HELIPLAT®: High Altitude Very-long Endurance Solar Powered Platform for Earth Observation and Surveillance.

CAPECON: SHAMPO Solar HALE-UAV

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DIASP

7th EUROPEAN WORKSHOP ON AIRCRAFT DESIGN EDUCATION (EWADE 2005)

Laurea Specialistica in Ing Aerospaziale (MSc in Aerospace Eng.)

Corso: PROGETTO DI AEROMOBILI

(Course: AIRCRAFT DESIGN)

Credits: 10 - Total hours: 115 (L. 80 + E. 35)

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POLITECNICO TORINO,
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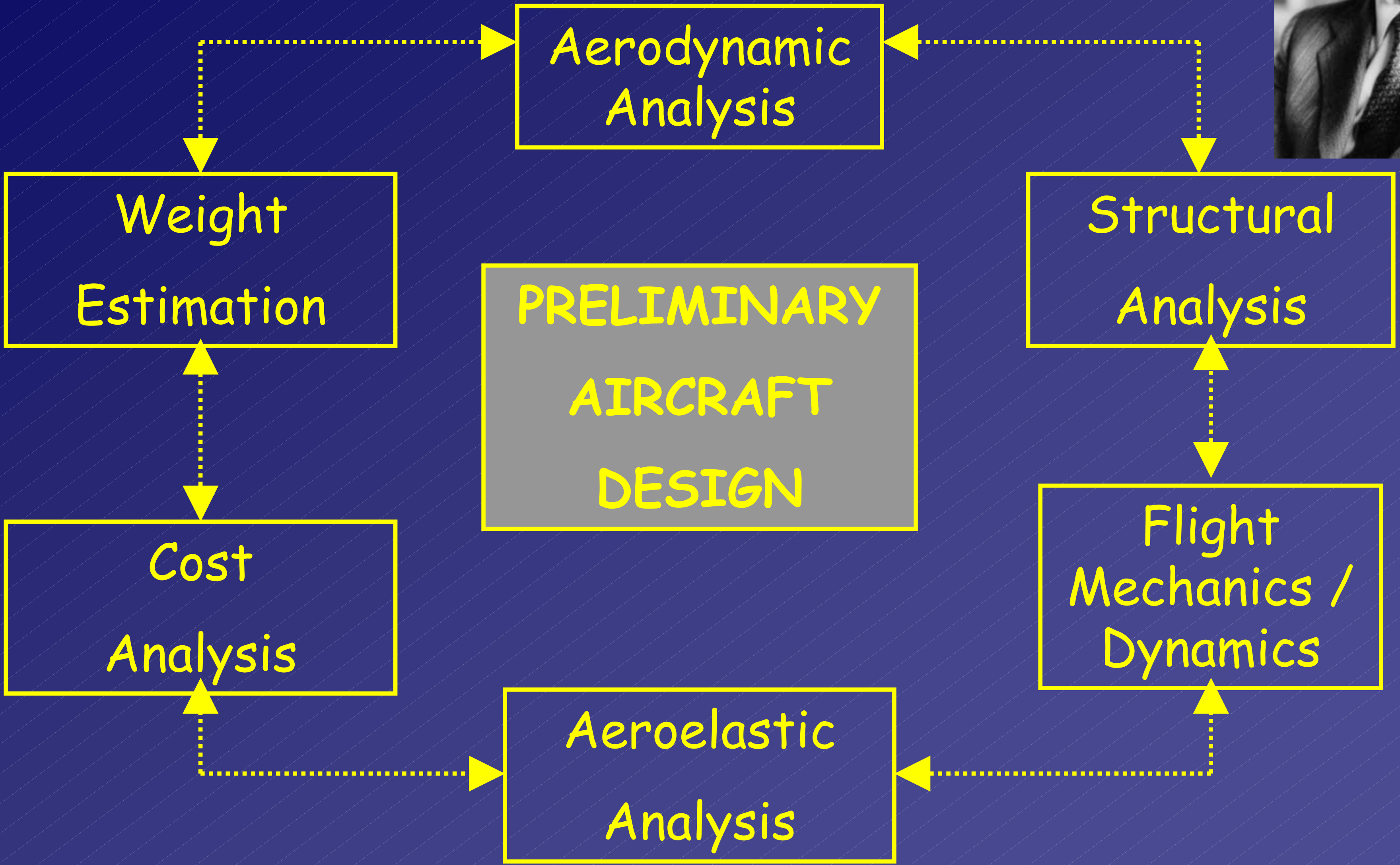
LA SCIENZA DEL PROGETTO DI AEROMOBILI
Prof. Ing. Giuseppe GABRIELLI



Theories and/or empirical methods concerning a single design aspect

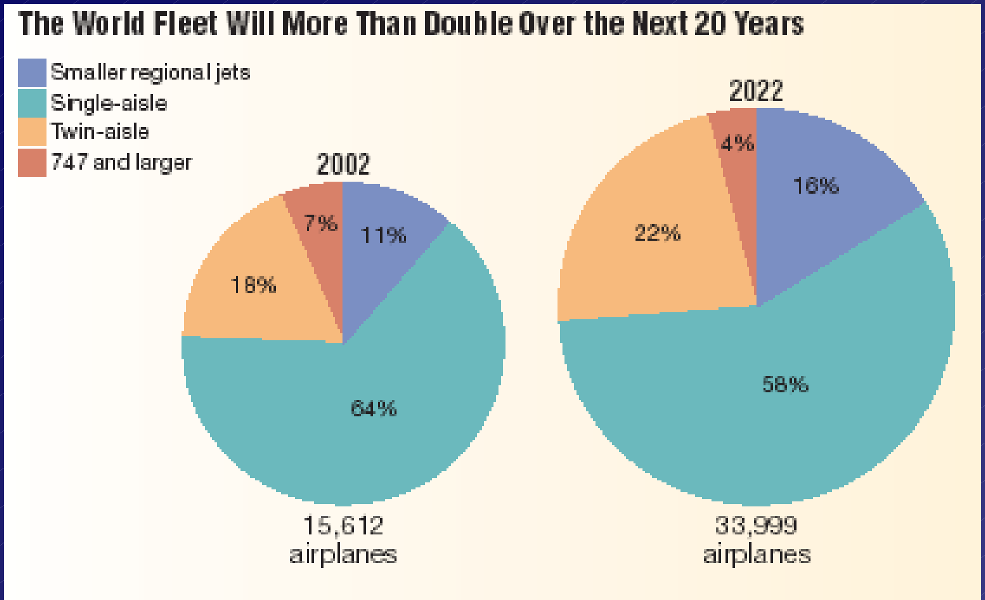
↓

Use of commercial software and/or self-developed software to solve specific problems

↓

Preliminary aircraft design by integration of the previously developed tools

BOEING - Current Market Outlook 2003-2022

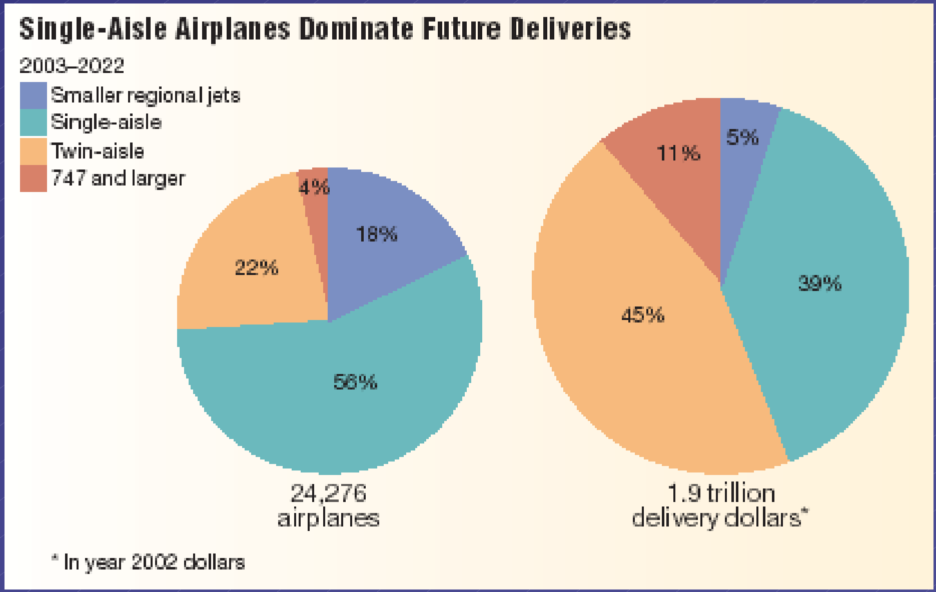


4,300: smaller regional jets.

5,440: intermediate-size airplanes.

13,645: single-aisle airplanes.

890: 747-size or larger airplanes.

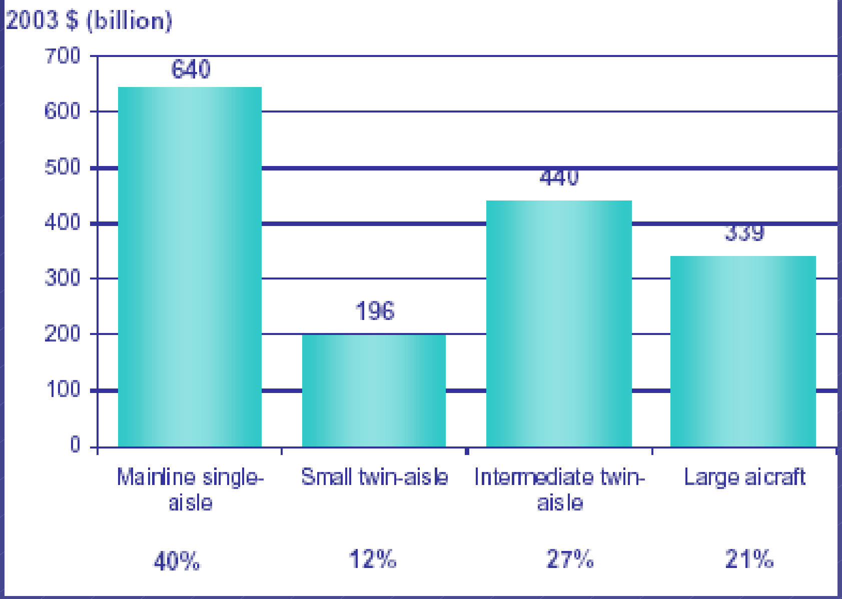


AIRBUS Global Market Forecast 2003-2022

ly 16,500 new aircraft will be ered

	20-year deliveries
Mainline single-aisle aircraft like the Airbus A318, A319, A320 and A321	10,184
Small twin-aisle aircraft like the Airbus A330-200	1,782
Intermediate twin-aisle aircraft like the Airbus A330-300 and A340	2,962
Very large and economical aircraft like the Airbus A380	1,535
Total aircraft	16,463

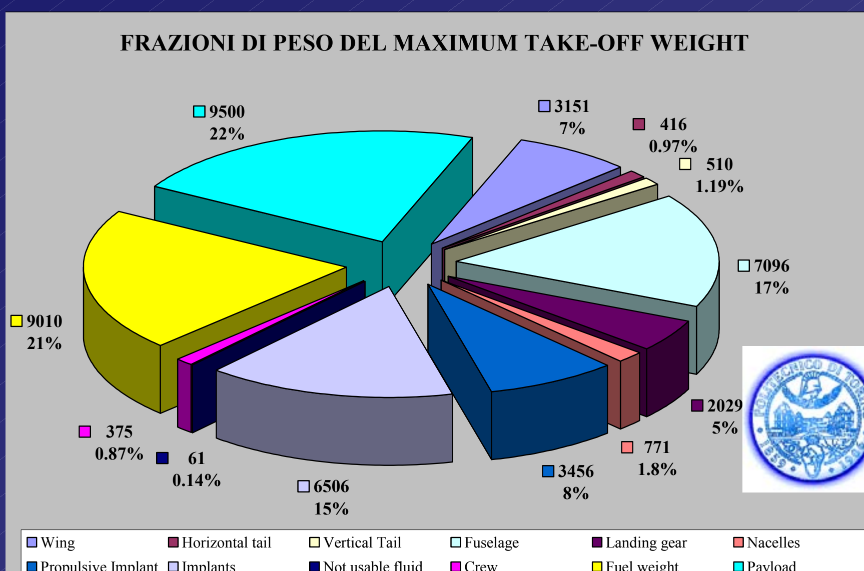
business worth $1.6 trillion



2004-05: Design of Regional Aircraft

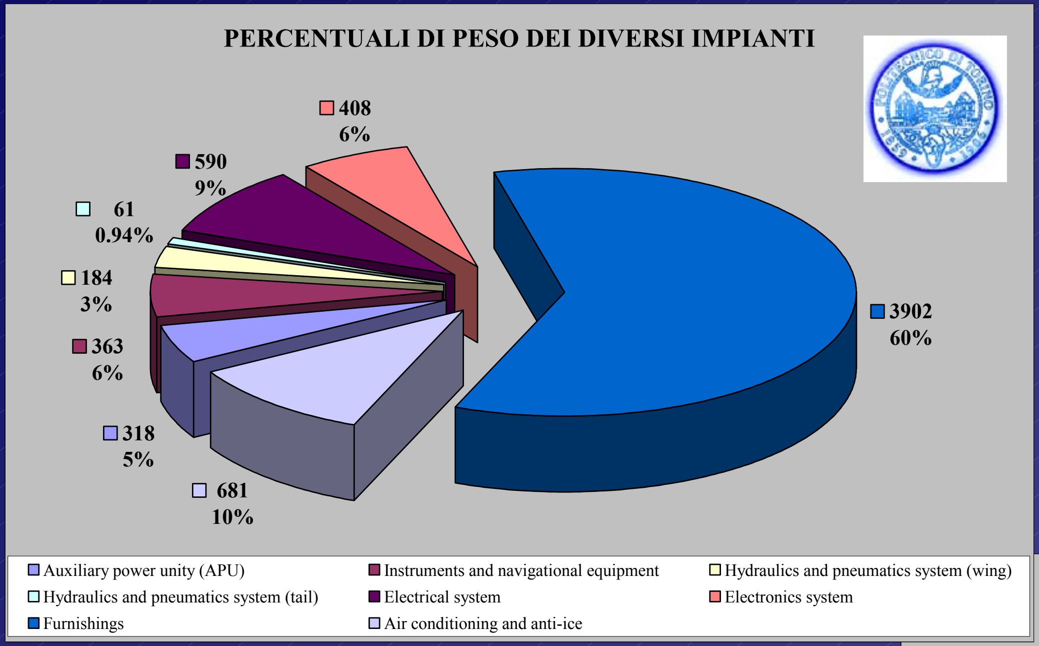
Weight Estimation

By adopting empirical methods, commonly found in literature (Torenbeek, Jenkinson, Stanford Univ., Howe, Raymer, etc…) and statistical data, students develop a software to evaluate total aircraft mass and masses of each of the sub-systems (structure, propulsion group, crew, equipments…)

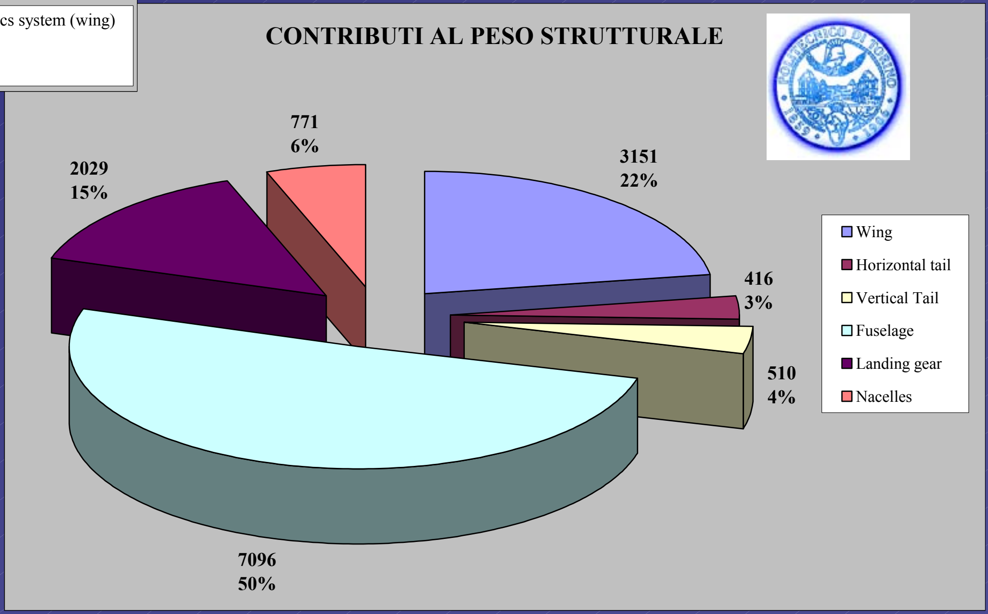


Overall Aircraft Weight Breakdown **(Avro RJ100)**

Weight Estimation



Systems Breakdown

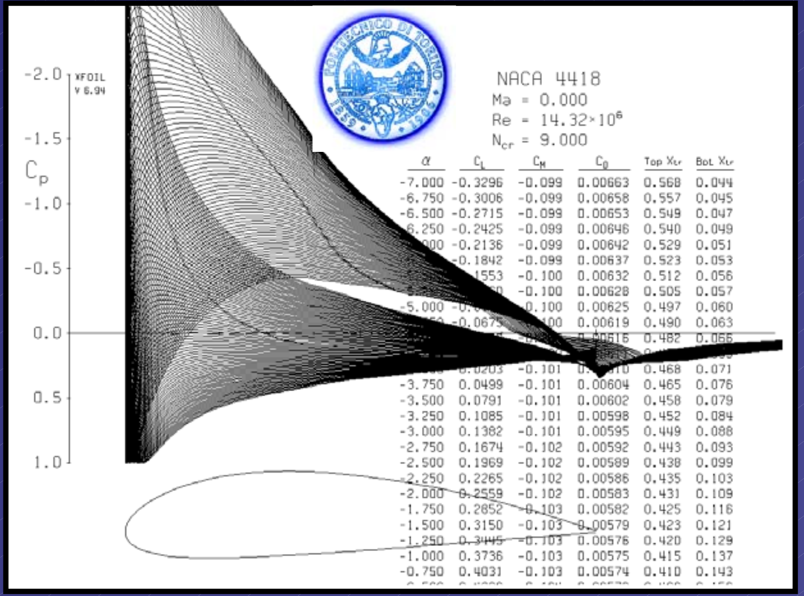


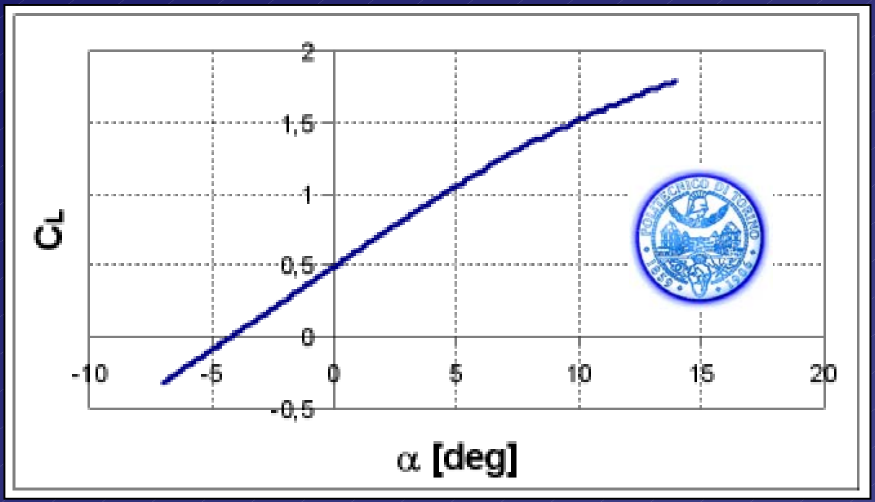
Structure Breakdown

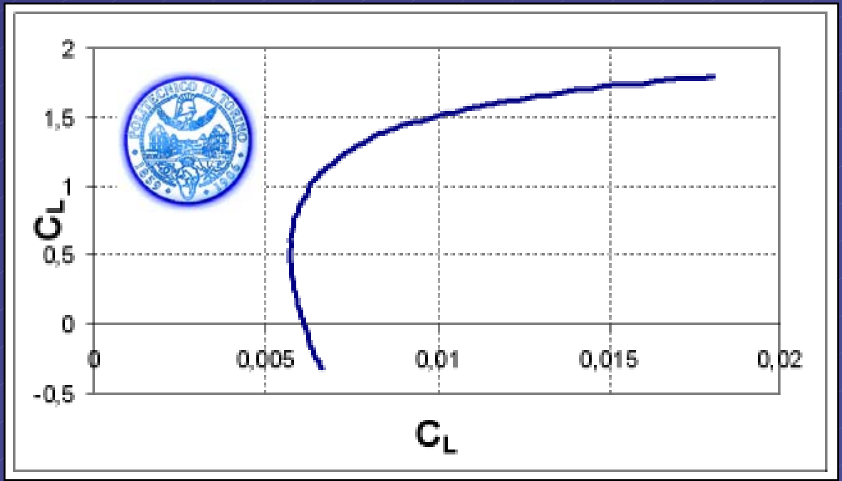
Aerodynamic Analysis

Airfoil → Wing → Aircraft

The panel code *XFOIL* has been used to study airfoil performances in subsonic flows…





