{s}$

*Flow Focusing*TM (1 injector): ~ 200.000 droplet/s

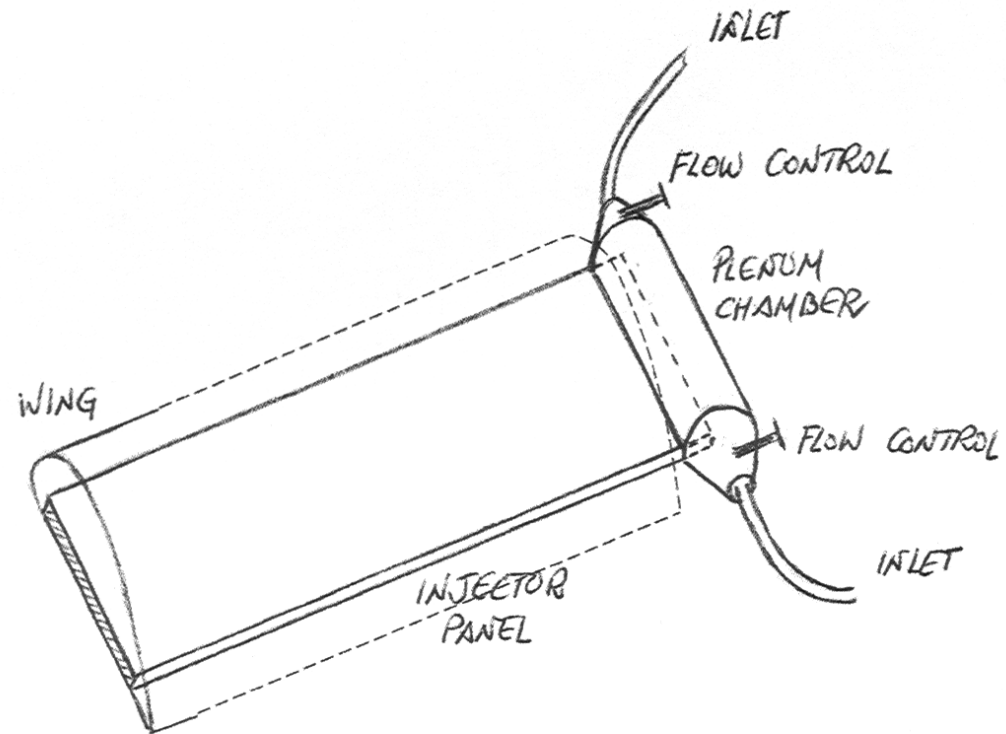
$\implies \sim 20.000$ injectors

Injection area (1 injector): $\sim 50 \text{ mm}^2$

Total injection area: $\sim 1 \text{ m}^2$

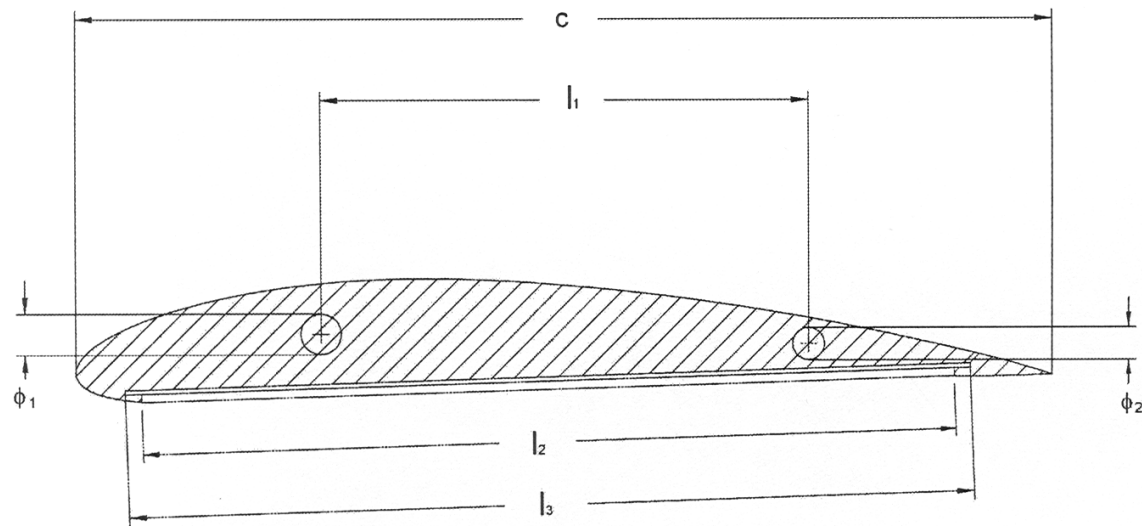
$\implies$ **Two wings of 1m×0.5m each**