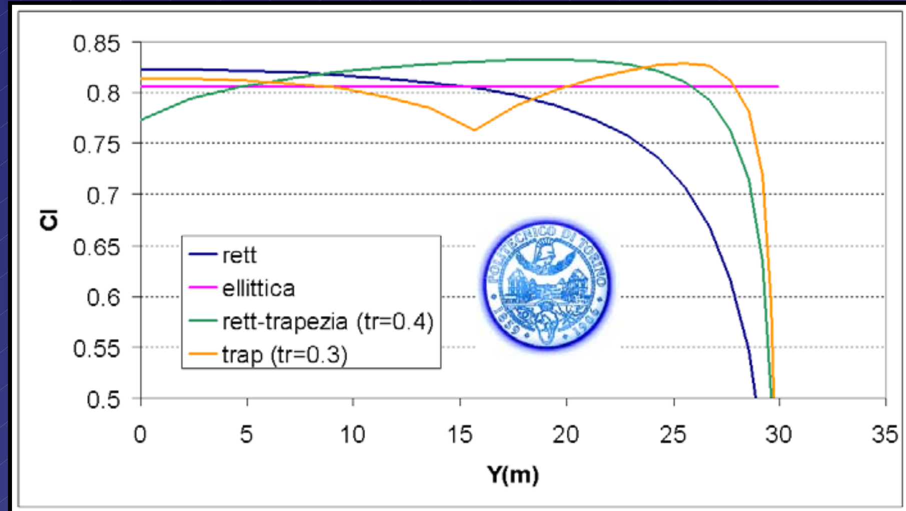


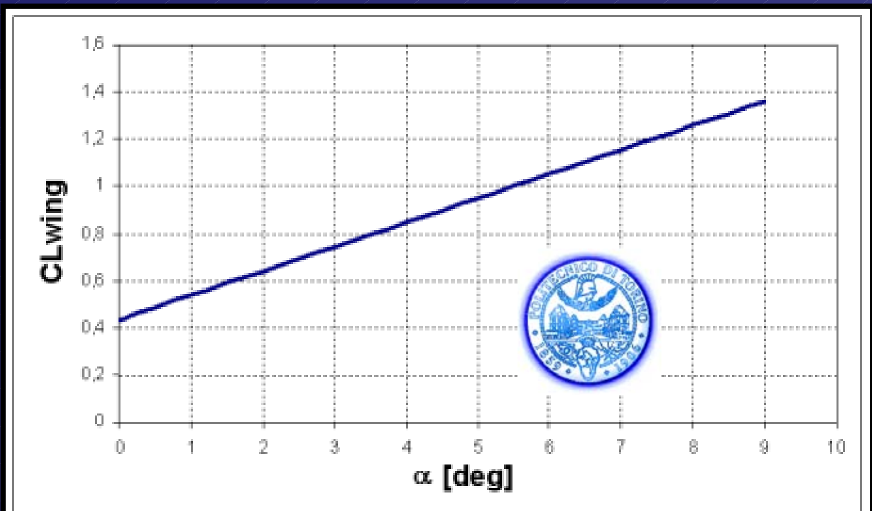
… and to draw Cl-α and polar curves

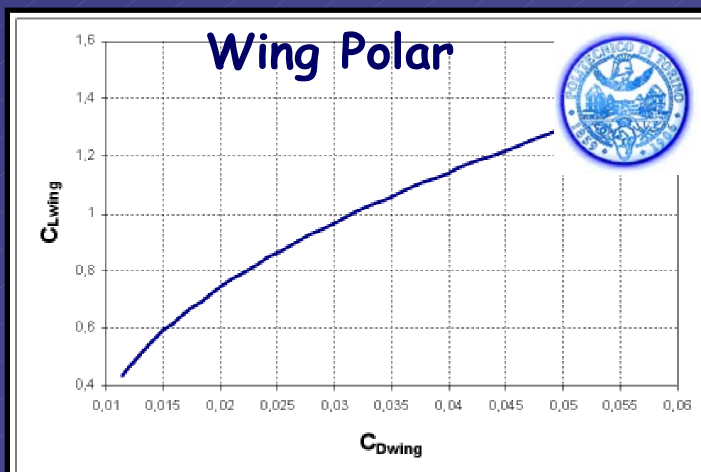
Aerodynamic Analysis

Airfoil → Wing → Aircraft

XFOIL results and Prandtl lifting line theory are implemented in a software developed by students in order to study wing aerodynamic behaviour





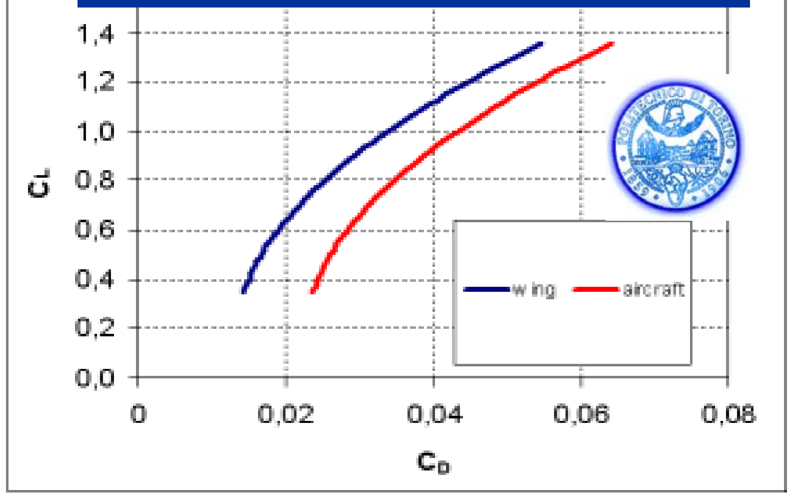


Aerodynamic Analysis

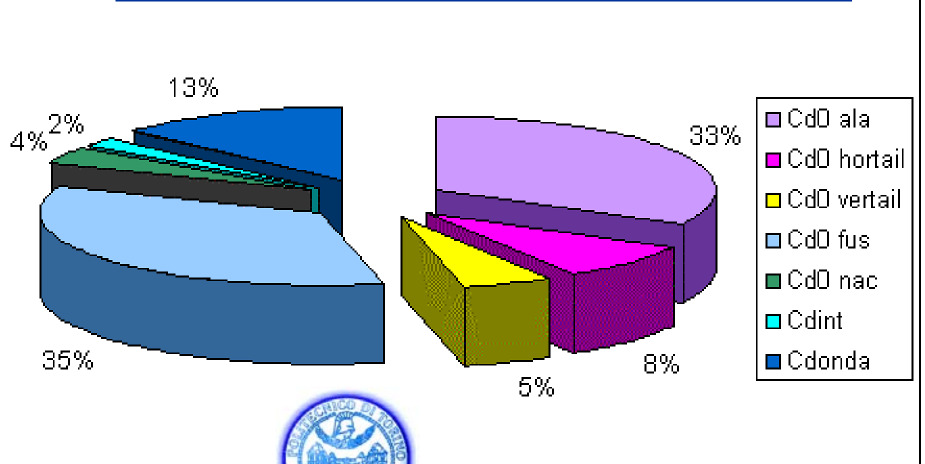
Airfoil → Wing → Aircraft

Parasite drags due to aircraft components are evaluated through empirical methods, allowing aircraft polar to be plotted

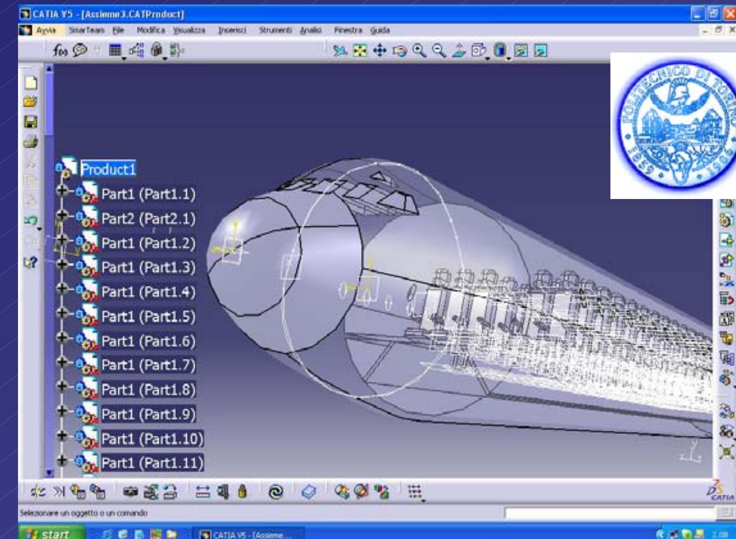
Wing and Aircraft Polar

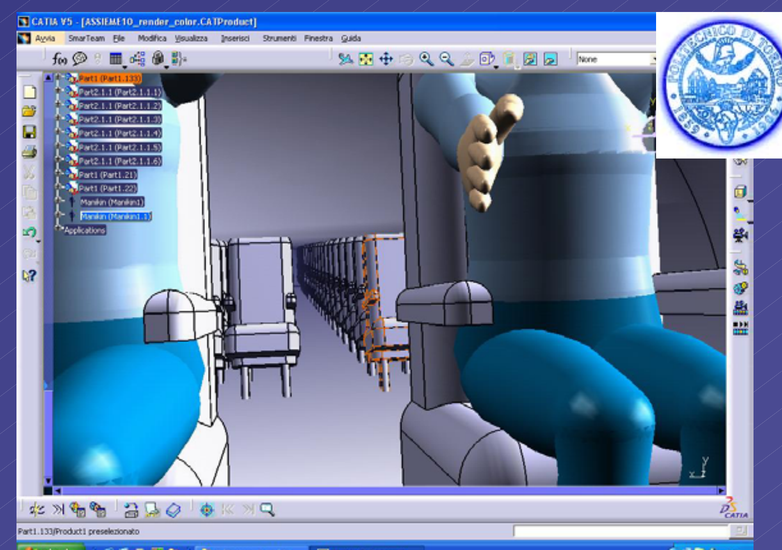


Parasite Drag Breakdown



CATIA 3D DRAWING

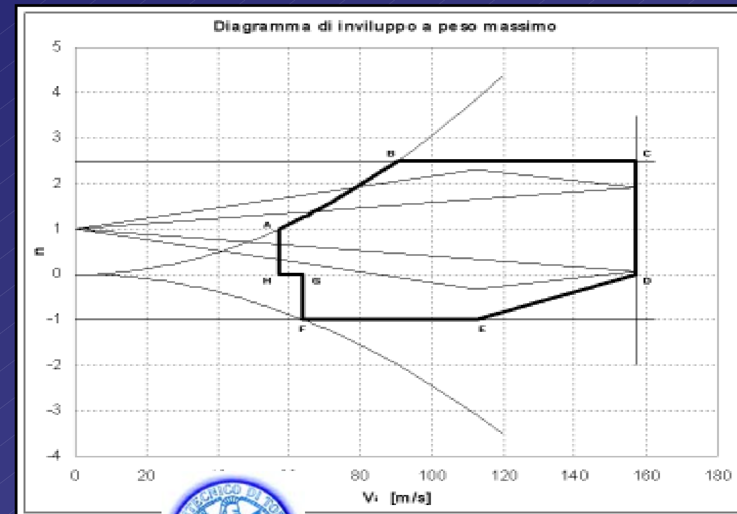


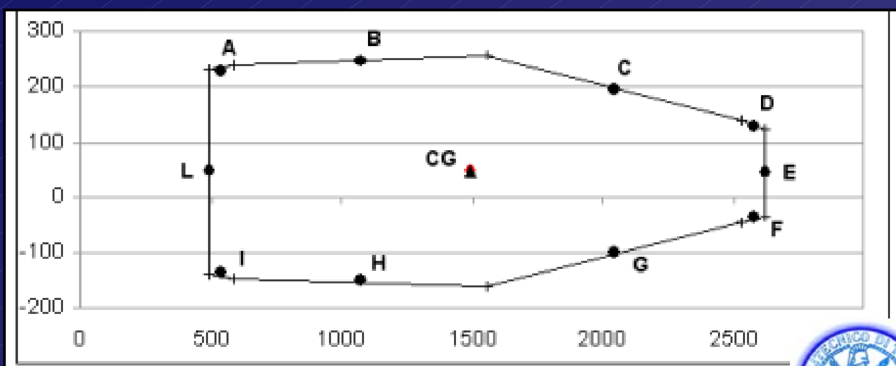


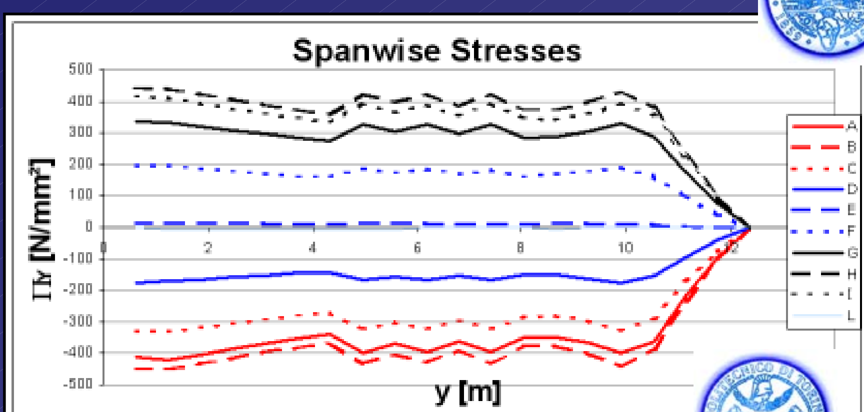
Structural Analysis

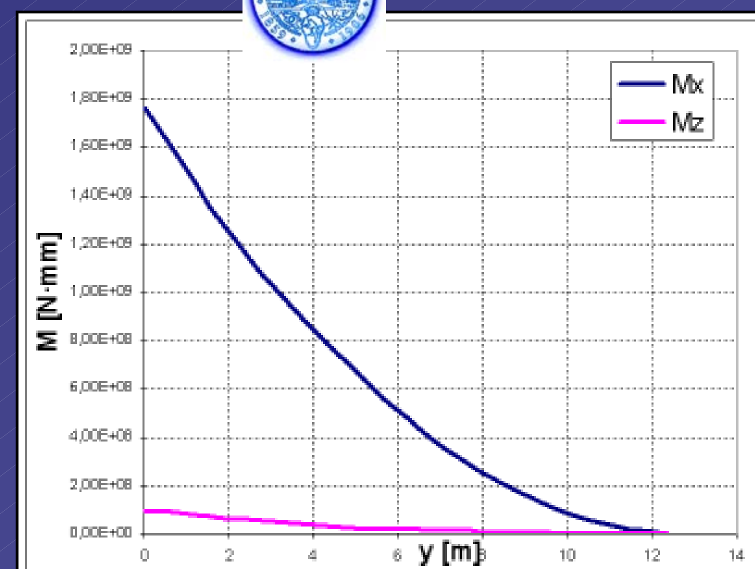
The structural analysis of wing-box is carried out by a preliminary structural design program developed by students.

First attempt wing-box geometry and materials are defined and stress/strain state computed

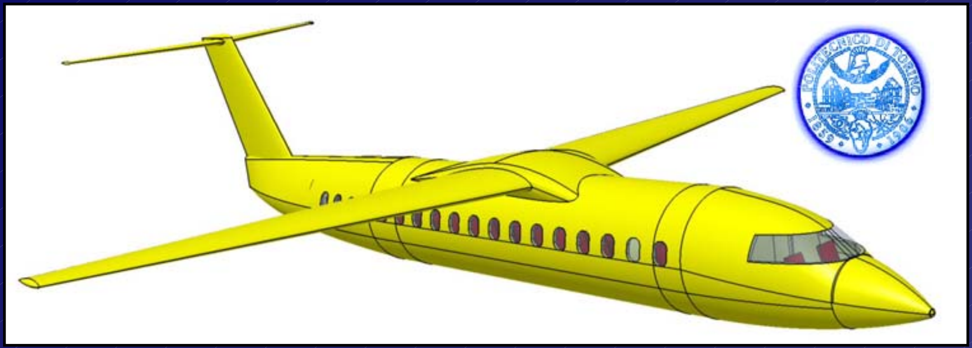




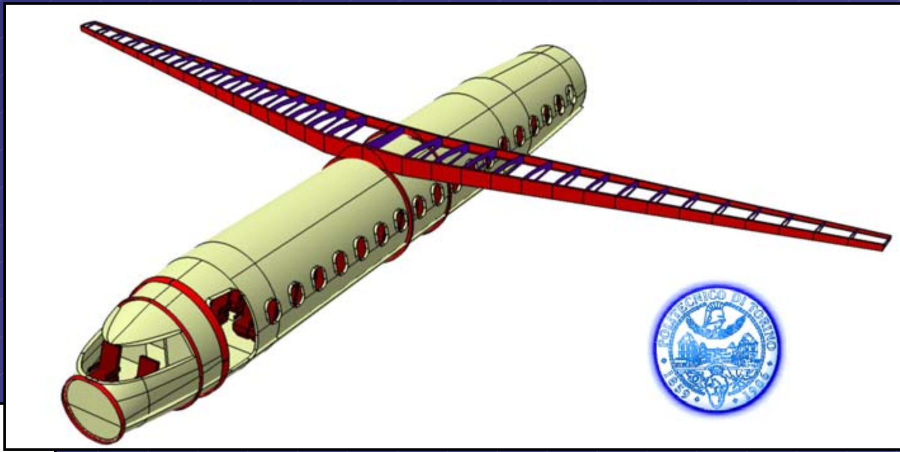


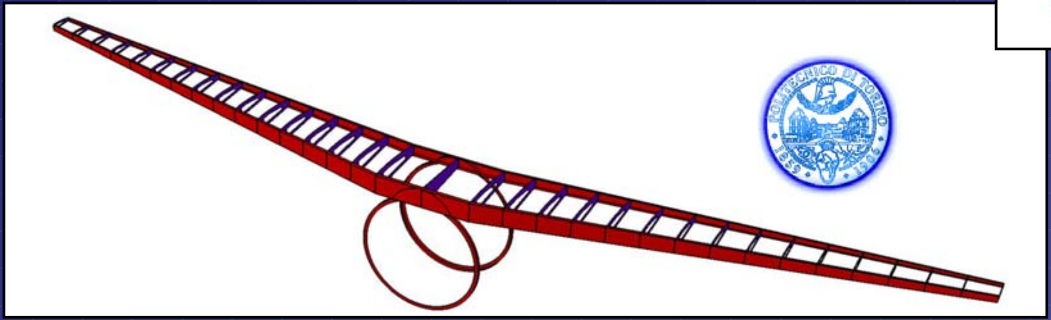


Structural Analysis



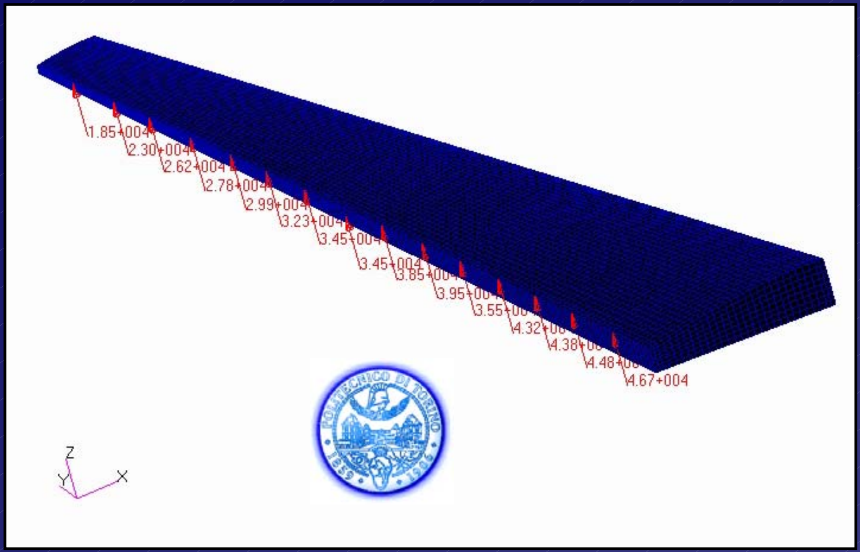
A *CATIA V5* model is built to outline a 3D external & internal configuration and to define geometries for *MSC PATRAN*...

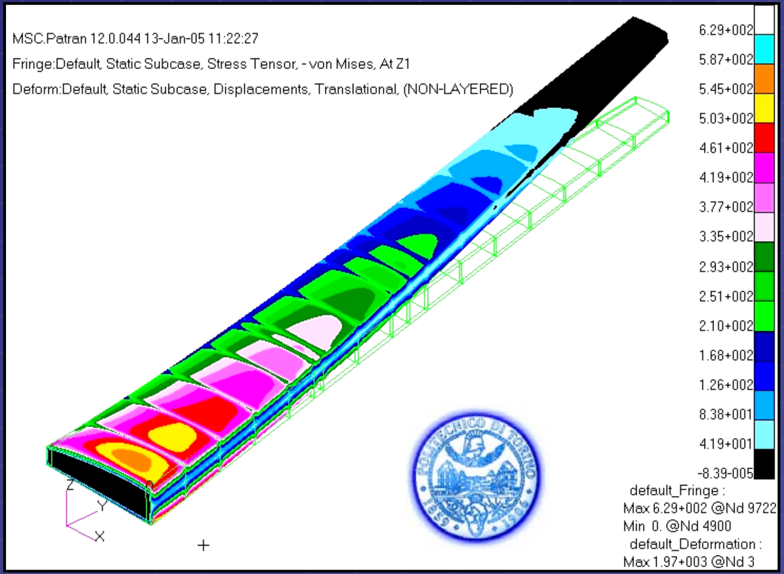


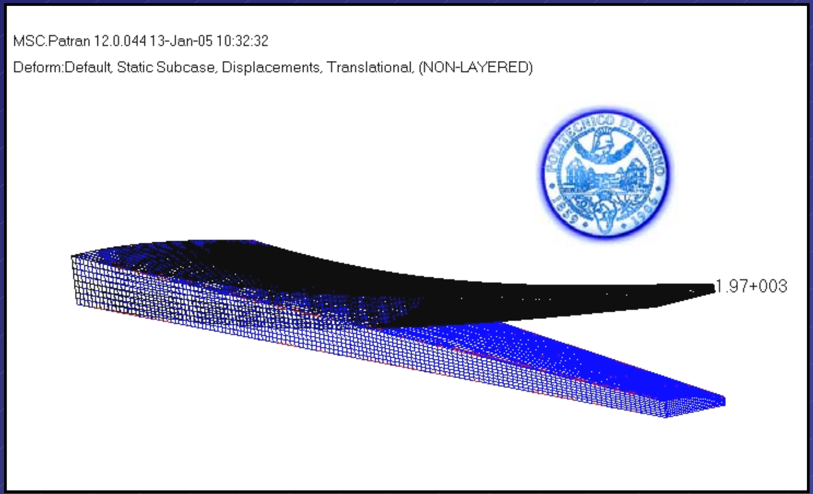


Structural Analysis

… and a more accurate analysis is achieved through FEM (*MSC NASTRAN*)

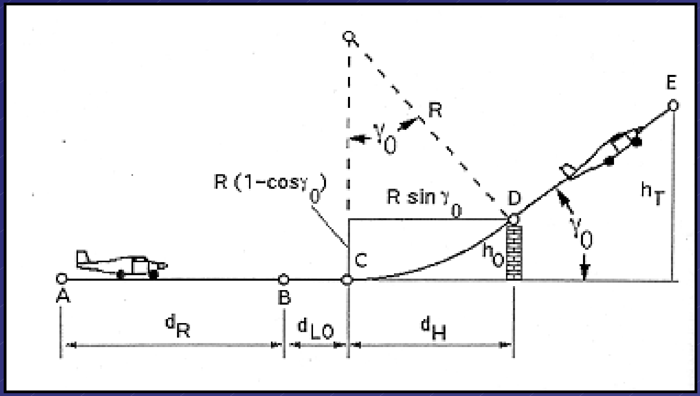




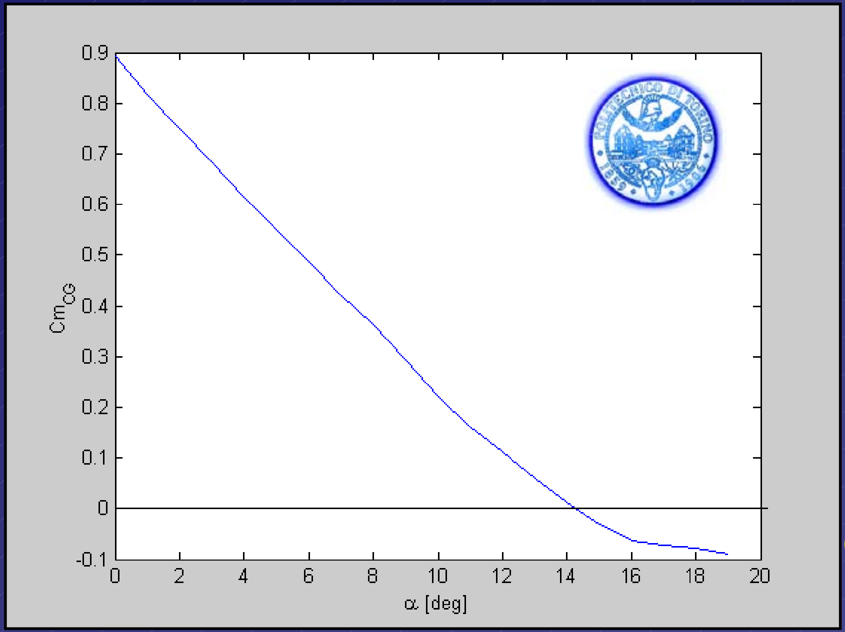


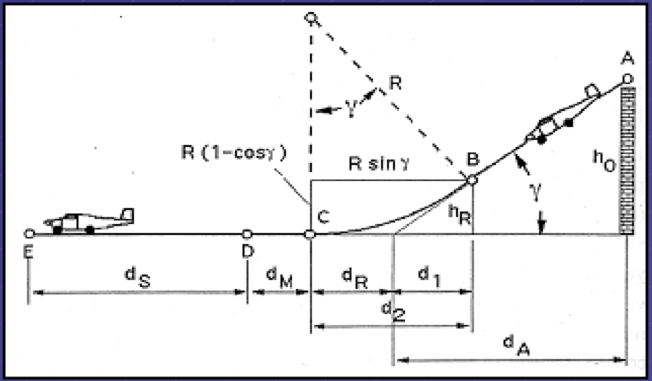
Flight Mechanics / Dynamics

Main flight qualities as well as static and dynamic stability are evaluated.



static longitudinal stability evaluation

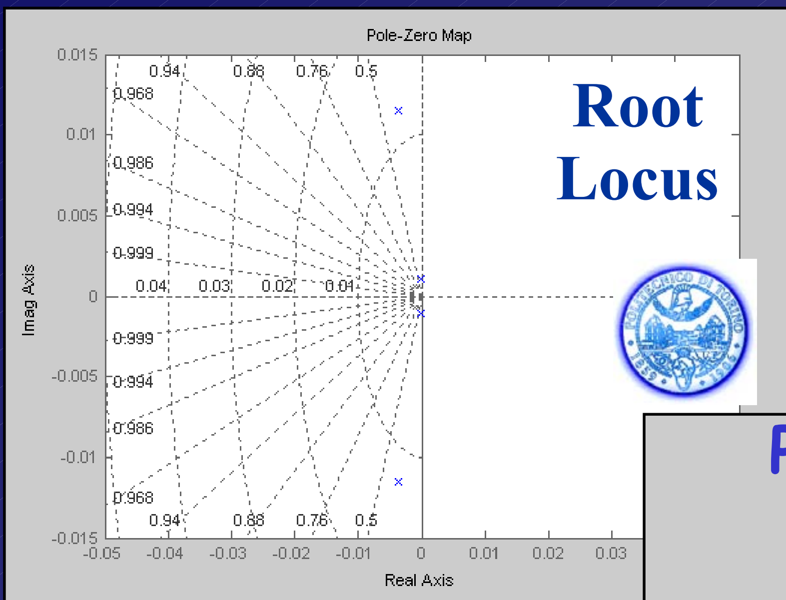




$$dCm_{CG} / d\alpha < 0$$

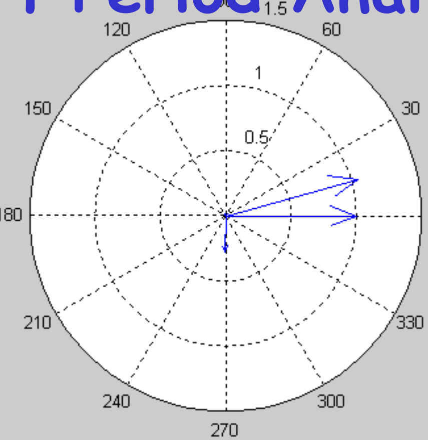
$$Cm_{CG} = 0 \text{ for } \alpha = 0$$

Flight Mechanics / Dynamics

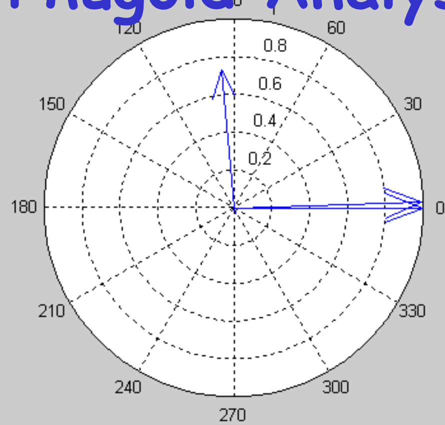


Argand Diagrams

Short Period Analysis



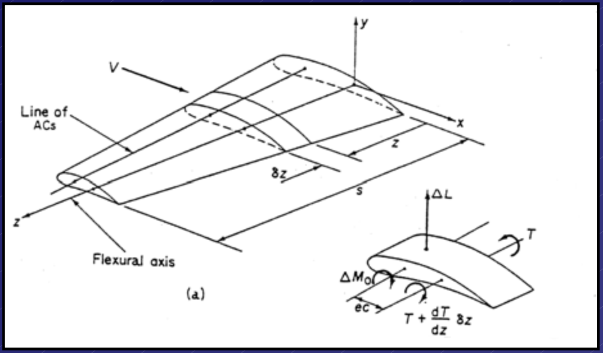
Phugoid Analysis

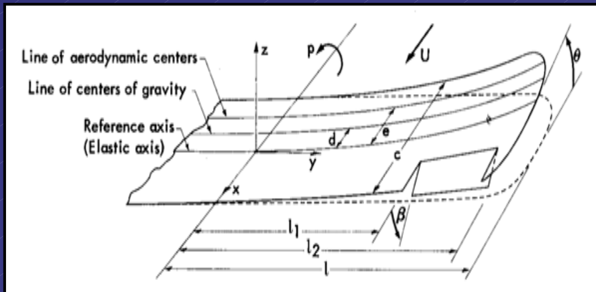


Aeroelastic Analysis

Static aeroelastic problems :

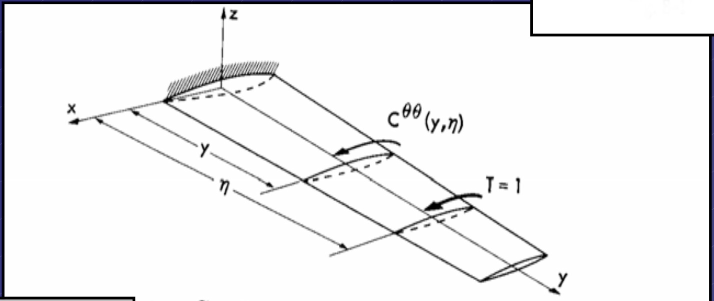
- Divergence Speed
- Aileron Reversal





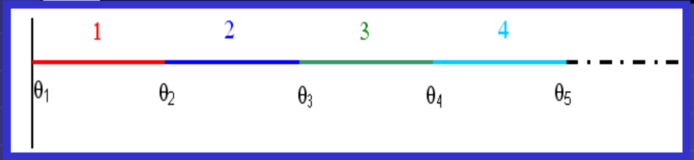
Elastic straight wing with displaced aileron.

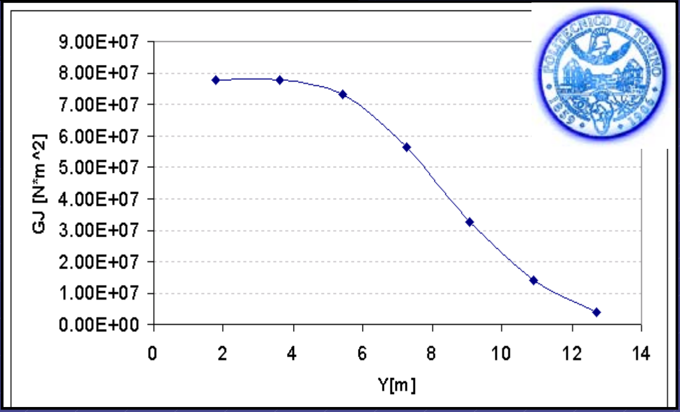
Both FEM approach & Influence Coefficients approach are used



Cantilever wing under unit torque load.

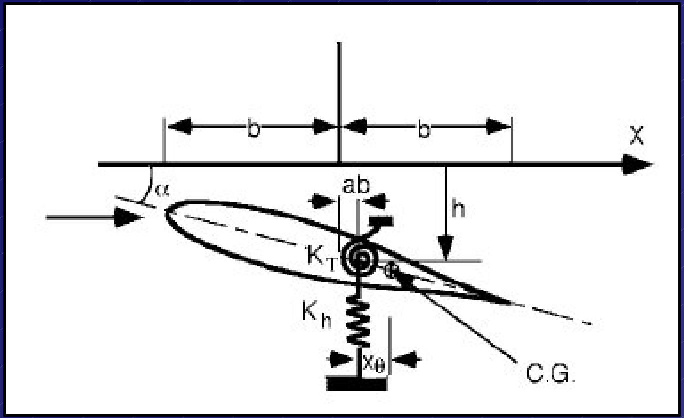
Kg*								
	9,75E+07	-4,88E+07	0	0	0	0		
	-4,88E+07	9,75E+07	-4,88E+07	0	0	0		
	0	-4,88E+07	9,71E+07	-4,84E+07	0	0		
	0	0	-4,84E+07	9,20E+07	-4,36E+07	0	0	0
	0	0	0	-4,36E+07	7,51E+07	-3,15E+07	0	0
	0	0	0	0	-3,15E+07	4,97E+07	-1,82E+07	0
	0	0	0	0	0	-1,82E+07	2,61E+07	-7,94E+06
	0	0	0	0	0	0	-7,94E+06	7,94E+06

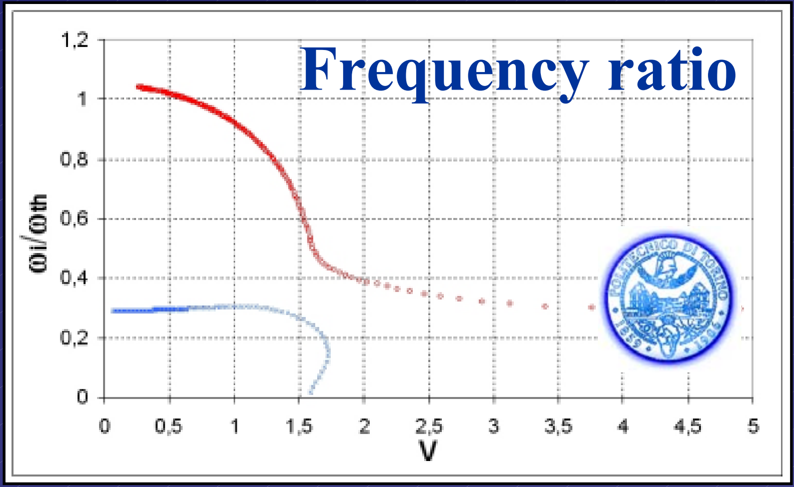




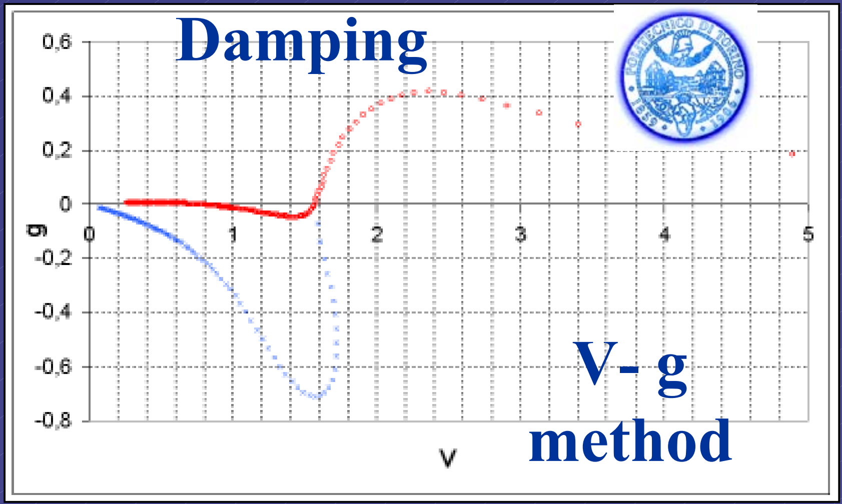
Aeroelastic Analysis

Dynamic Aeroelastic problem:
- Flutter

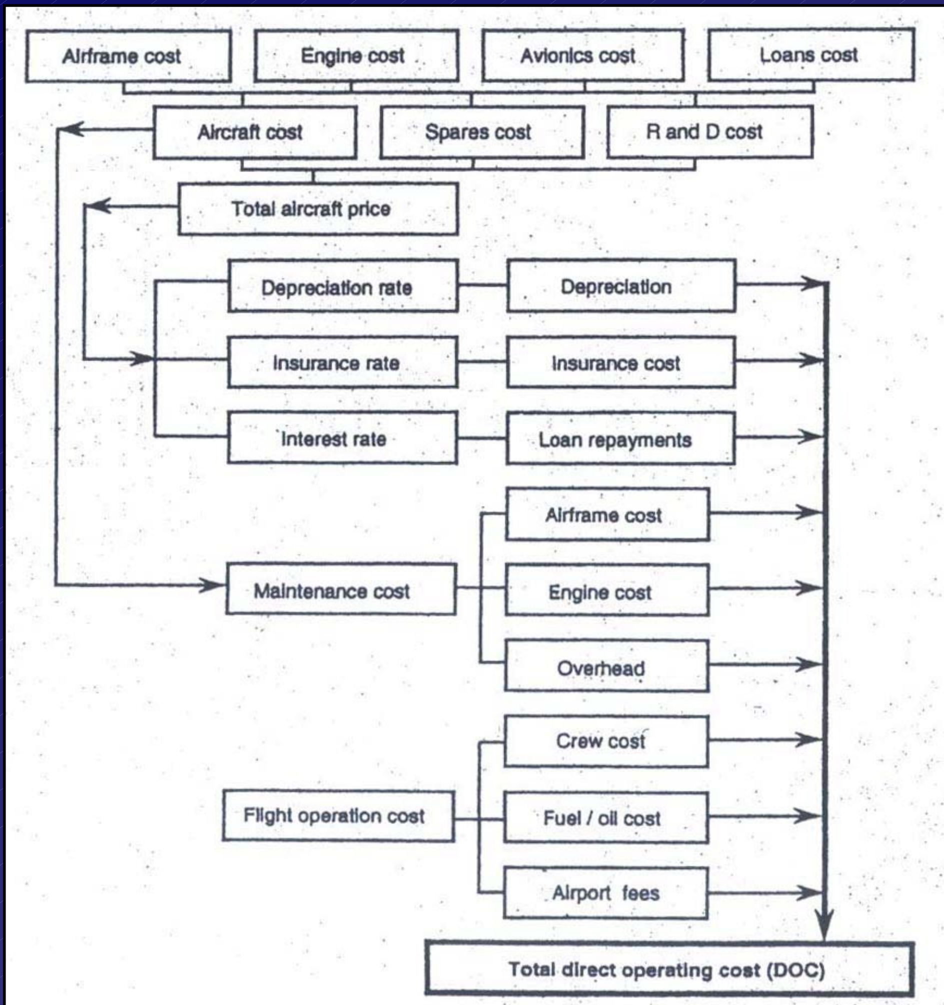


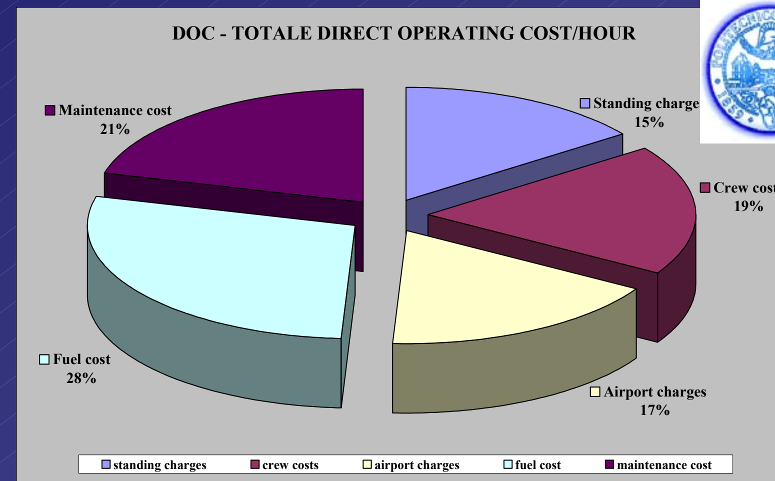


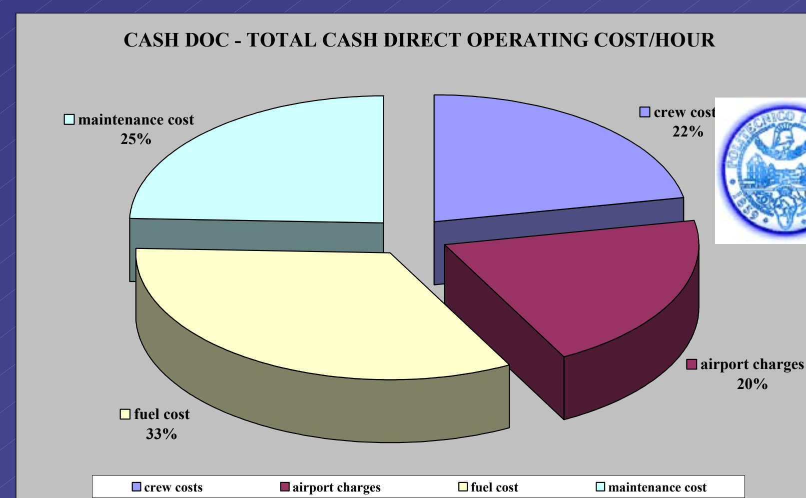
- Typical Section Approach
- Theodorsen Aerodynamic Theory



Cost Analysis

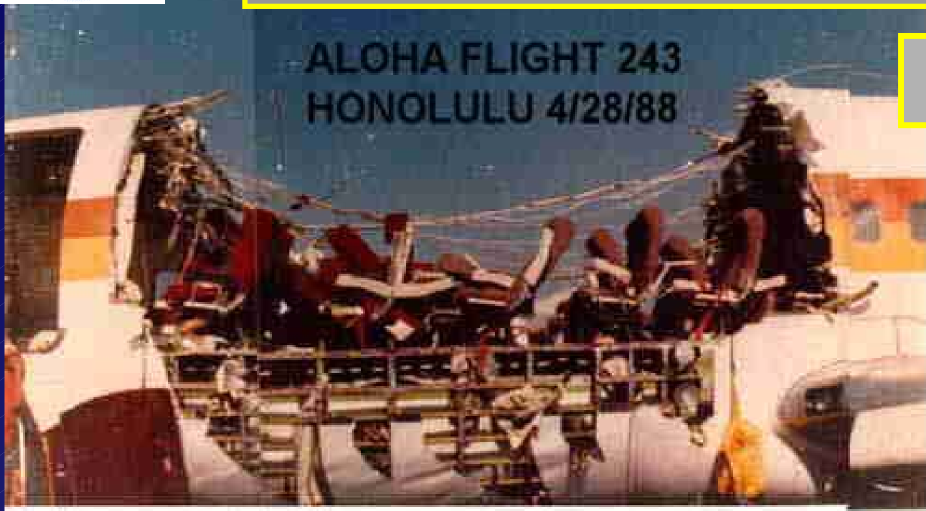




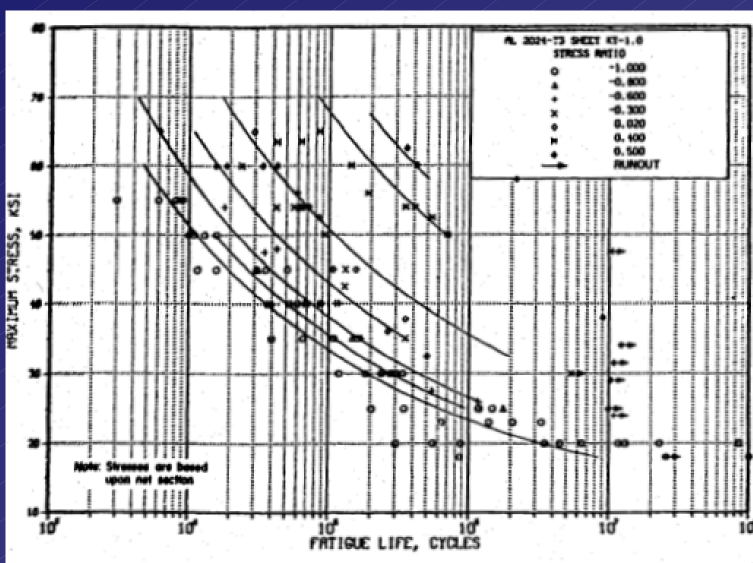


Airframe Structure Design

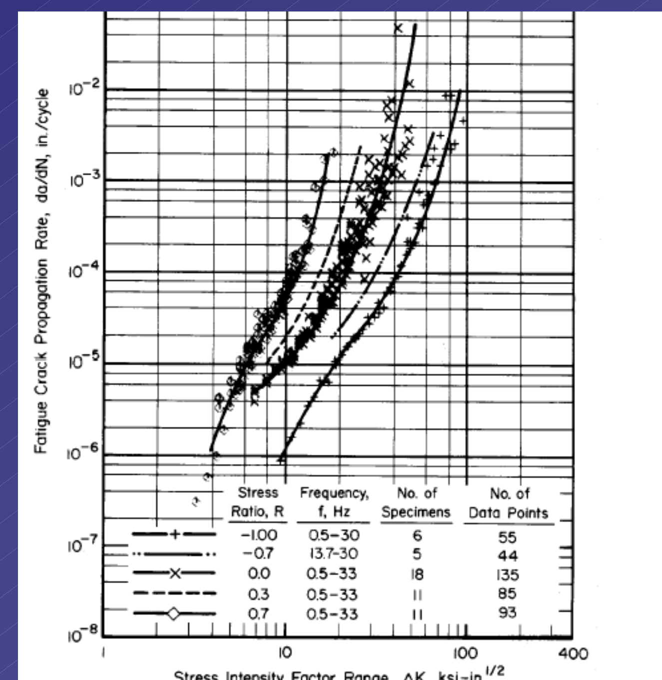
Aircraft Structural Integrity



Design Philosophies:
- "safe life"
- "fail safe
- "damage tolerance"