Project NAW

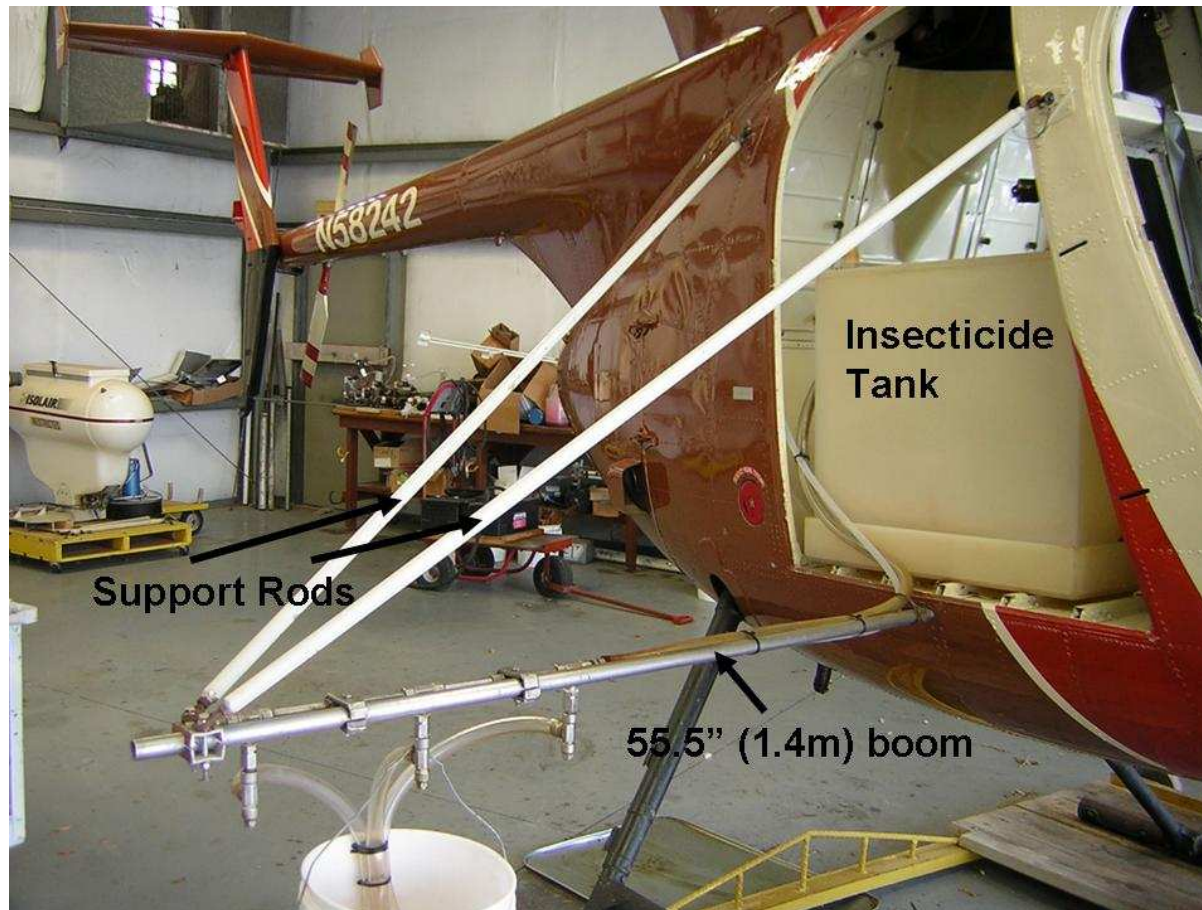


Project NAW

Profile NACA 4412



Project NAW



Project NAW



Project NAW



Proposed NAWs

3. PROJECT AAO

Autonomous Aircraft Operation (Air Traffic Control System)