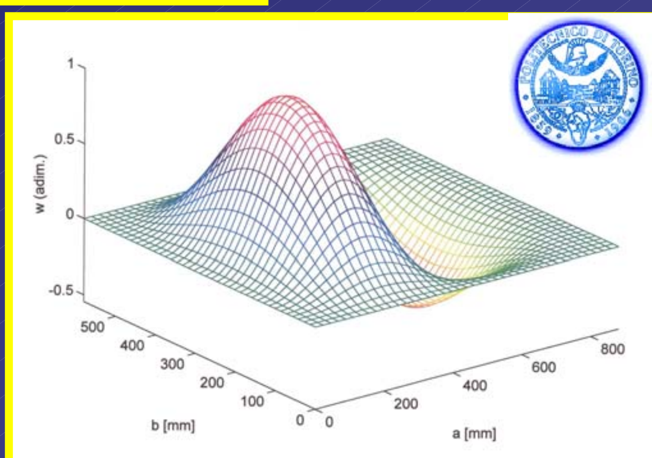
E 3.2.3.1.8(e). *Best-fit S/N curves for unnotched 2024-T3 aluminum alloy sheet, longi direction.*

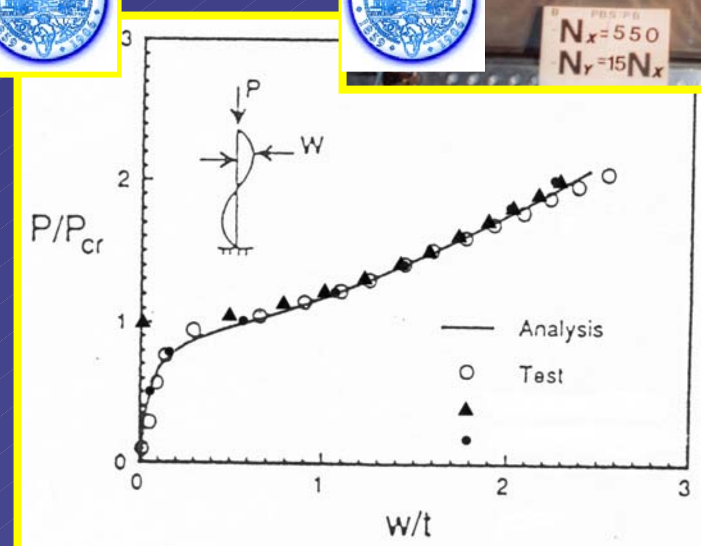


7.4.1.9. Fatigue-crack-propagation data for 0.090-inch-thick 7075-T6

Design of Advanced Composite Structure

Buckling & Post-buckling of CFRP Panels Under Combined Loads

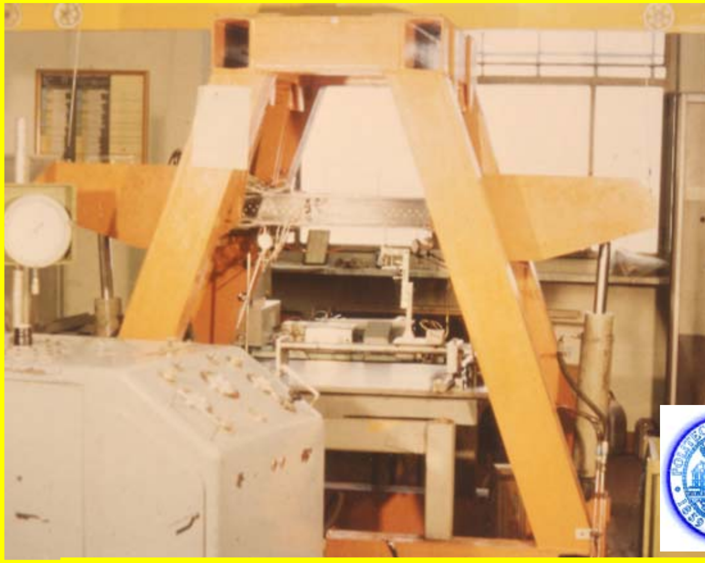


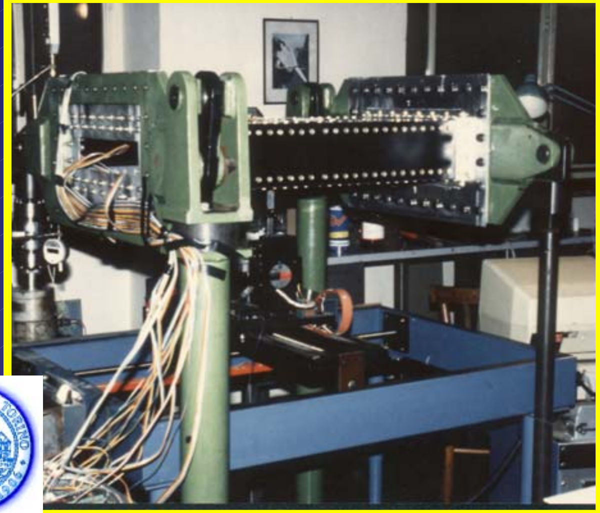


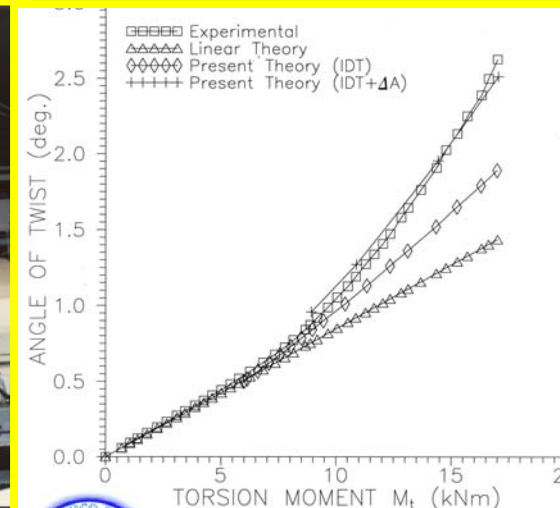
G. ROMEO – Aircraft Design, Politecnico Torino, DIASP, giulio.romeo@polito.it

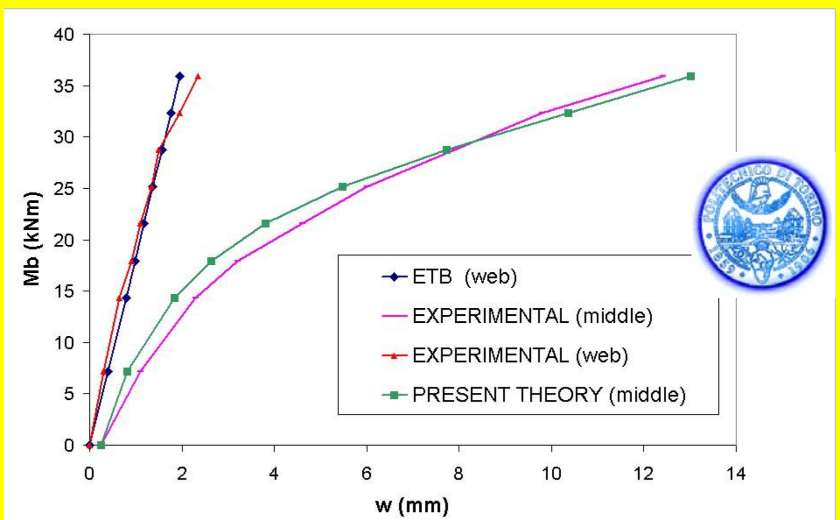
Design of Advanced Composite Structure

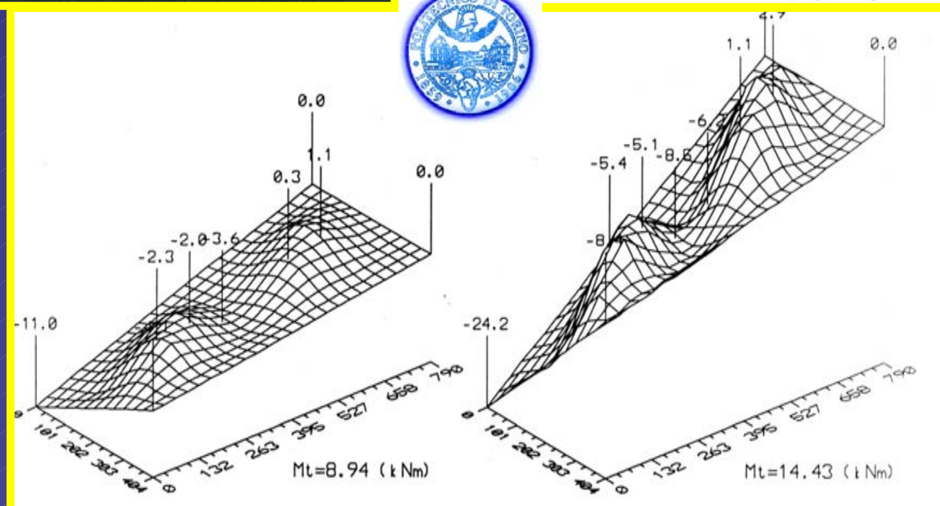
Non-linear Analysis of CFRP Wing Box Under Bending or Torsion











DIASP

A.S.I. (1995-2000)

EC-5FP (2000-2003)

NETwork of HELIplat UAVs

1st European Project of Stratospheric Aircraft

- **High Altitude (15-20km)** *Very-long Endurance Solar Powered Autonomous Stratospheric aircraft* (**VESPAS**) **flying for long period of time (4-6 months) by solar-power & fuel cells system. Easily recovered for maintenance.**
- **Pseudo satellites, with advantage of being much cheaper, closeness to the ground (more detailed land vision) & more flexible than a real satellite.**

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UAV: Unmanned Air Vehicles

Civil & Commercial UAV Market

(by Frost & Sullivan, 2005)

- **Global Market close to \$ 2billion by 2014**
- **The largest market shares are expected to belong to:**

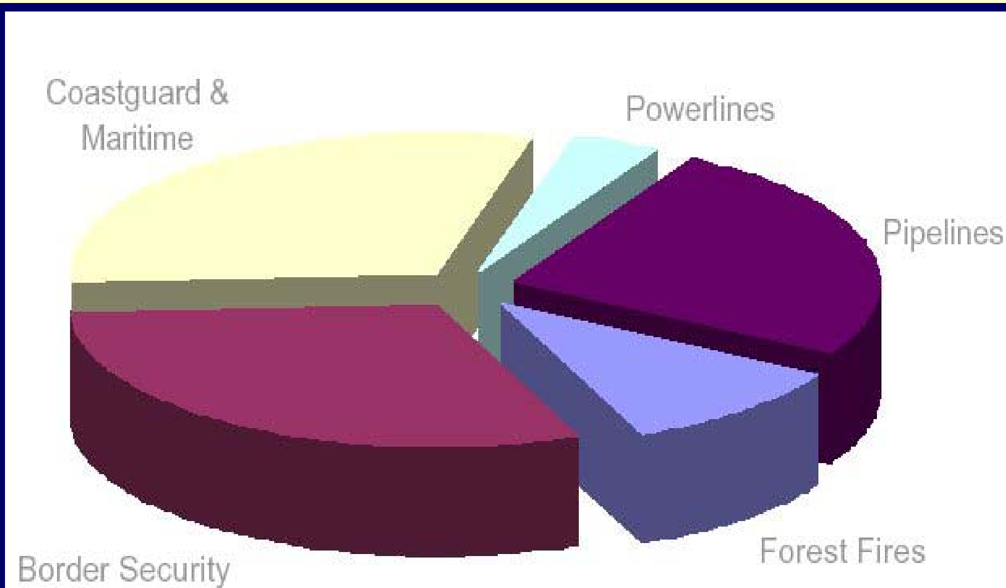
❑ **Coast Guard & Maritime Surveillance**

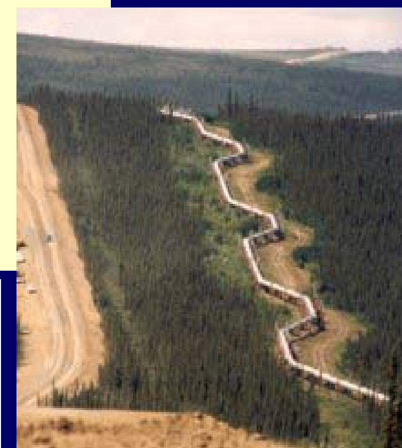
❑ **Border Security**

❑ **Forest Fire Management**

❑ **Pipelines**

❑ **Power lines**





DIASP HELIPLAT

LANDSAT - Orbit: 705Km
Spatial Resolution: 15-60m
Repeat Cycle: 14 days
Design Life: 5 years


e 4.6.1 – Landsat Image of Fire from Helicopter Crash

BIRD - Orbit: 570 Km
Spatial Resolution: 370 m
Repeat Cycle: 24 HOURS
Design Life: 5 years

Integration SATELLITE + UAV = Higher Resolution + Continuous Data

Homeland Security – Airborne or Ground Sensors

Borders Patrol, actually, is made by piloted airplanes or helicopters (several personal) or from military ships, increasing the cost tremendously.

High costs are sustained by Italian Coast Guard for their ATR-42 airplane equipped for border surveillance; with 4 crew minimum, the cost of aircraft is around € 4.500 /hour of fly.

Cost of helicopter equipped for border surveillance is also very high.

In Spain, the cost from Morocco (about 50-60 km) are controlled with a radar system (SIVE) at a cost of 145 M€. Similar very expensive system are being installed along all the Italian coast (more than 2000 km long!!!!).

At which cost?

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NASA Solar-powered UAV (AeroVironment) (1994)

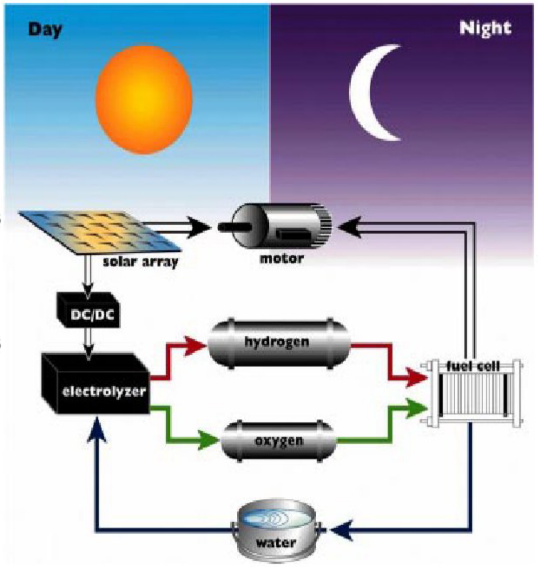
Regenerative Fuel Cell Energy Storage System Summary

Day Cycle

Sun energy converted to electricity by Solar Cells

Half of electricity goes to Motor to propel plane

Other Half of electricity goes to Electrolyzer to convert water into Hydrogen and Oxygen fuel

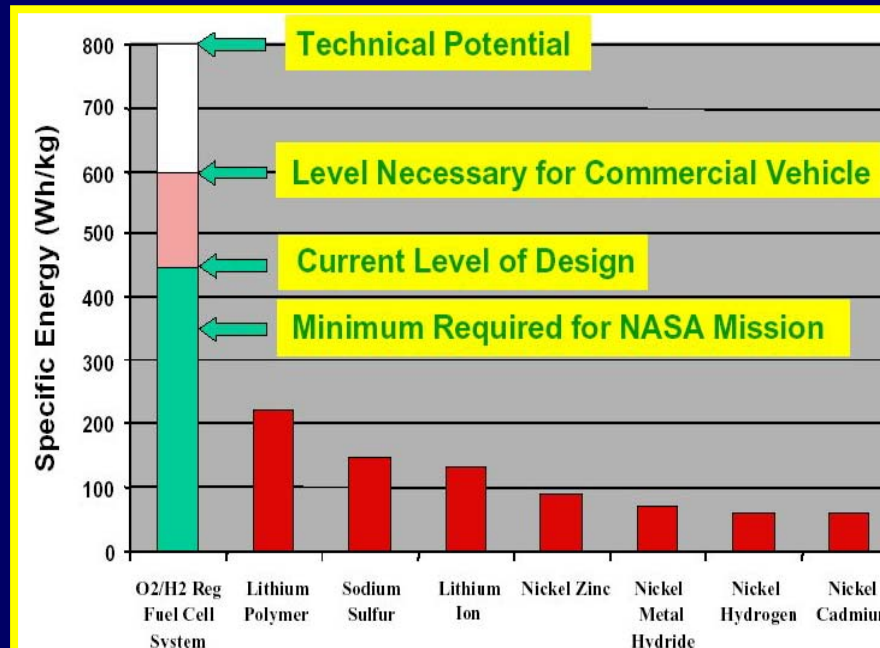


Night Cycle

- Oxygen and Hydrogen combine in Fuel Cell to produce electricity to propel plane
- Water from Oxygen and Hydrogen stored until next day

uel cell energy storage system enables continuos flight through night

Helios Fuel Cells Specific:
5 kW – 10.8 kg (462W/kg)
Gas Consumption:
Ox: 1400l/hr,
Hyd:2800 l/hr
Total volume: 5 litres



DIASP HELIPLAT

NASA Solar-powered UAV

Helios

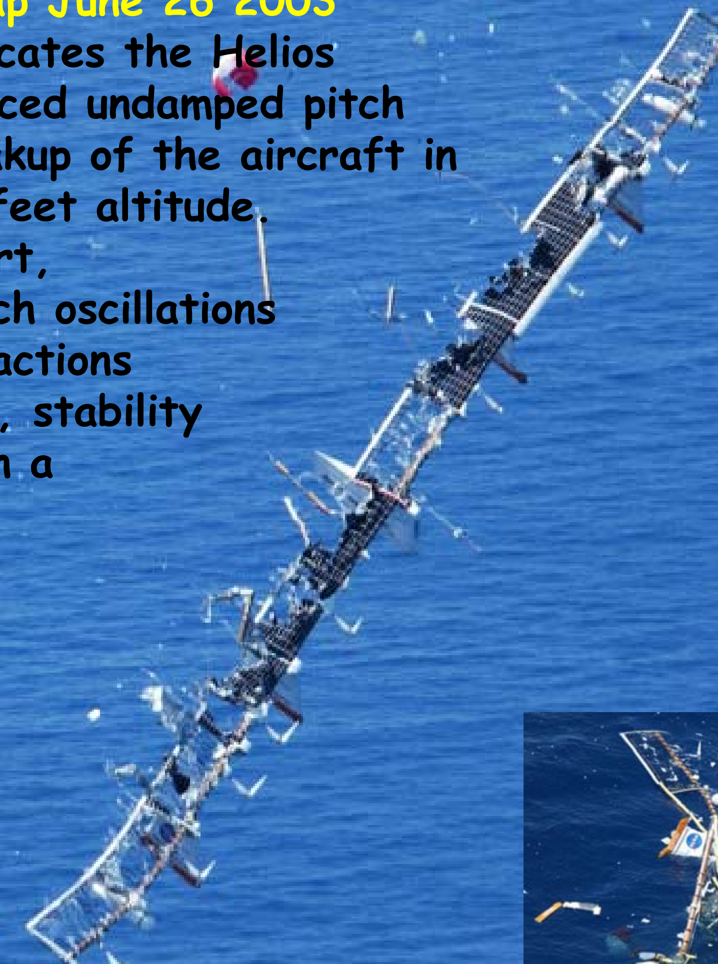
Pathfinder

HELIOS (AeroVironment):
Span 76m; Altitude: 29.5 km
TOGW: 7.3kN Payload weight: 1kN
Payload power: 1kW.
Endurance:4-6 months

Helios Solar UAV should had fly at 20km altitude using renewable energy, for day/night operations, aiming at a flight of several days in summer 2003.

DIASP

Helios Solar-powered UAV



HELIOS PROTOTYPE:In-flight mishap June 26 2003

"the NASA Mishap Investigation indicates the Helios Prototype appeared to have experienced undamped pitch oscillations that led to a partial breakup of the aircraft in mid-air while flying at about 3,000 feet altitude.
According to the interim status report,
the board believes the undamped pitch oscillations may be related to the complex interactions between the aerodynamic, structural, stability and control and propulsion systems on a flexible aircraft."

DIASP

HELIPLAT® Solar-powered UAV

- 1995: ASI (Italian Space Agency), design of Solar-powered HAVE-UAV
- Jan 2000: EC (V FP- IST action): project HELINET (HELIplat NETwork) (Network of stratospheric platforms for traffic monitoring, environmental surveillance and broadband services.- Coordinator: Politecnico di Torino);

  - 1st European project in the field of stratospheric platform.

The main objectives of the HELIPLAT project, are:

- Design of HAVE-UAV flying for very long period of time (4-6 months) by a solar-powered & fuel cells system; feasibility of near term aerodynamic HAVE concept, high efficiency & affidability of solar cells, fuel cells and electric motors).

- Design all advanced composite wing (75 m long), and structures and to verify the production cost for each platform.

- Manufacture a scale-sized technological demonstrator (24m wing span) and to perform static tests on it up to the ultimate load.

- Assess the safety and regulatory aspects of the platform.

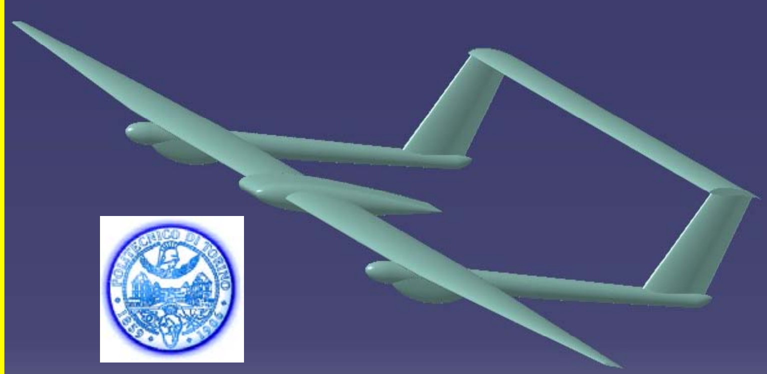
HELIPLAT® (*HELIos PLATform*)

DIASP

Multi-disciplinary optimisation program:
1) Solar radiation change over year
2) Altitude; 3) Wind speed;
4) Mass and efficiency of solar cells
5) Mass and efficiency of fuel cells
6) Aerodynamic performances;
7) Structural mass.

ASI 1995

® Trademark of Dept. of Aerospace Eng Politecnico di Torino



EC 2000

- A twin boom configuration would reduce the wing bending moment.
- A tubular spar for wing, tails or booms would allow a very light structure; indeed, it has to fulfil all the JAR requirements.

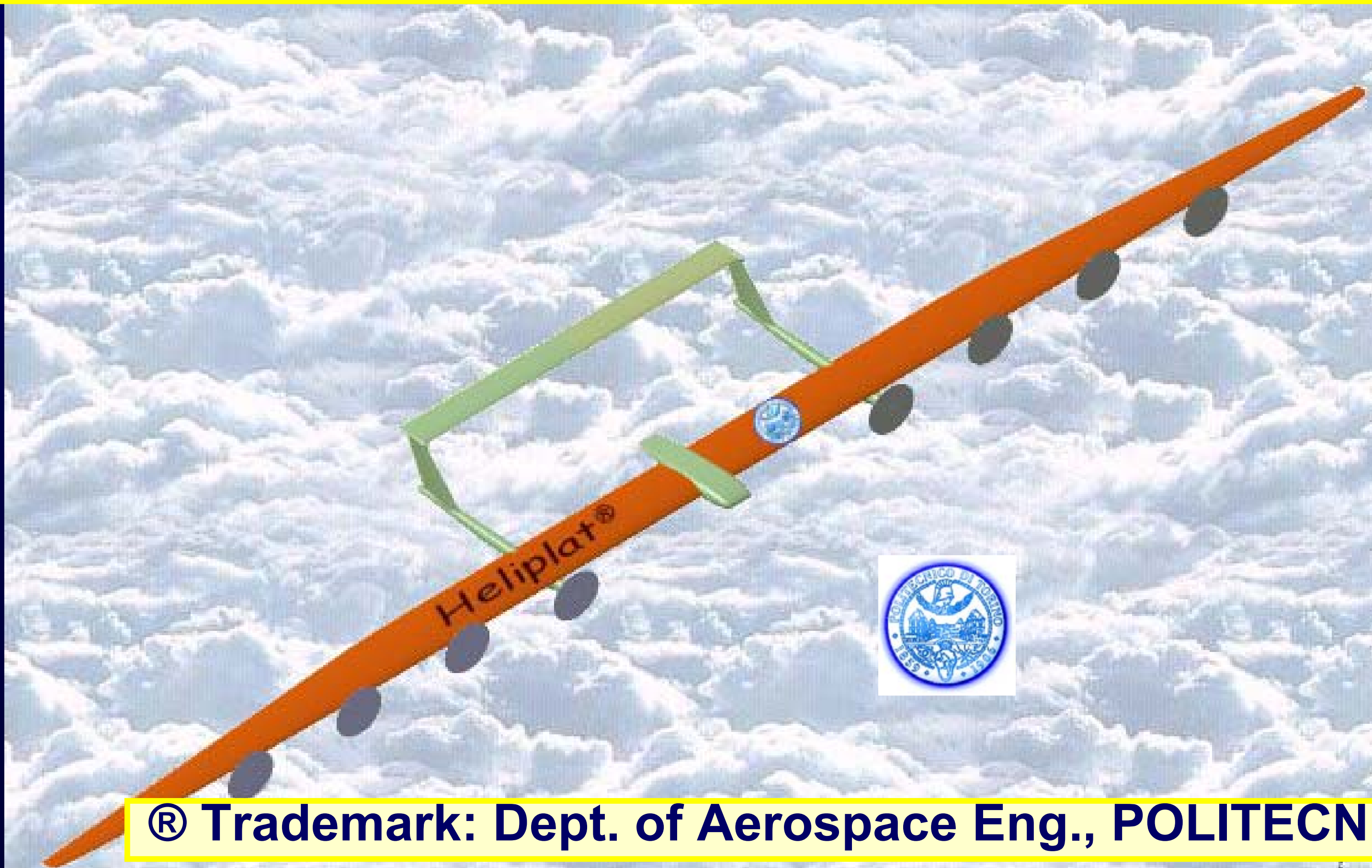
EC 2002

DIASP

HELIPLAT® (*HELIos PLATform*)

WT=750kg; Wpl=130kg; Preq=6.5kW; Ppl=1.5kW;
Vc=71km/h; Solar cell effic. 21%; Fuel cell effic. 60%

Sw=176.5m2; b=73m; ARw=30.2; S ht=28m2; b=17.5m;



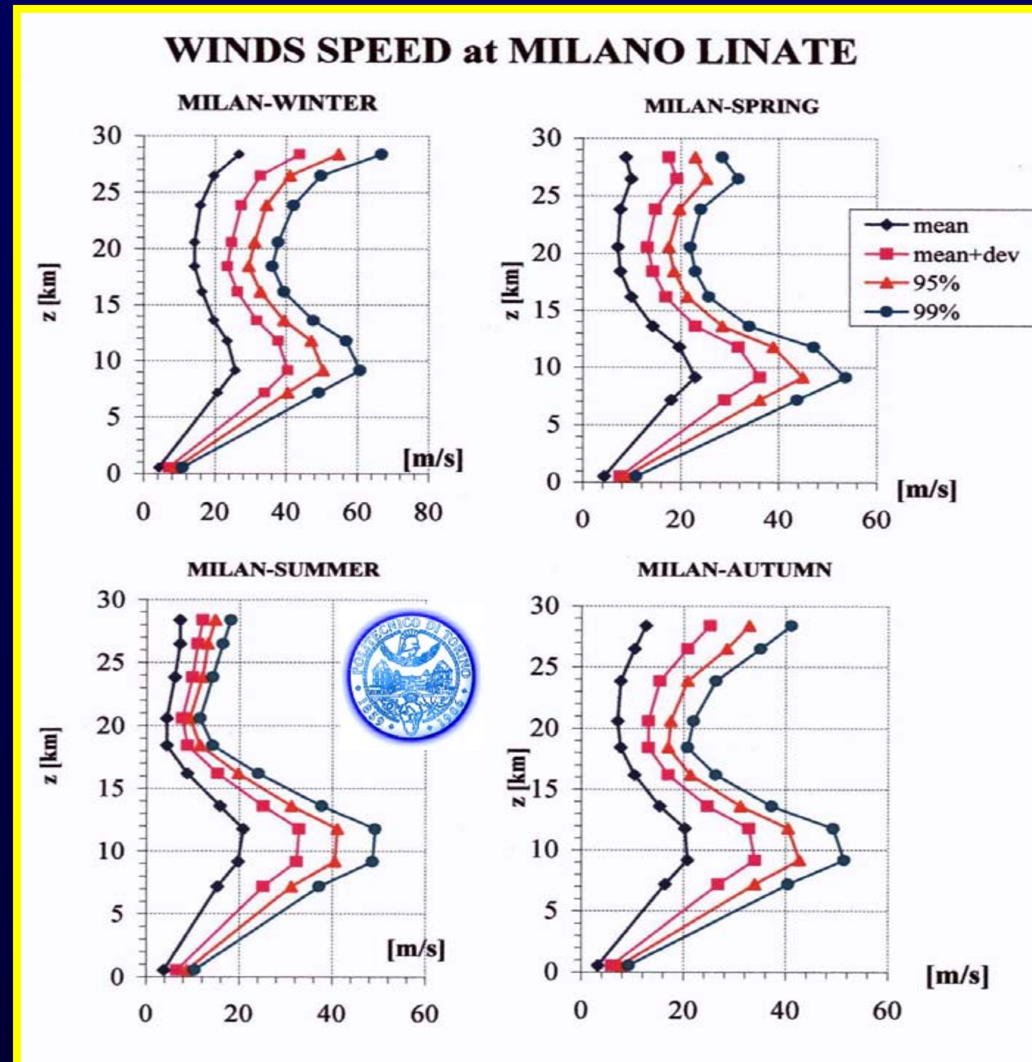
EC - 5FP

® Trademark: Dept. of Aerospace Eng., POLITECNICO DI TORINO

DIASP

WIND SPEED STATISTICAL DATA

Elaboration from Italian Air Force Record Data



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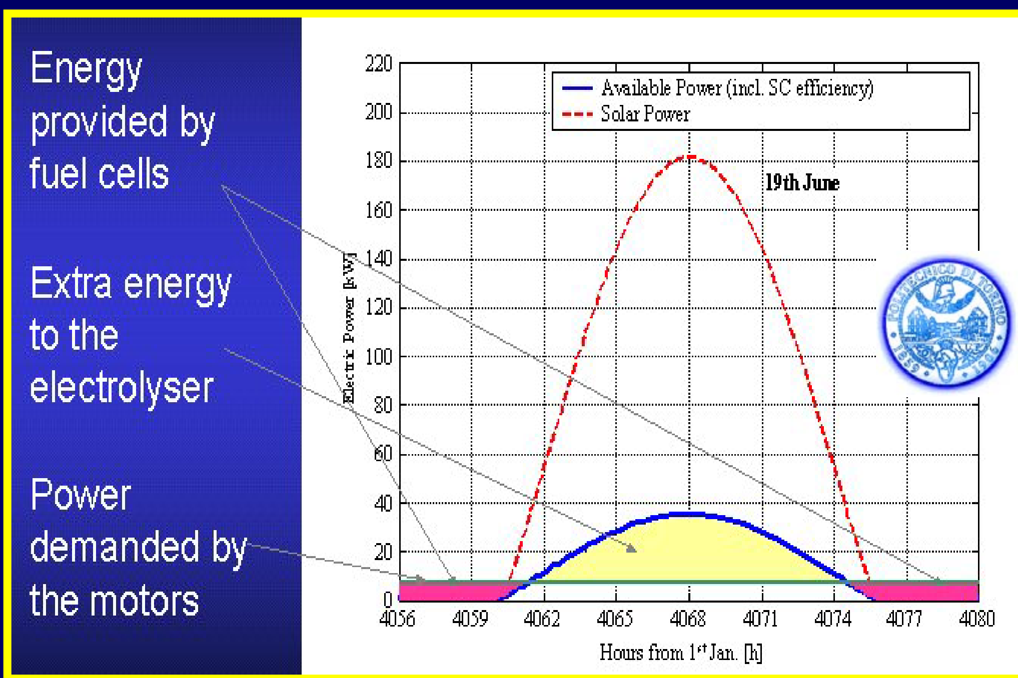
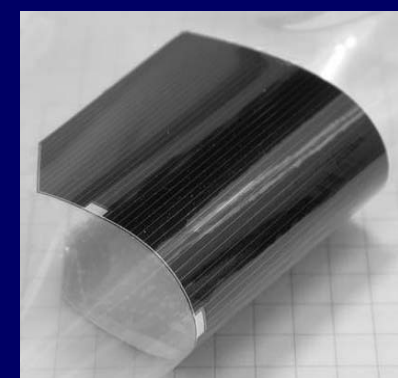
SOLAR CELLS

- **Maximum available Solar cell efficiency: 85%.**
- **To-date obtained solar cells efficiency: 36%.**
- **High efficiency (15-17%) thin (2-300 microns) single-crystal silicon cells are to-day available at low price (about 800 €/m2) .**
- **Higher efficiencies (up to 25%) very thin (50 microns) single-crystal silicon or GaAs cells are also available, at higher price (about 30 k€/m2) .**





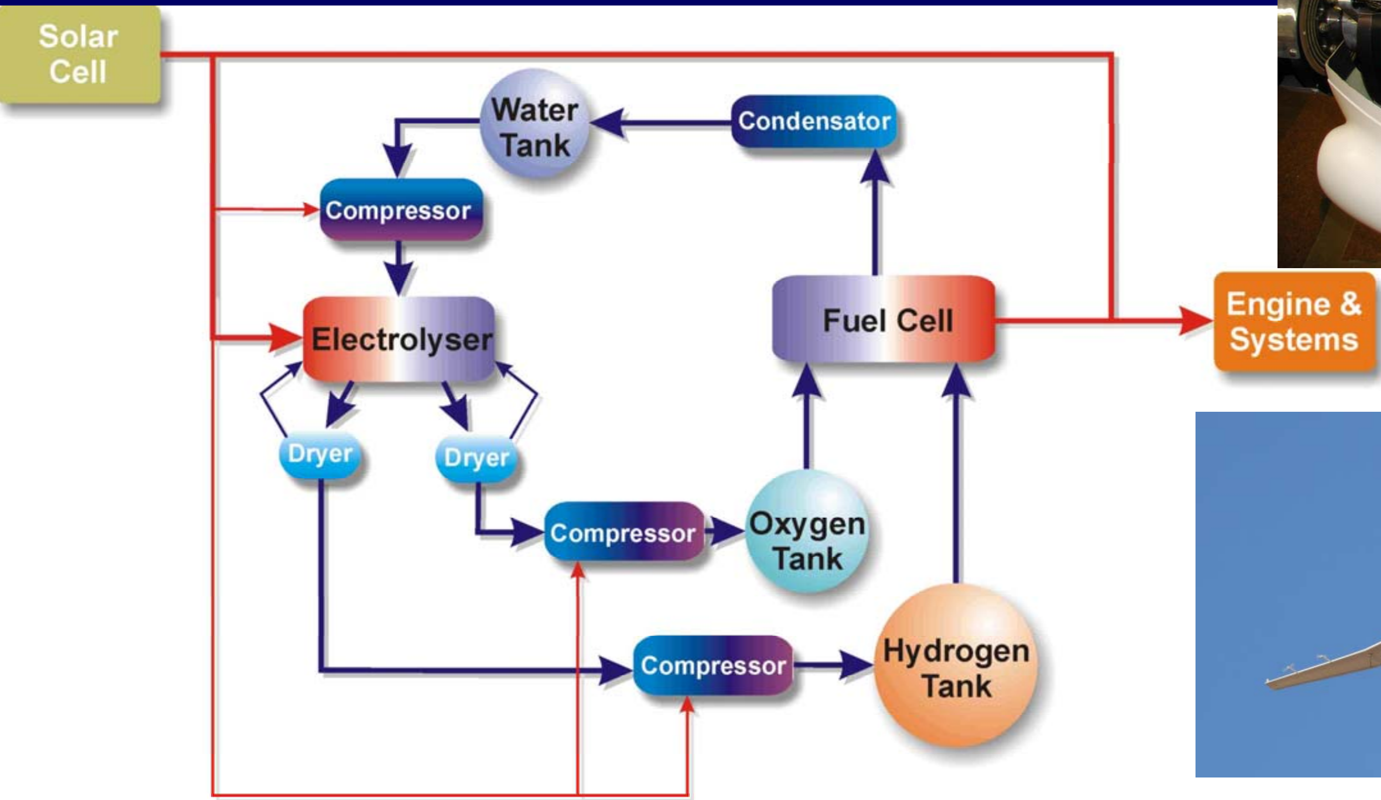
Price: ≈ 30 k€/m2
Weight:0.15 kg/m2

InGaP/GaAs THIN FILM CELL

Technologies – fuel cells

Based on dedicated electrolyses & fuel cells (solid polymer type)
Energy Density: 400-600 Wh/kg; Present day efficiency: 55%
Production cost: 3-4 hundred thousands Euro.

FASTec/NASA E-Plane



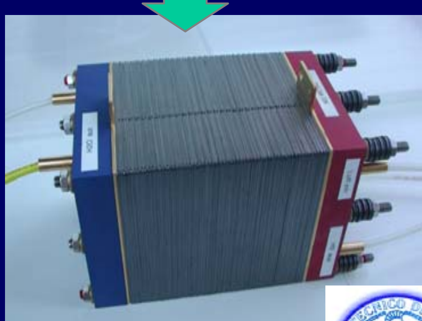
Scaled Global Observer

Technologies – fuel cells

DEPT. ENERGETICS

1 : 12

H_2 O_2

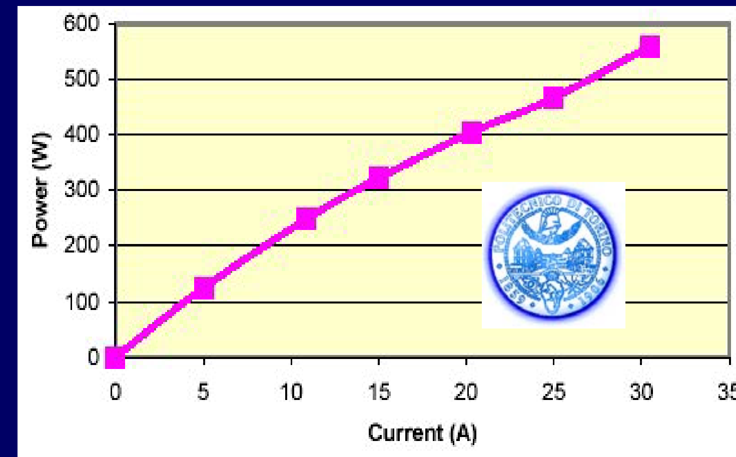


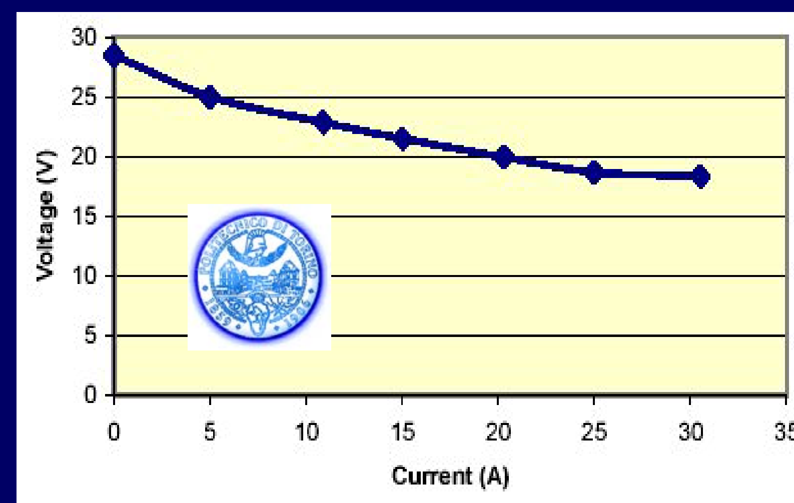
WATER

1/12 Electrolyser

- Peak power: 2800 W
- Max H_2 mass flow: 500 Nl/h
- Pressure: 9 bar

H_2 O_2





Technologies – fuel cells

ENFICA–FC: ENvironmentally Friendly Inter City Aircraft powered by Fuel Cells.–6FP-3rd call-proposal under evaluation

1) A feasibility study will be carried out to define preliminarily transport aircraft propulsion systems that can be provided by fuel cell technologies,

2) A two-seat electric-motor-driven airplane powered by fuel cells will be developed and validate by flight-test, by converting a high efficiency existing aircraft.

POLITECNICO DI TORINO (Coordinator) – IAI - INTELLIGENT ENERGY- BRNO UNIVERSITY OF TECHNOLOGY– EVEKTOR - JIHLAVAN AIRPLANES- ENIGMATEC- AIR PRODUCTS- UNIVERSITE' LIBRE DE BRUXELLES – INFOCOSMOS.

IAI- G100 (Astra SPX)

L-610 40-seat commuter

EV-97 VLA HARMONY

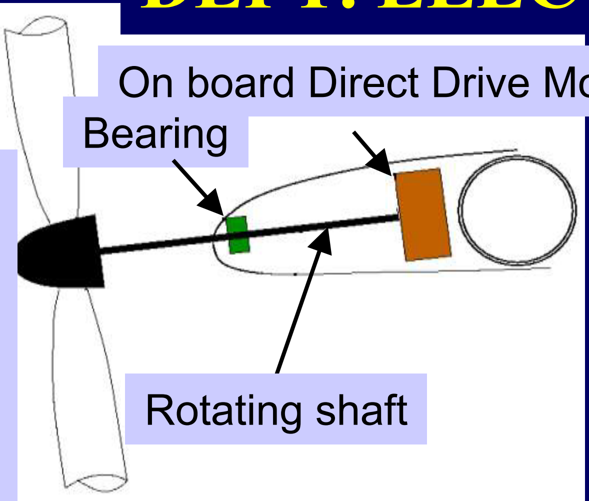
JIHLAVAN KP-2U

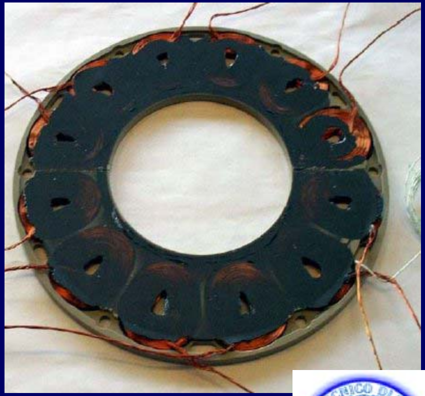
Technologies - electrical engines

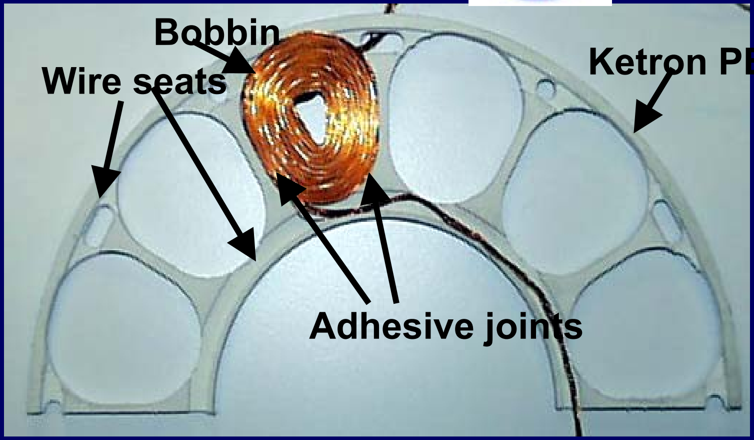
DEPT. ELECTRIC ENG.