Project supported by **Fundación El Monte**

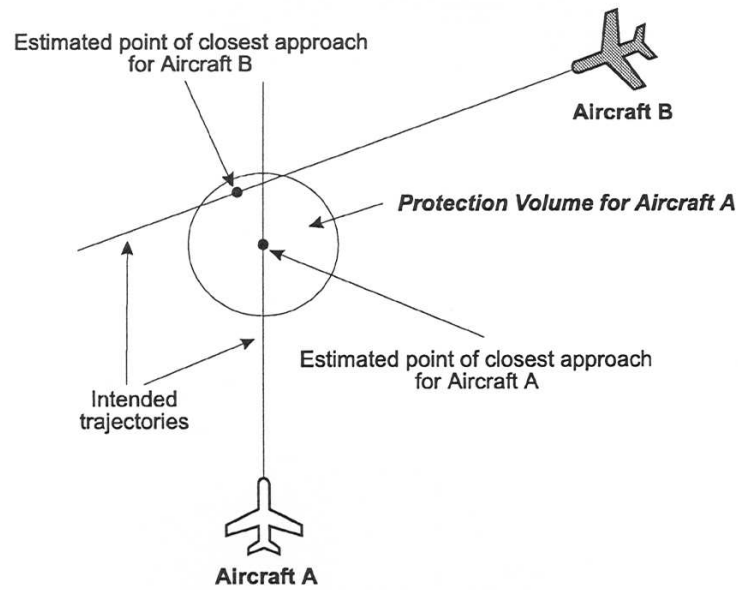
Duration: 1 year

Grant: 30.000 euro

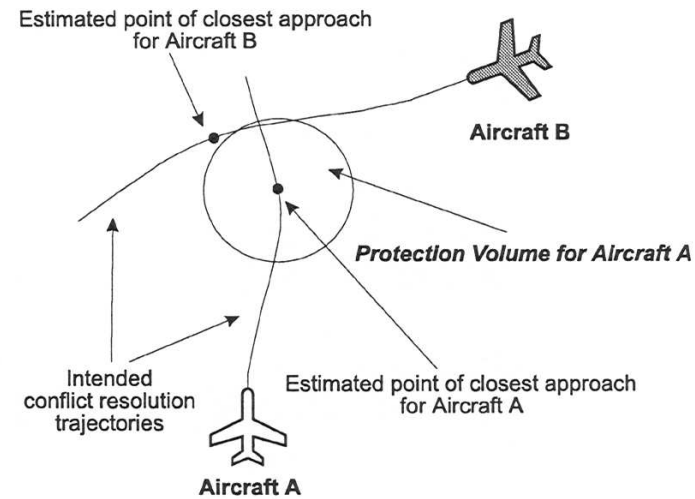
Students:

- Javier Ramos Ramos (Ingeniero Técnico Aeronáutico)
- José Luis de Augusto Gil (Airline Pilot)