- **Direct-drive DC-brushless motors**

- **permanent magnets brushless motors**
- **1.5kW nominal, 3kW peak**
- **96% efficiency**





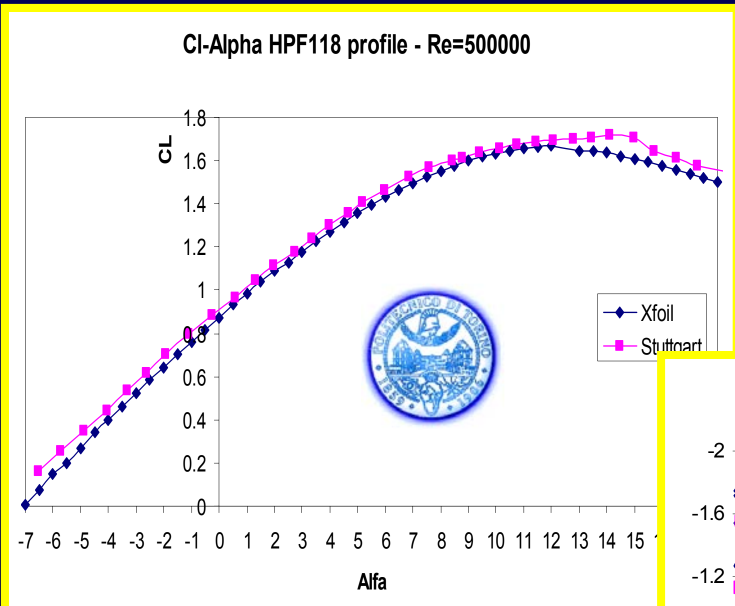


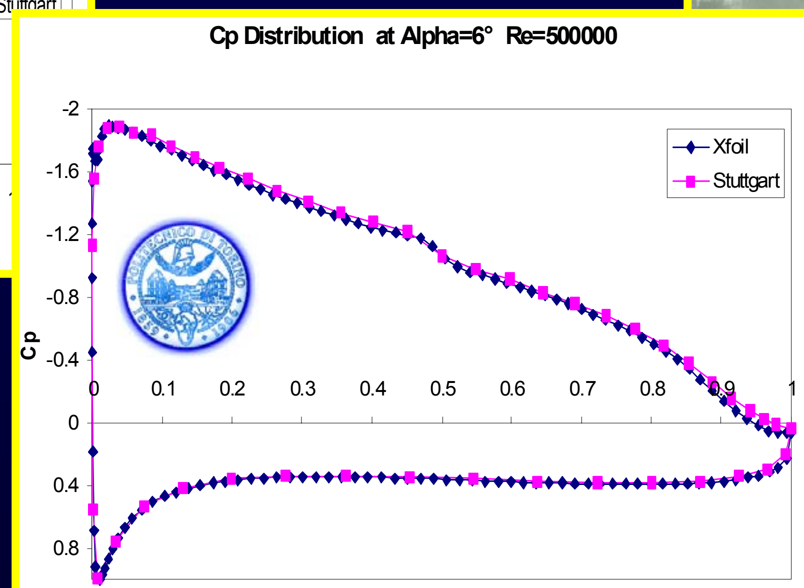
inverter

HELIPLAT® Aerodynamic Design

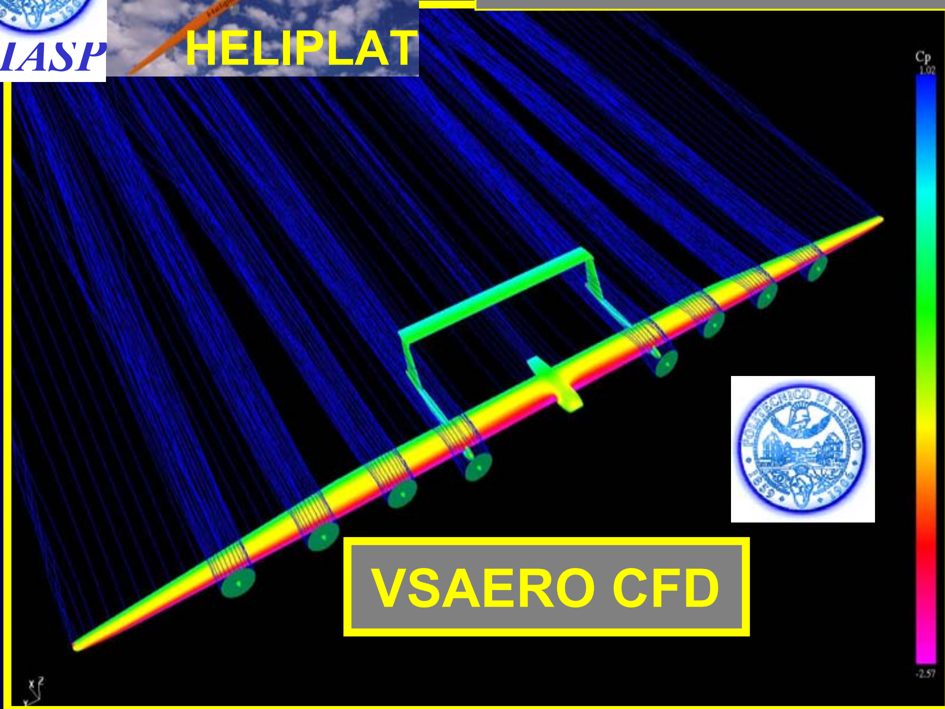
$$P = W \cdot \left(C_D / C_L^{1.5}\right) \cdot \sqrt{(2/\rho) \cdot (W/S)}$$

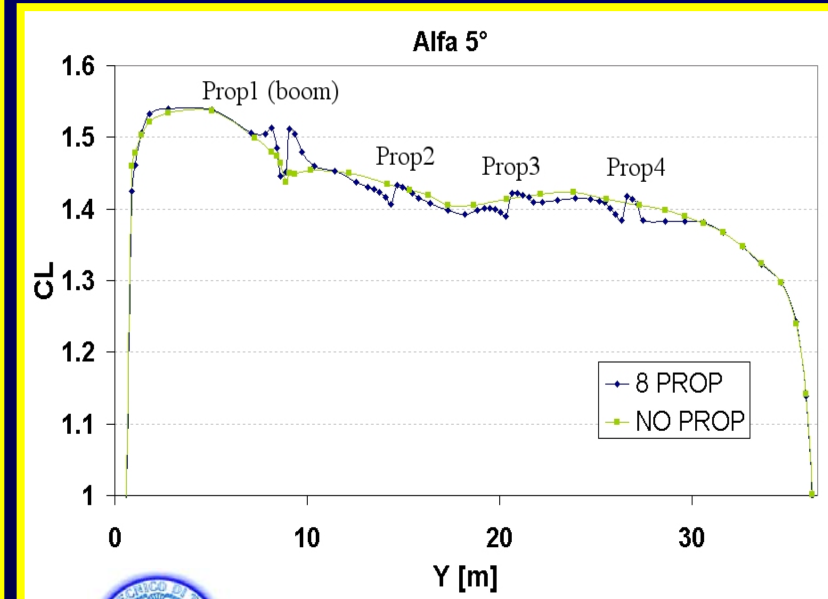
New high aerodynamic performances airfoils for low Reynolds numbers have been developed to reduce the power required for the flight.

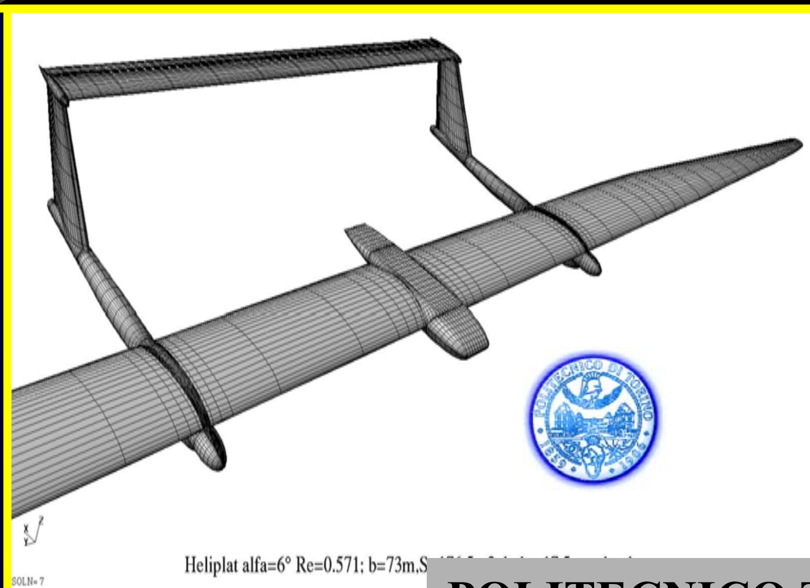


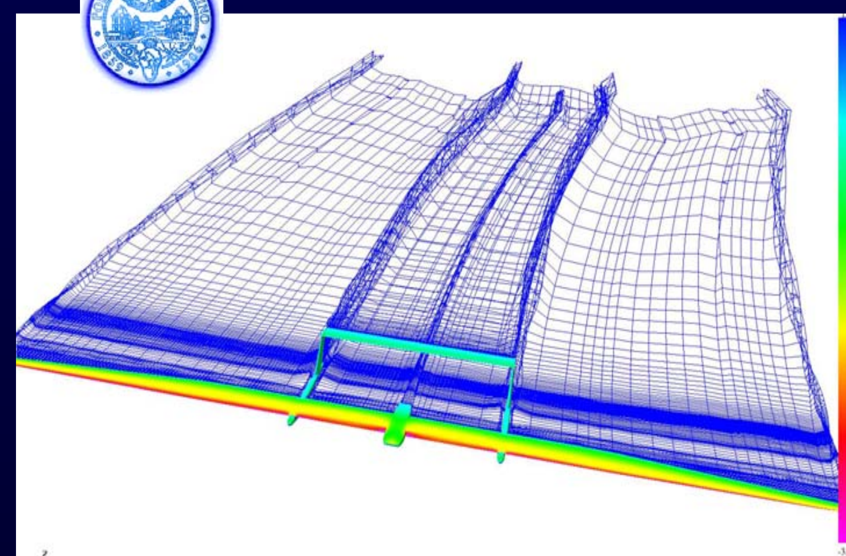


HELIPLAT® Aerodynamic Design









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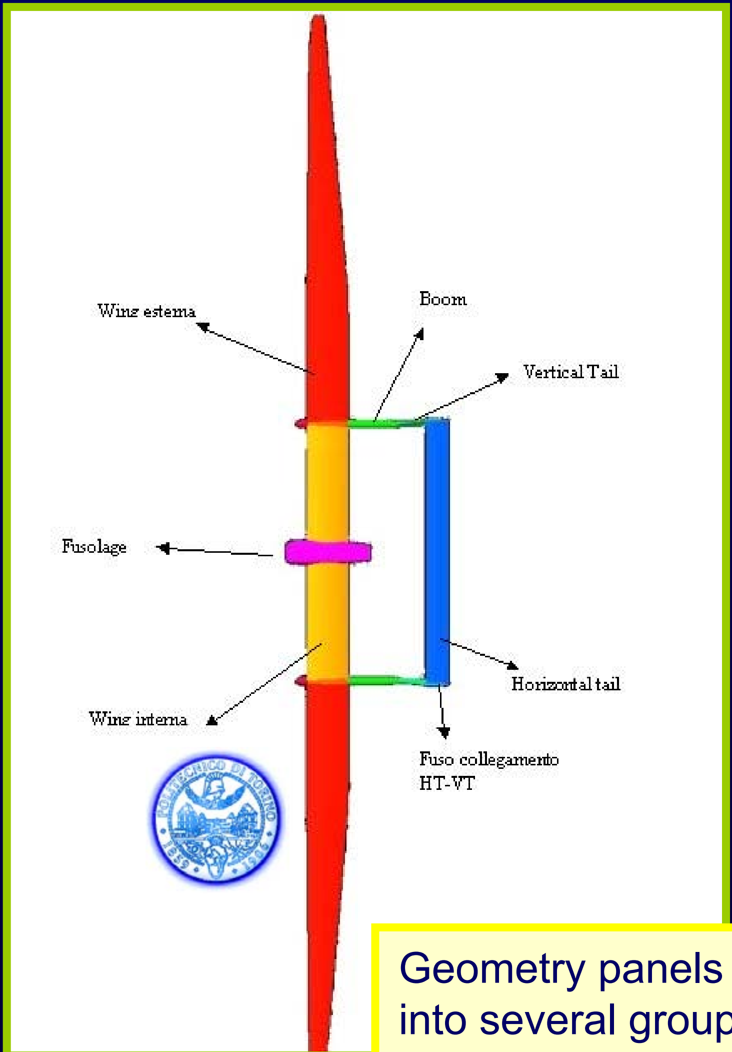
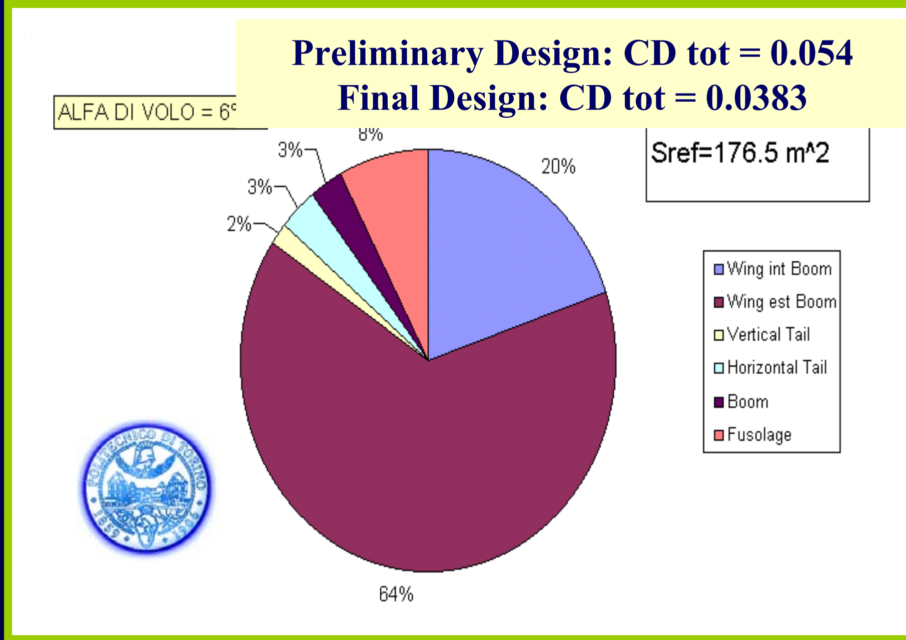
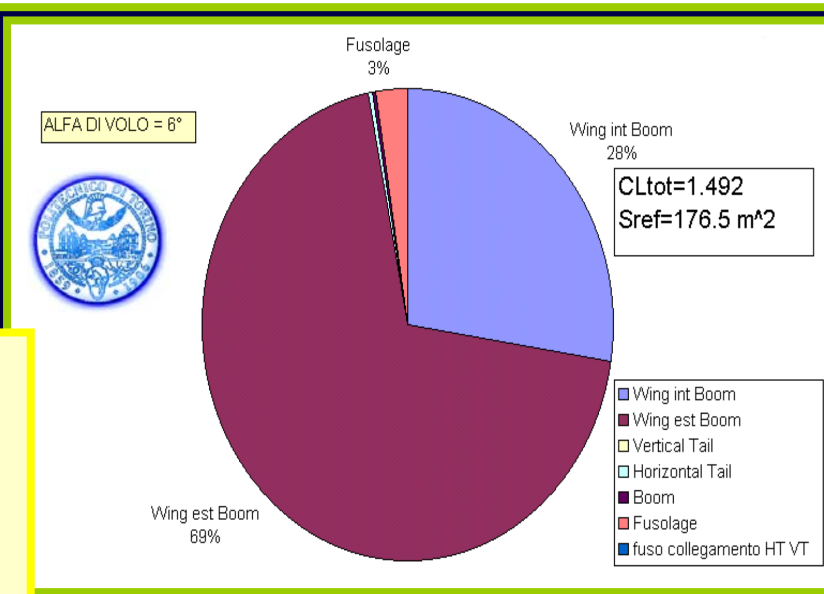
HELIPLAT® Aerodynamic Design



Preliminary Design: CD tot = 0.054
Final Design: CD tot = 0.0383

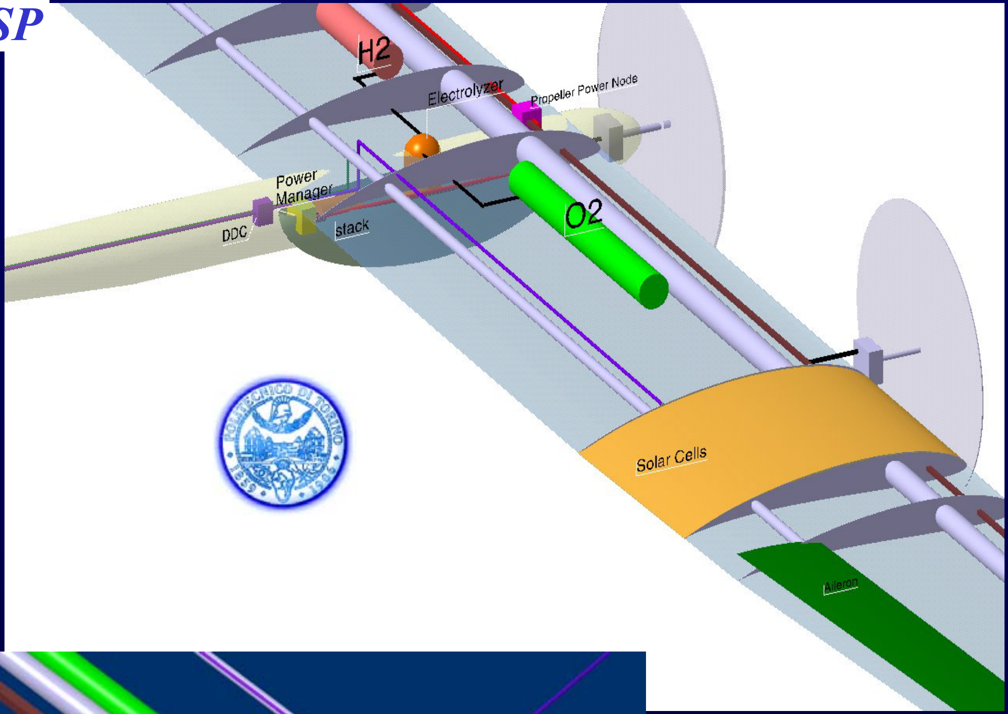


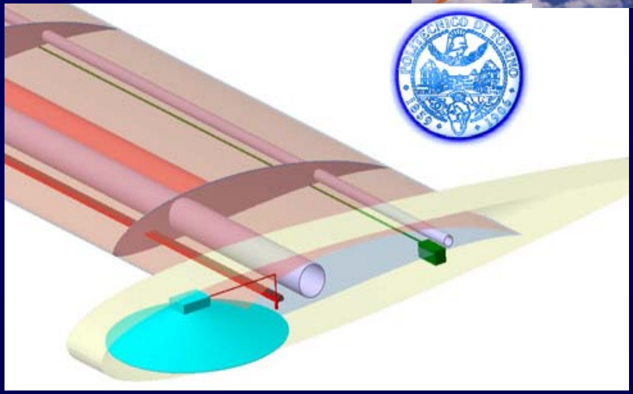


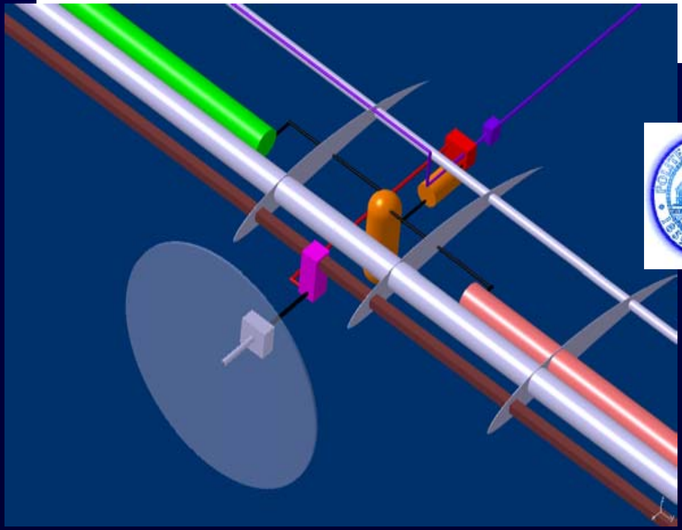
Geometry panels are divided into several groups to identify the single part contribution to the total DRAG and LIFT coefficient

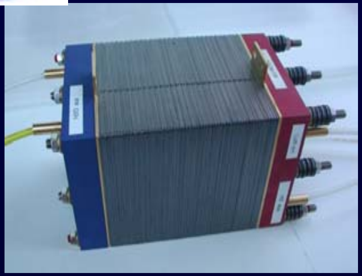
HELIPLAT® Preliminary layout

DIASP









BRUSHLESS ELECTRIC MOTOR

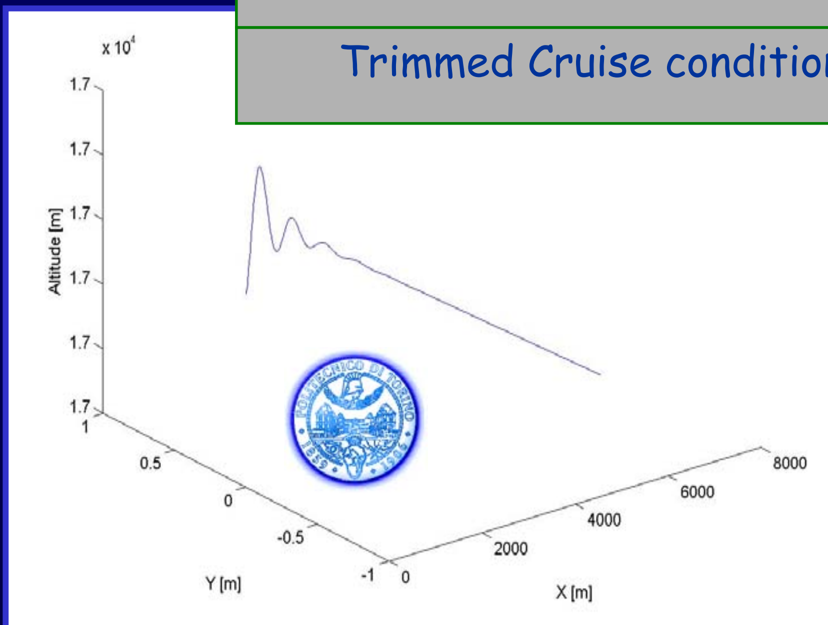
FUEL CELL STACK

POLITECNICO TORINO, DIASP, giulio.romeo@polito.it

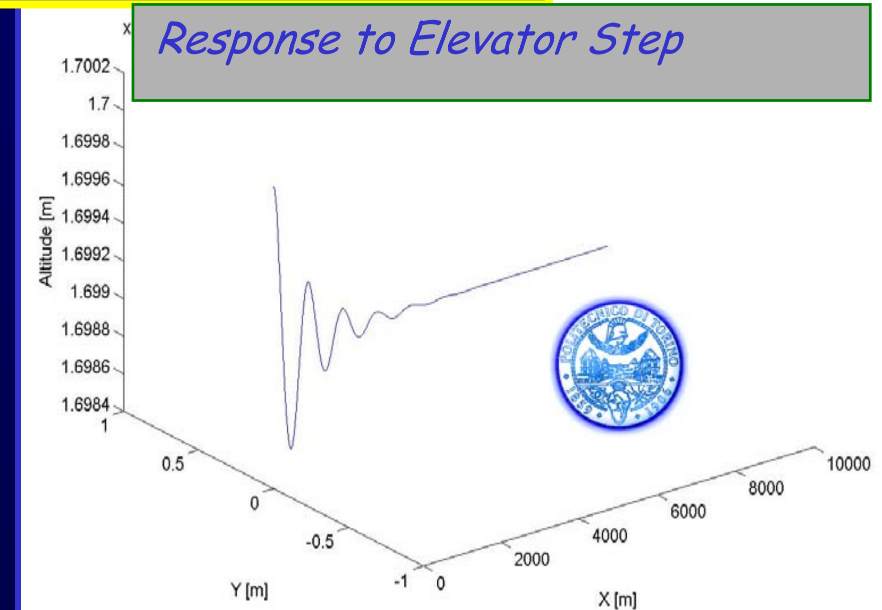
FLIGHT MECHANICS

Dynamic Stability Results

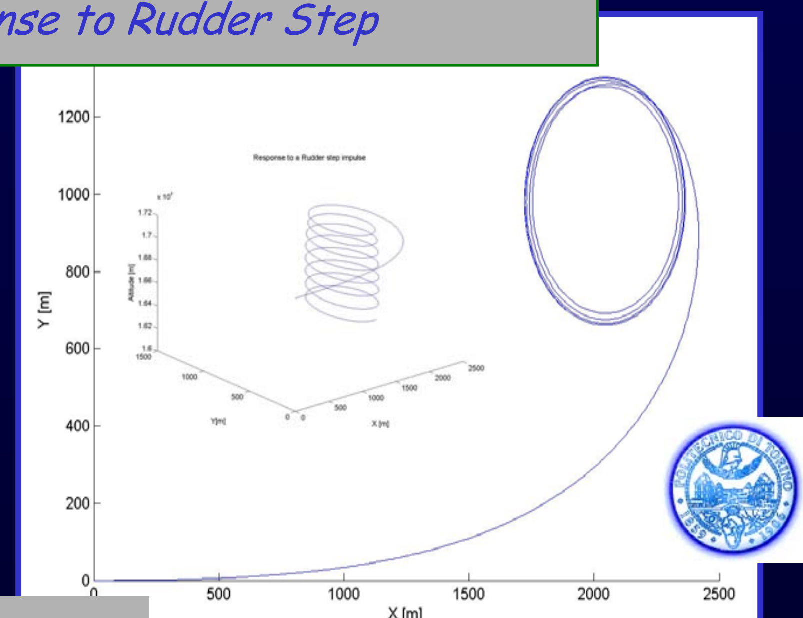
Trimmed Cruise condition



Response to Elevator Step



Response to Rudder Step



Spiral divergence is strongly affected by Clr, roll torque due to yaw rate. In long-span airplanes which fly slowly the inboard wing is flying very slow compared to the outboard wing when turning and this velocity difference, due to yaw rate, causes the lift across the wing to vary, and the aircraft rolls into the turn

DIASP

COST MODEL

Total Life Cycle Cost

Index — Project Name: HALE Solar - 2 (1.1,40prod,2920fh) [27/01/05]

Project Name:	HALE Solar
Configuration:	2 (1.1,40prod,2920fh)
Analysis Date:	27/01/05
Currency:	€
Exchange Rate: 1 $ =	0.766 €

Manufacturer

- Development & Production Cost >>
- Price >>

Operator

Inputs	Outputs
Acquisition >>	Direct Cost >>
Initial Support >>	Fixed Cost >>
Operating >>	Flight Hour Cost >>
Infrastructure >>	Annual Budget >>
	Life Cycle Cost >>

Total Life Cycle Cost — Project Name: HALE Solar - 2

			% of LCC
Operating cost per year	€	28'743'960	
Years of operation		20	
Development	€	3'054'012	0%
Acquisition	€	101'329'438	13%
Initial Support	€	19'505'888	3%
Operating	€	574'879'201	77%
Infrastructure (7.50% of sub total)	€	52'407'640	7%
TOTAL LCC	**€**	**751'176'180**	
TOTAL LCC / FLIGHT HOUR [€/FH]	**€**	**713**	

Operative Costs

Total Operating Cost per Year — Project Name: HALE Solar - 2

ITEM	NOTES	DESCRIPTION	Flight line workers	GCS workers	Supervisor	TOTAL WORK	LOCAL EXPENSE	LOCAL SUB CONTR-ACTOR	TOTAL OPERATING COST
1	Labor	Flight line (pre flight - 1 shifts/day)	€ 23'424	€ 140'544	€ 29'280	193'248			193'248
2	Labor	Flight line (flight - 3 shifts/day)	€ 702'720	€ ########	€ 878'400	5'797'440			5'797'440
3	Labor	Flight line (post flight - 1 shifts/day)	€ 234	€ 1'405	€ 293	1'932			1'932
4	Food ...	Food & sleeping expense					€ 102'147		102'147
5	Car	Car rent					€ 16'119		16'119
6	Generators	Rent of Generators						€ 64'475	64'475
7	Generators	Fuel for Generators						€ 40'297	40'297
8	Engineering	Engineering support						€ 384'000	384'000
9	Communication	Communication support						€ 120'000	120'000
10	Propulsion	Propulsion system inspection	€ 78'080			78'080	€ 231'800		309'880
11	Propulsion	Propulsion system replacement	€ 14'757			14'757	€ ########		4'283'781
12	Spares for UAV	Other spares- 5% of UAV value					€ ########		3'372'811
13	Spares for GCS	Other spares- 5% of GCS value					€ 70'000		70'000
14	Spares for GDT	Other spares- 5% of GDT value					€ 60'000		60'000
15	Inspection labor	Included in items 1-3							
16	Insurance	Insurance of ground equipment (2.0					€ 52'000		52'000
17	Insurance	Insurance of UAVs (14.1%)					€ ########		13'875'830
18	Fuel	Fuel & Additives					0		0
	TOTAL	OPERATING COST PER YEAR	€ 819'215	€ ########	€ 907'973	6'085'458	€ ########	€ 608'771	28'743'960

#	NOTES	DESCRIPTION	Maintenance hours	Maintenance hours / FH
1	Labor	Flight line (pre flight - 1 shifts/day)	586 hr	0.01
2	Labor	Flight line (flight - 3 shifts/day)	17'568 hr	0.33
3	Labor	Flight line (post flight - 1 shifts/day)	6 hr	0.00
10	Propulsion	Propulsion system inspection	1'952 hr	0.04
11	Propulsion	Propulsion system replacement	369 hr	0.01
	TOTAL Maintenance Hours per Year		20'480 hr	0.39

<<<<>>>>

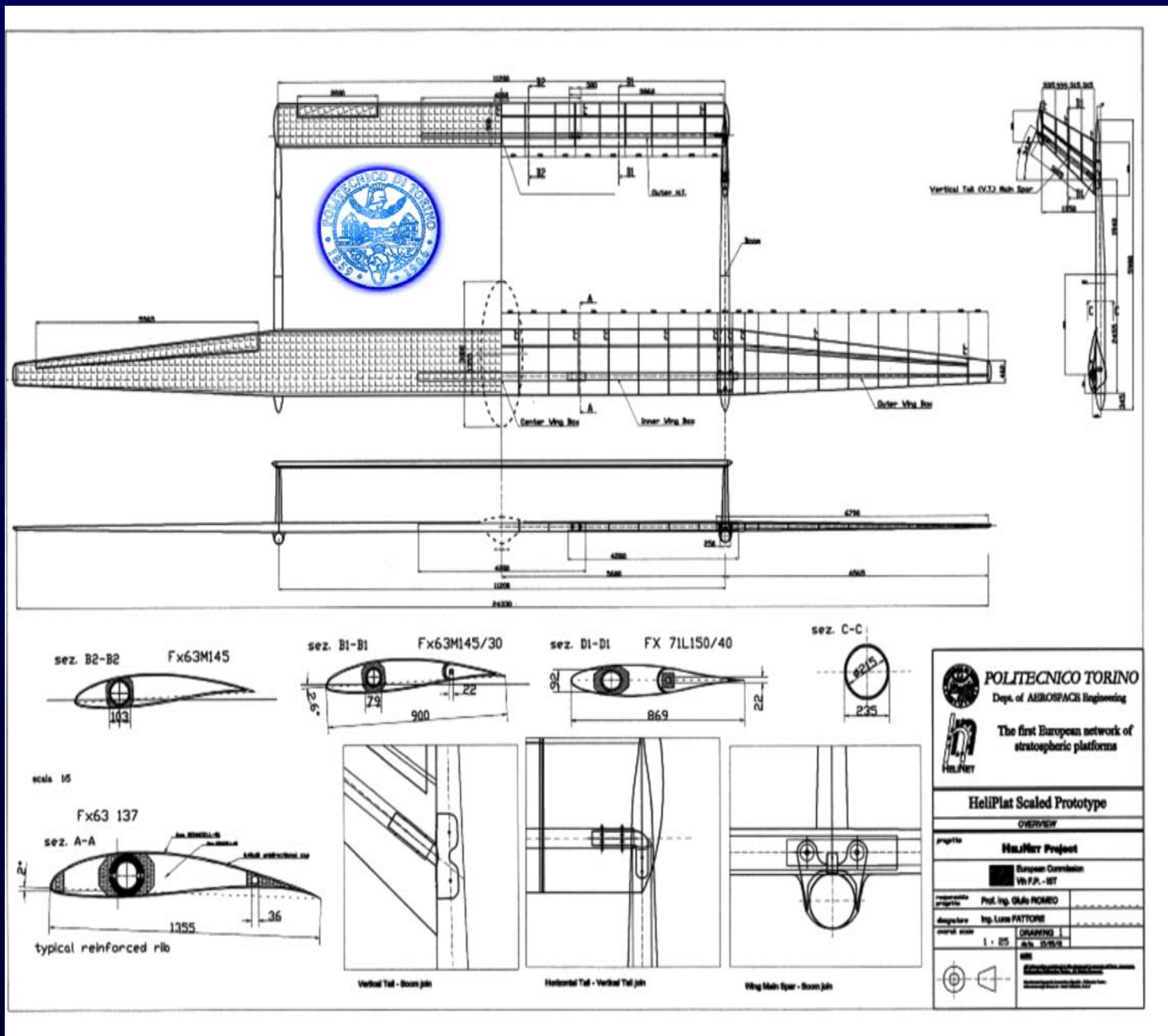
To compare to DB values press here:

Maintenance Hour(s) per Flight Hour DB

Rules | Propulsion | Assumptions | << Back to Index

DIASP

Scaled Prototype Manufacturing



<u>CASA Space-EADS (E)</u>

1) Single CFRP elements: wing tubular spars and ribs, horizontal and vertical tail tubular spars and ribs, booms. 2) Metal fittings .

<u>POLITO-DIASP (I)</u>:

1) Assemble different parts of the aircraft (wing, horizontal and vertical tails, booms).

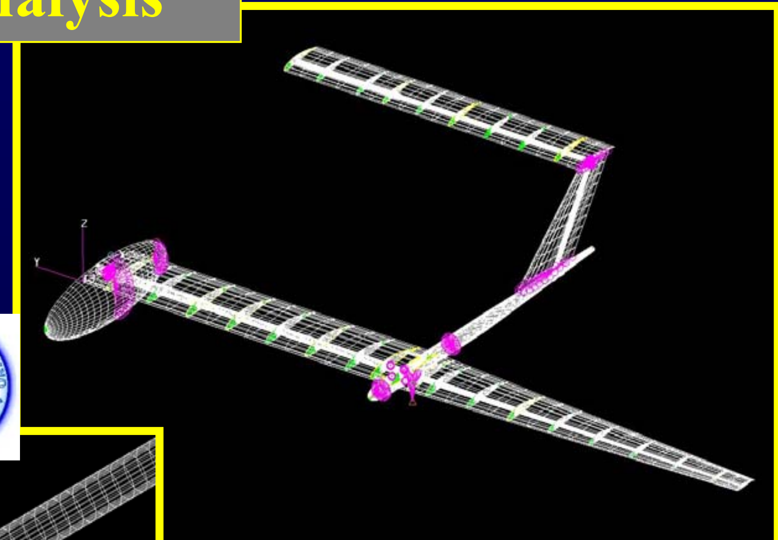
2) Assemble the whole aircraft.

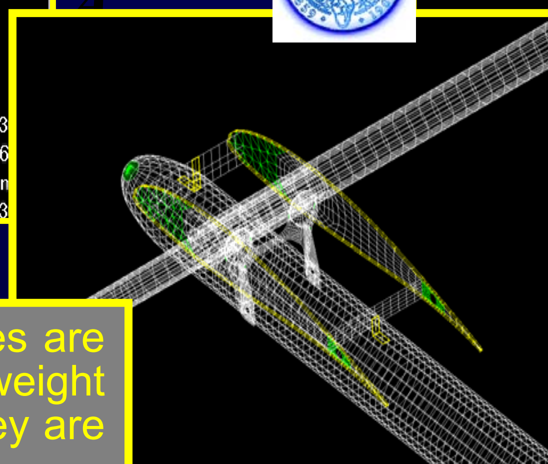
3) Perform static tests up to the design loads

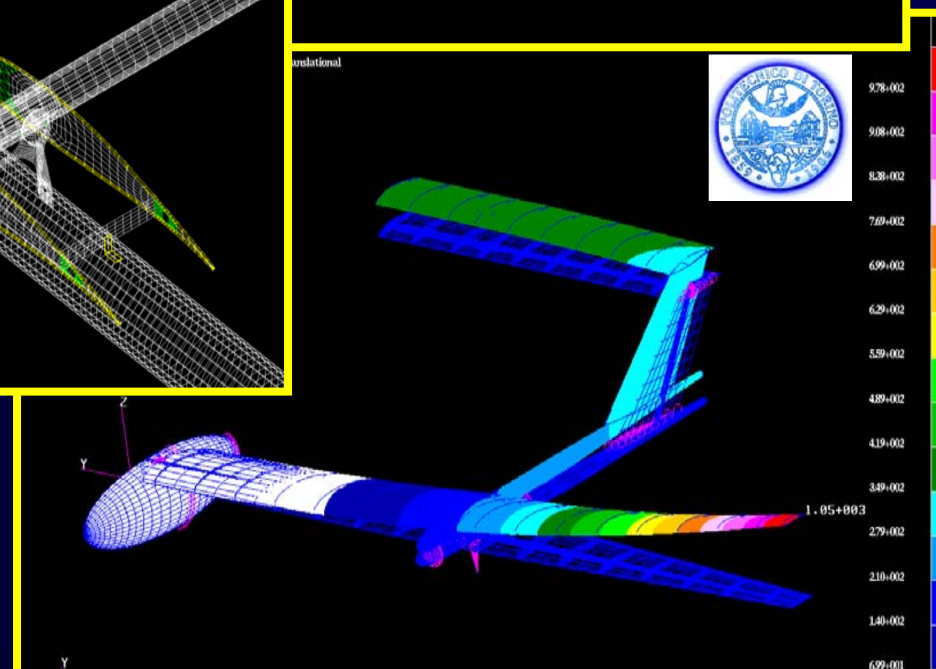
4) Find the correlation with the numerical analysis.

HELIPLAT® Scaled Prototype Design

NASTRAN FEM Analysis







The highest structural efficiencies are required to minimise airframe weight and increase payload mass. They are obtained by:

- Wide use of HM graphite/ epoxy material: very light - high stiffened structure.
- Numerical structural analysis (MSC/PATRAN/NASTRAN).

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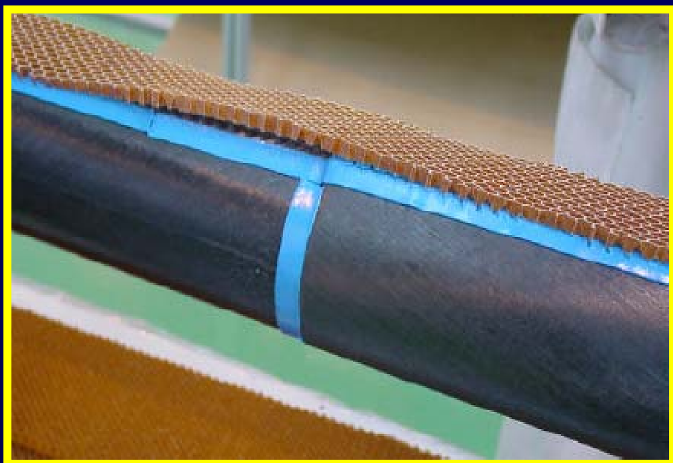
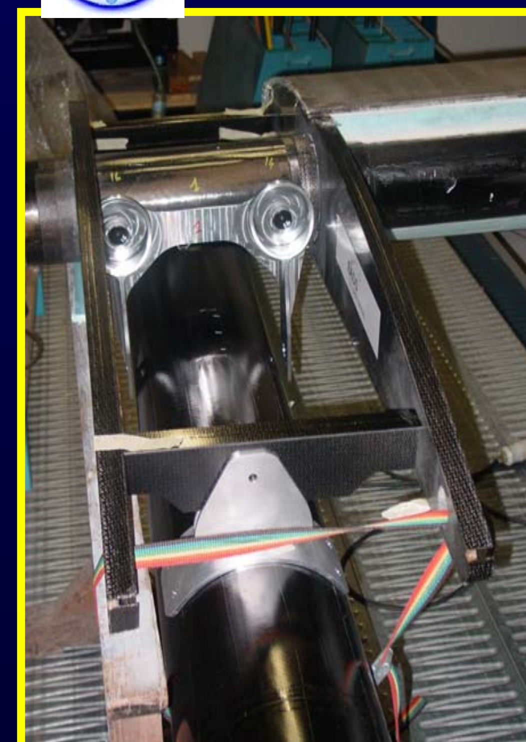
DIASP HELIPLAT