Project AAO



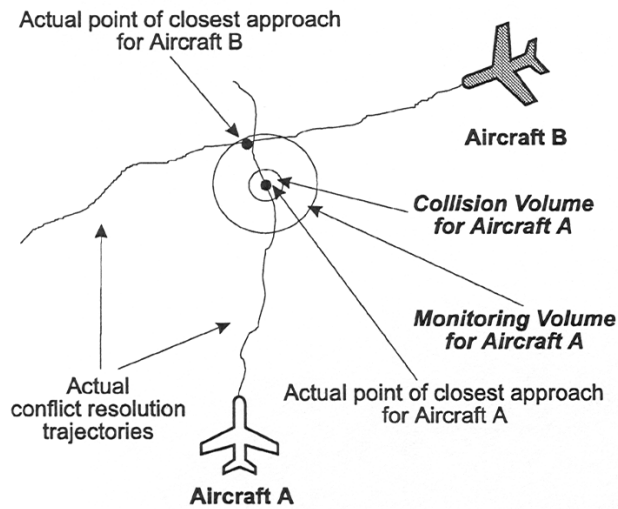
1. Conflict detection



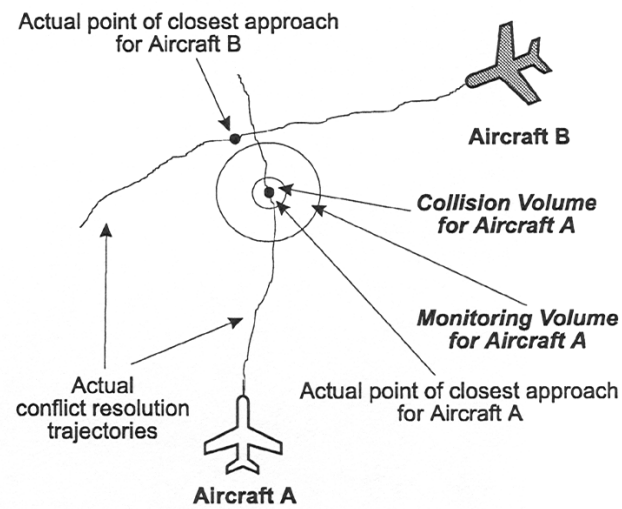
2. Planning of the conflict resolution actions

(M.A. Vilaplana Ruiz, Ph.D. Thesis, Univ. Glasgow, 2002)

Project AAO



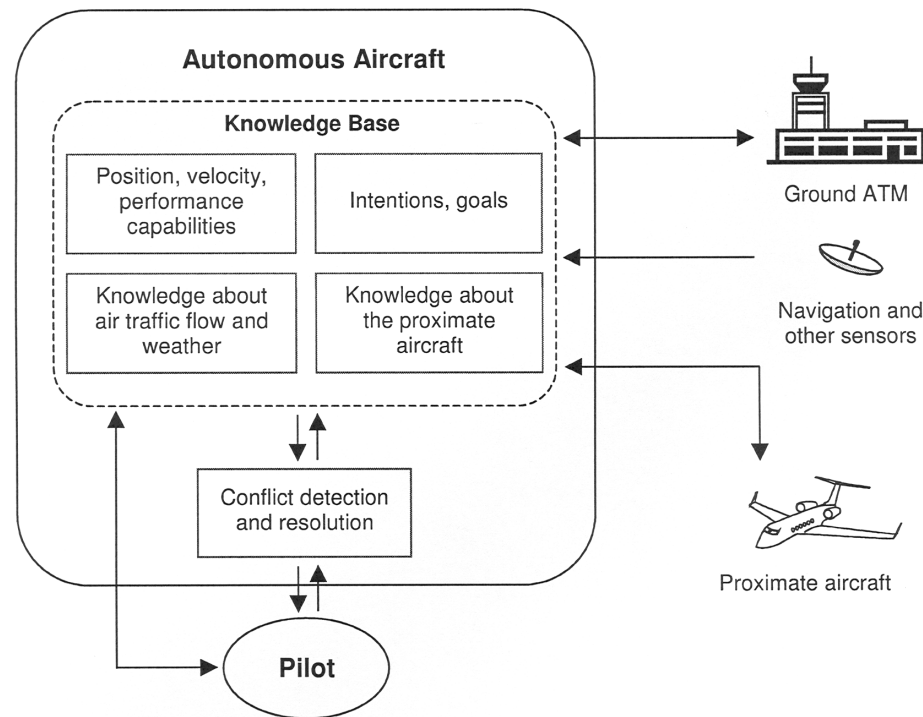
3a. Unsatisfactory conflict resolution action:
the action is safe but the Monitoring Volume is violated at actual passage



3b. Satisfactory conflict resolution action:
the action is safe and the Monitoring Volume is not violated at actual passage

(M.A. Vilaplana Ruiz, Ph.D. Thesis, Univ. Glasgow, 2002)

Project AAO



(M.A. Vilaplana Ruiz, Ph.D. Thesis, Univ. Glasgow, 2002)

4. PROJECT IMPACT

Advanced Multi-Purpose Infrastructure
for Trajectory Computation



IMPACT

Infraestructura MultiPropósito Avanzada
para el Cómputo de Trayectorias

BR&TE Engineering and Programs – ATM

Project IMPACT

Project supported by **Boeing Research & Technology Europe**

Duration: 2 years

Budget: 200.000 euro

Students:

- Javier Ramos Ramos (Ingeniero Técnico Aeronáutico)
- José Luis de Augusto Gil (Airline Pilot)

Project IMPACT

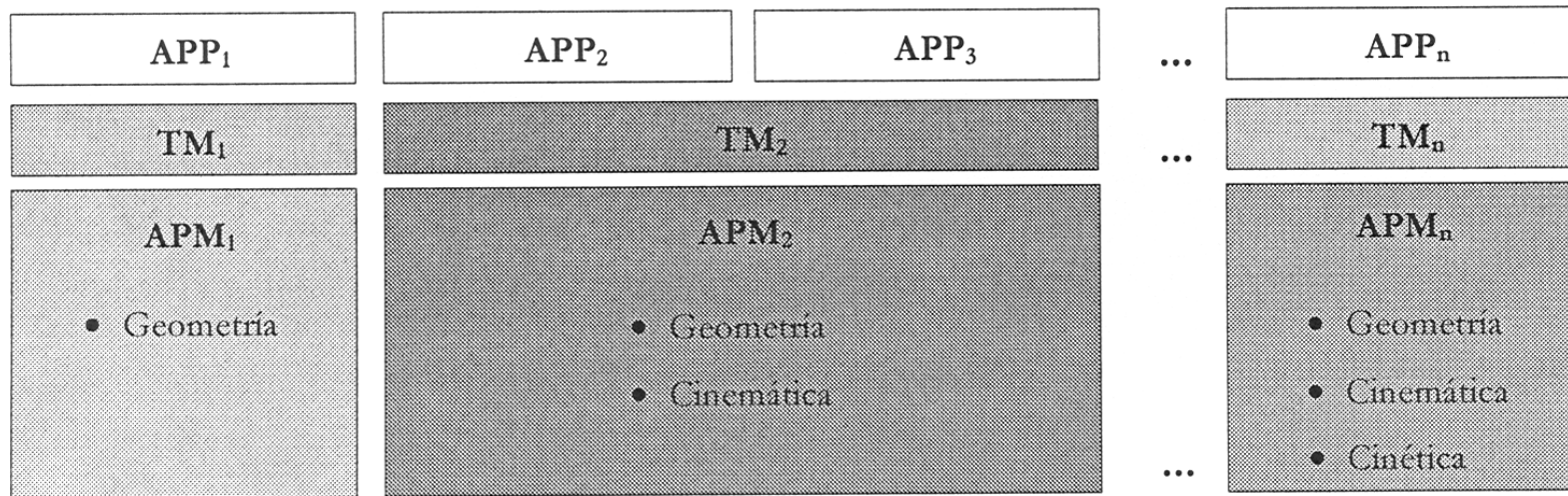


Figura 1. Concepto actual de aplicaciones de ATM basadas en trayectorias

Project IMPACT

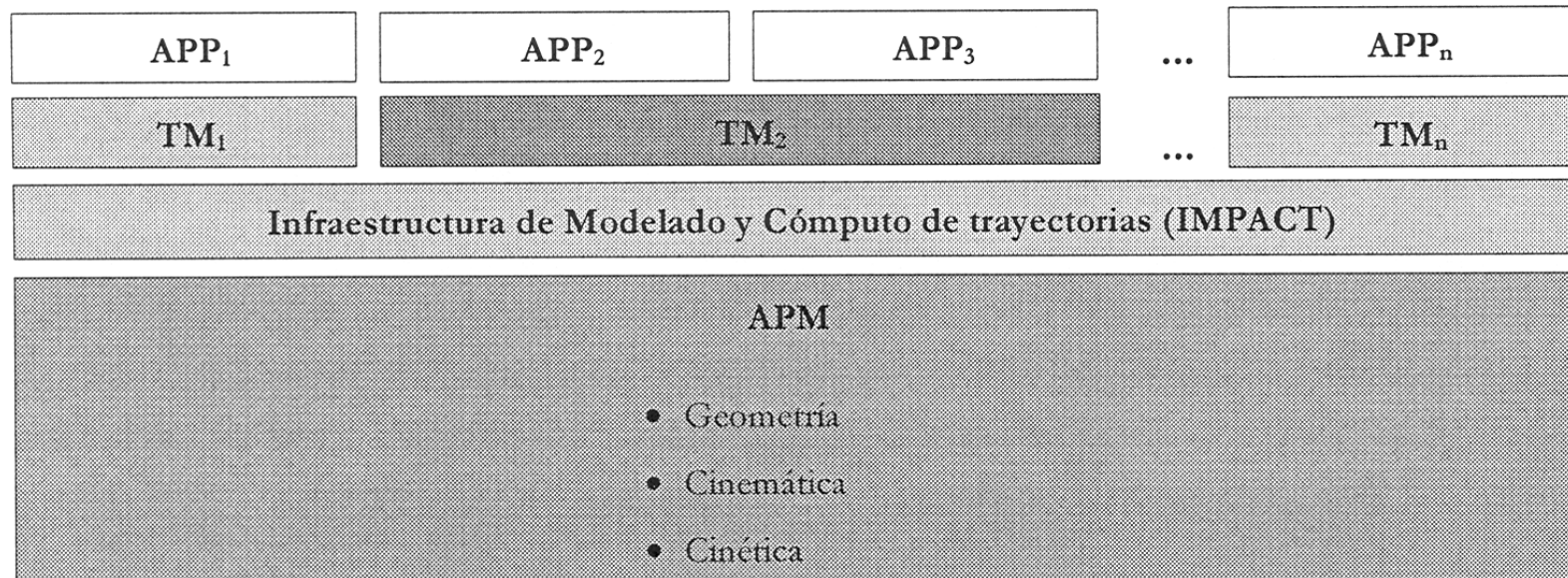


Figura 2. Concepto de aplicaciones de ATM basadas en trayectorias según IMPACT

AEROSPACE VEHICLES LAB



1. Flight Simulators

ELITE PI-135



2. Flight Simulators

Flight Link R-22



3. Trainer Helicopters SVH-3

EasyCopter (Cicare Helicópteros S.A.)



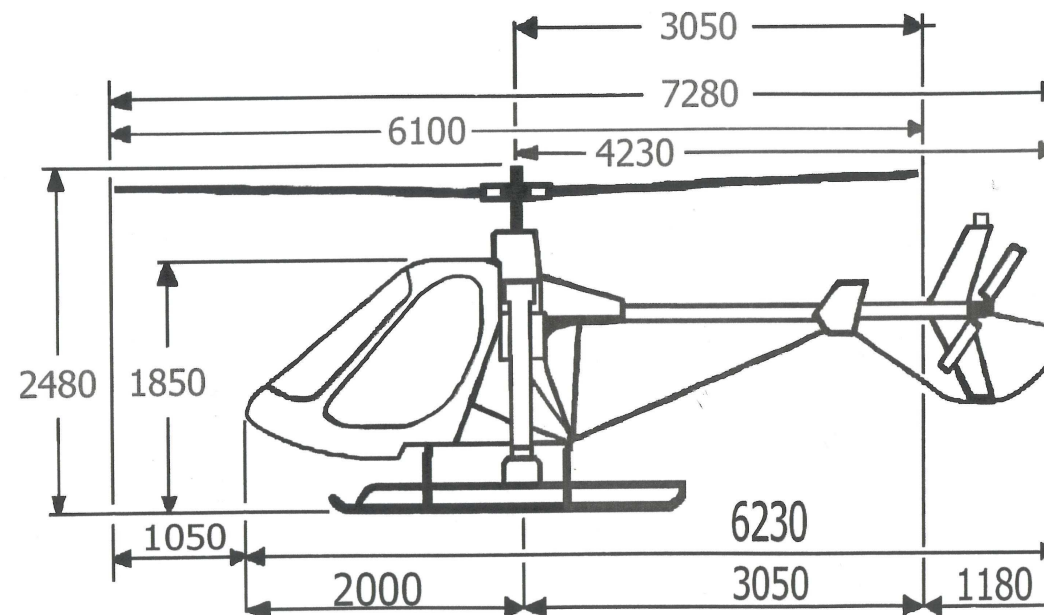
EasyCopter



EasyCopter



EasyCopter



Easy Copter

EasyCopter