Scaled Prototype Manufacturing





ARCHEMIDE/
POLITO

Scaled Prototype Manufacturing

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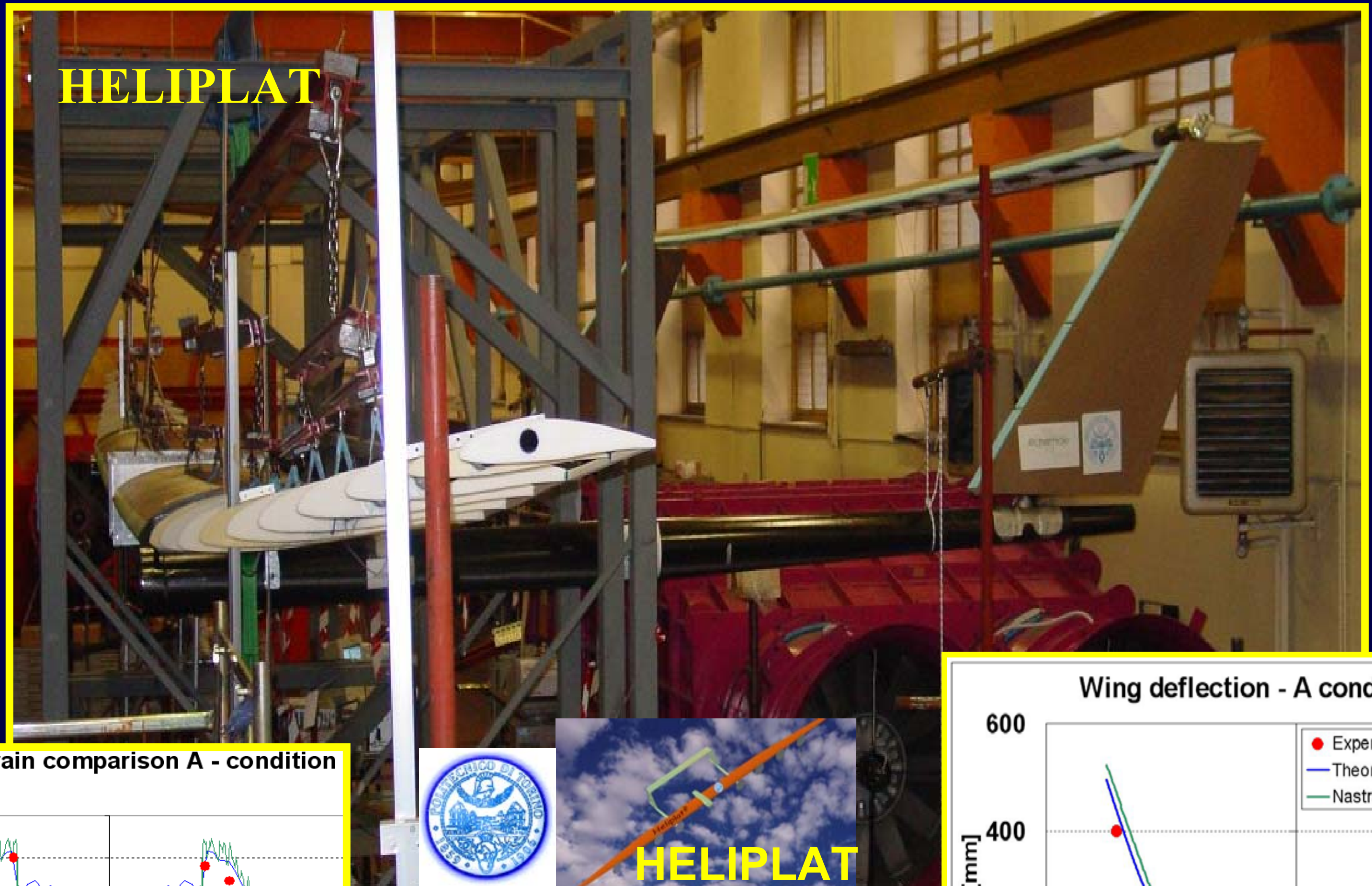
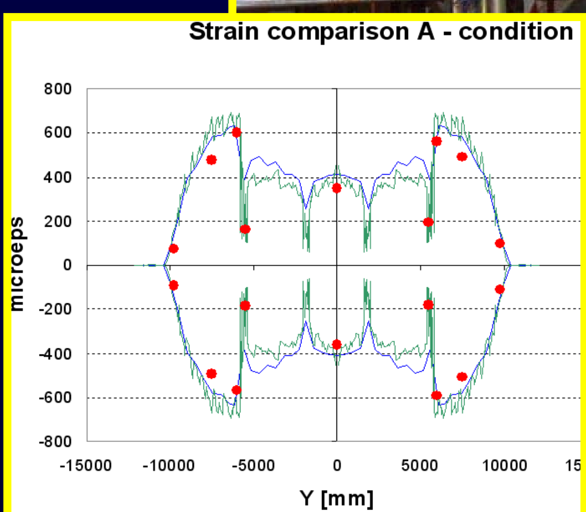
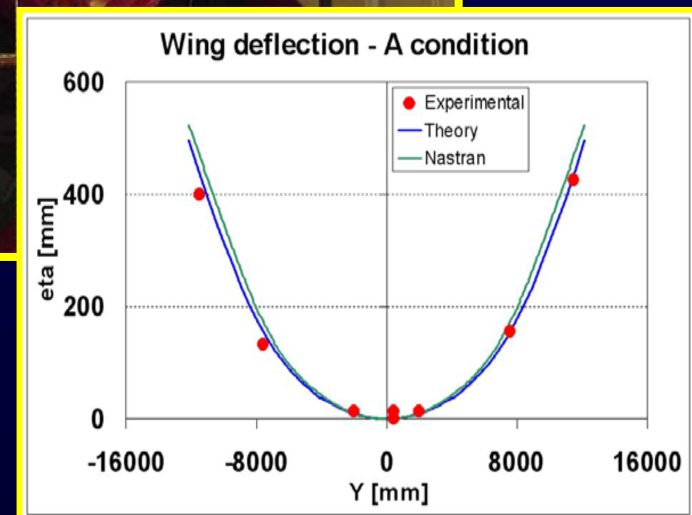
Scaled Prototype Testing







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Shear/Bending Static Failure Test n=7.5g

Torsion Static Test

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- EADS
- ONERA
- DLR
- NLR
- AGUSTA
- AIROBOTICS
- Eurocopter
- IAI
- CIRA
- UNINA – UNIBO
- WARSAW UNIV
- POLITECNICO TORINO (WP Leader Design New Configuration)

Civil UAV APplications & Economic Effectivity of Potential CONfiguration Solutions

CAPECON

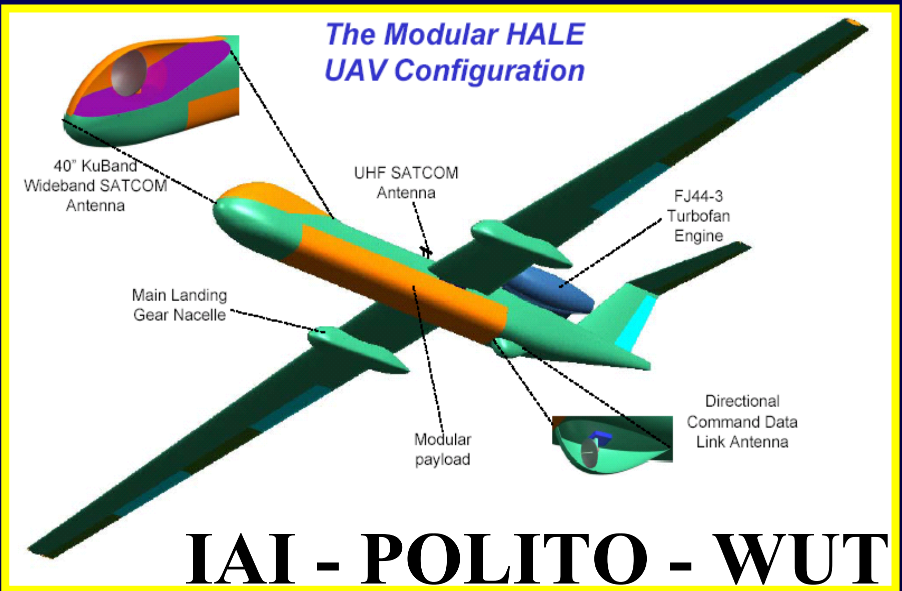
May 2002

Project No GRD1-2001-40162

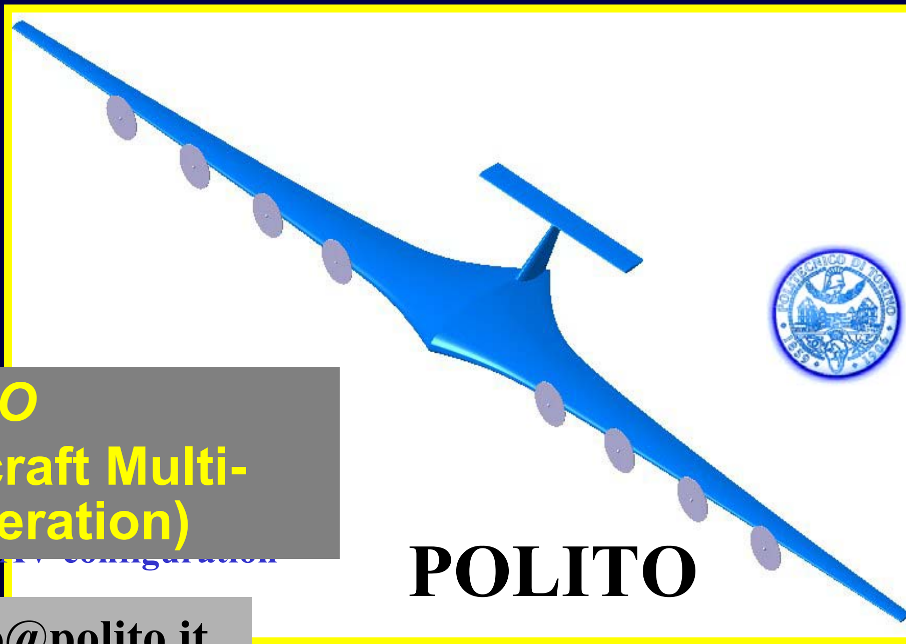
Promoting Competitive and Sustainable Growth
Key Action 4.2.5

HALE UAVs

Design of 3 HALE UAVs
WP Leader: Prof. G. Romeo



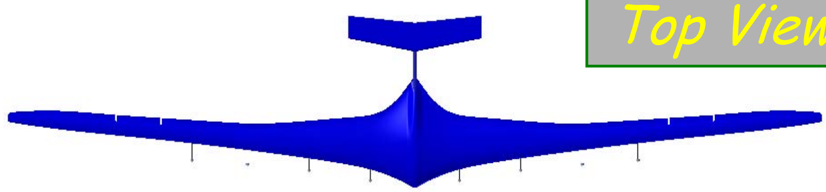
SHAMPO
(Solar Hale Aircraft Multi-Payload & Operation)



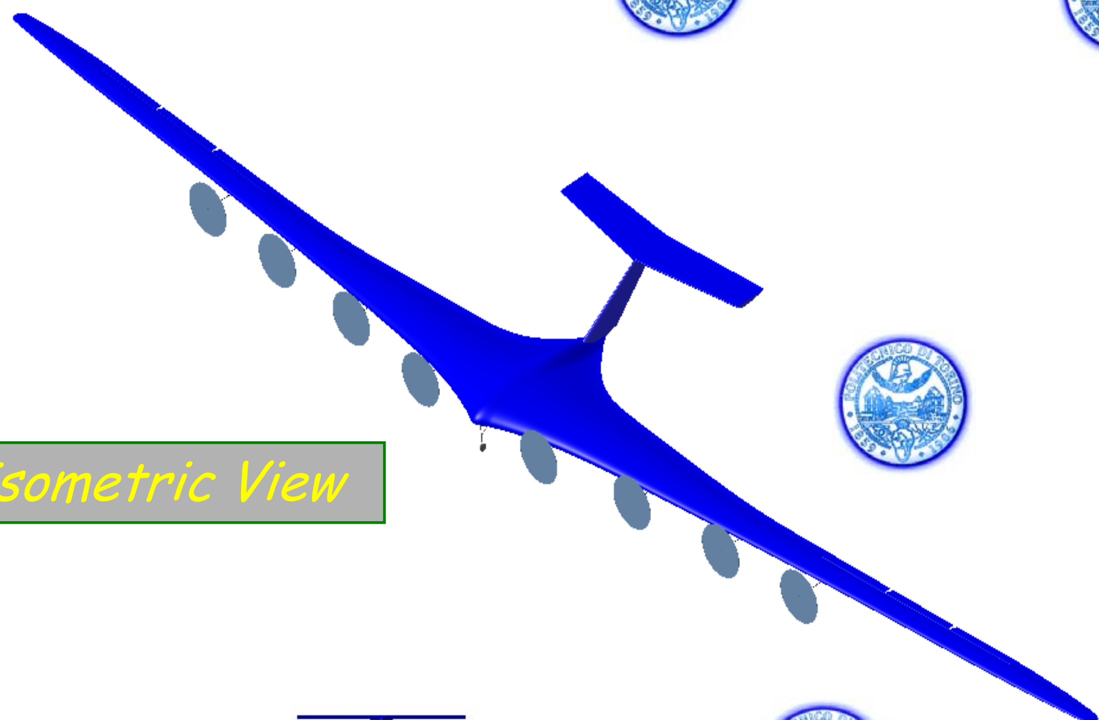
SHAMPO SOLAR HALE UAV

EXTERNAL LAYOUT

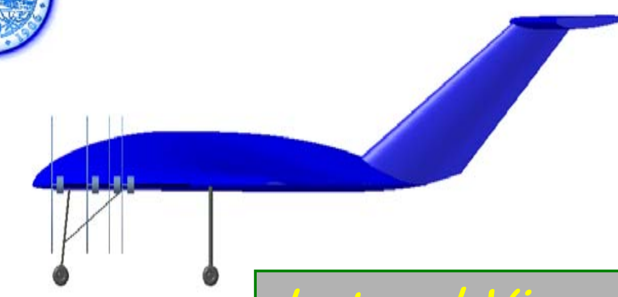
Solar
Hale
Aircraft
Multi
Payload &
Operation



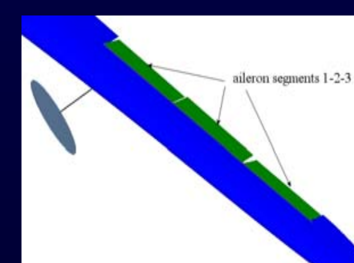
Top View

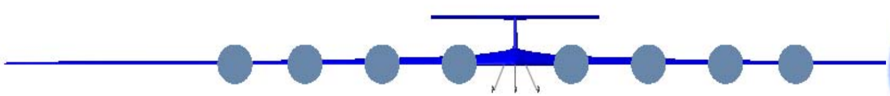


Isometric View



Lateral View





Front View

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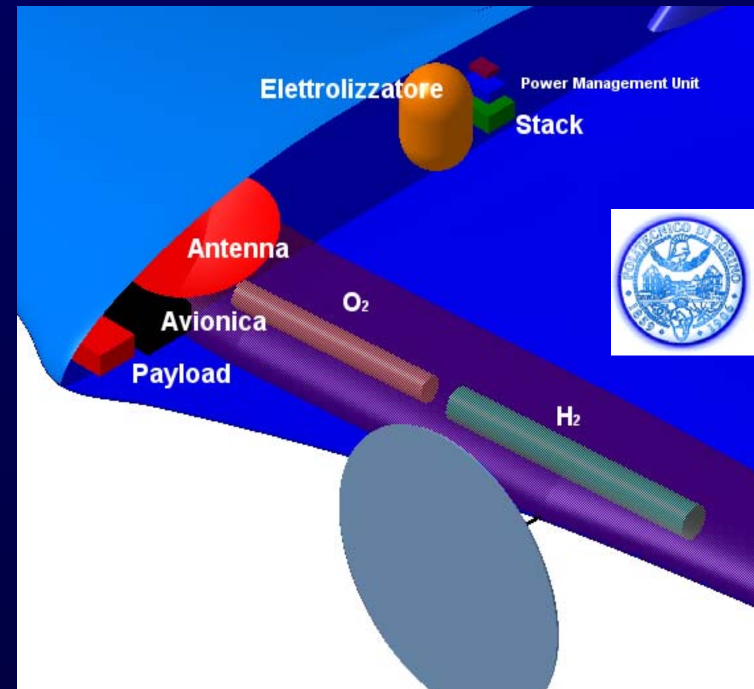
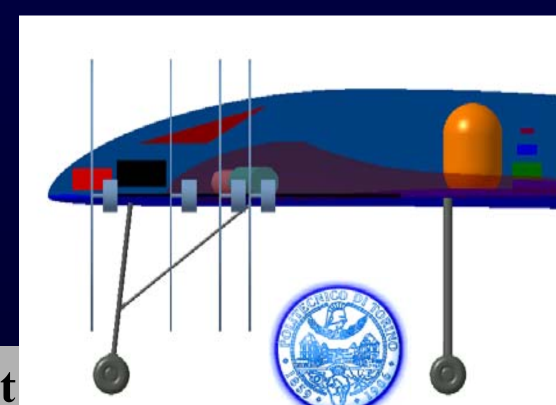
SHAMPO SOLAR HALE UAV

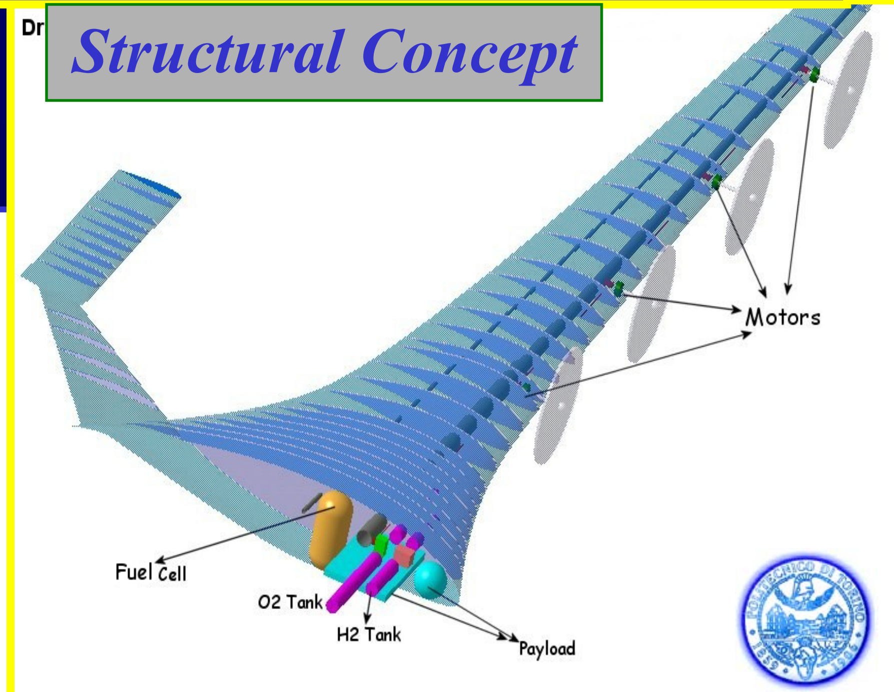


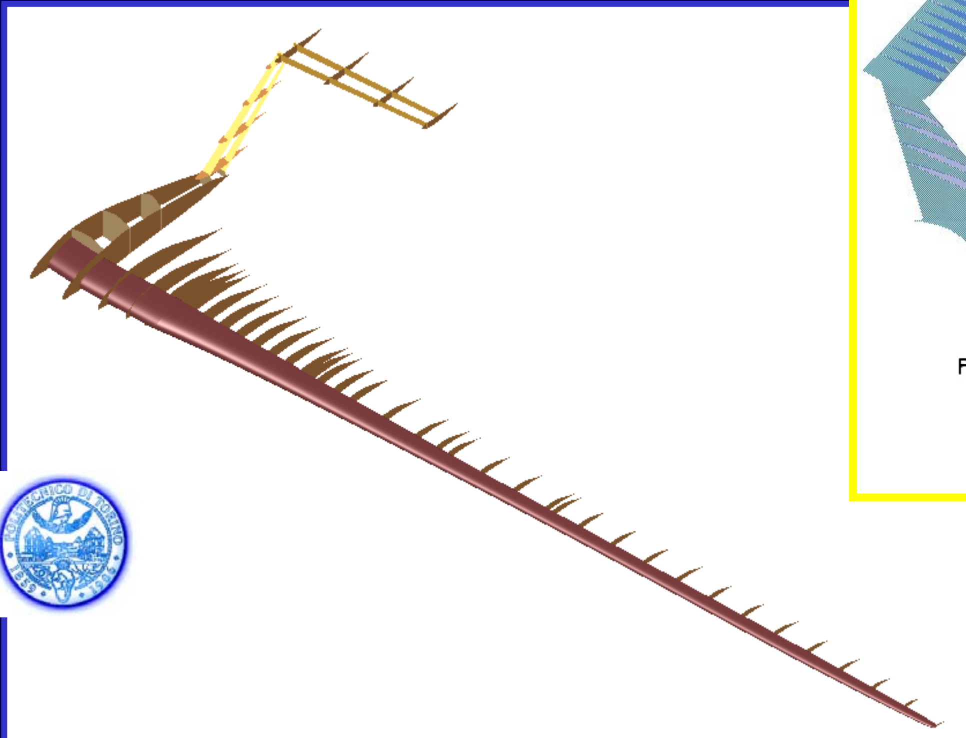
INTERNAL LAYOUT

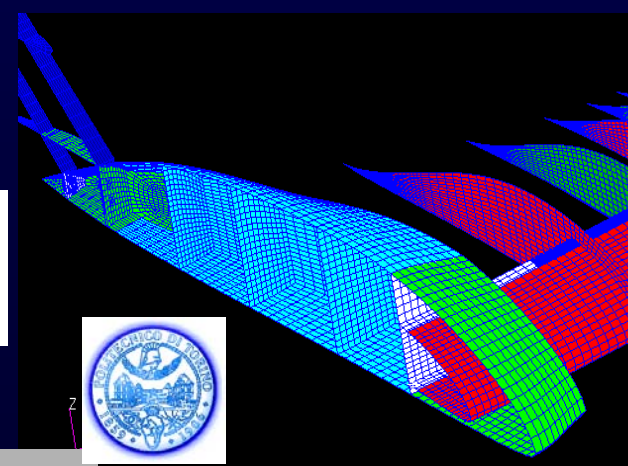


SHAMPO SOLAR HALE UAV

Structural Concept







Maximum fuselage deflection:29mm
Load factor = 4.5

SHAMPO SOLAR HALE UAV

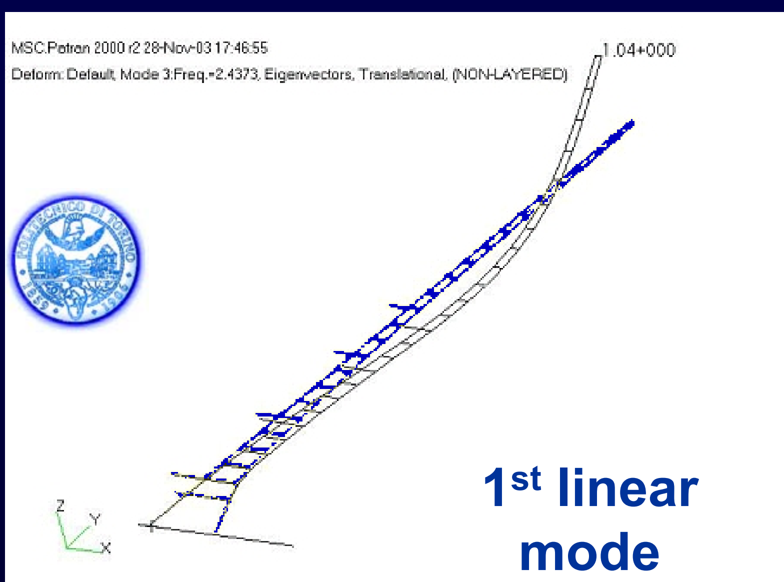
Aeroelastic Consideration

A preliminary linear mode analysis has been performed on the model.

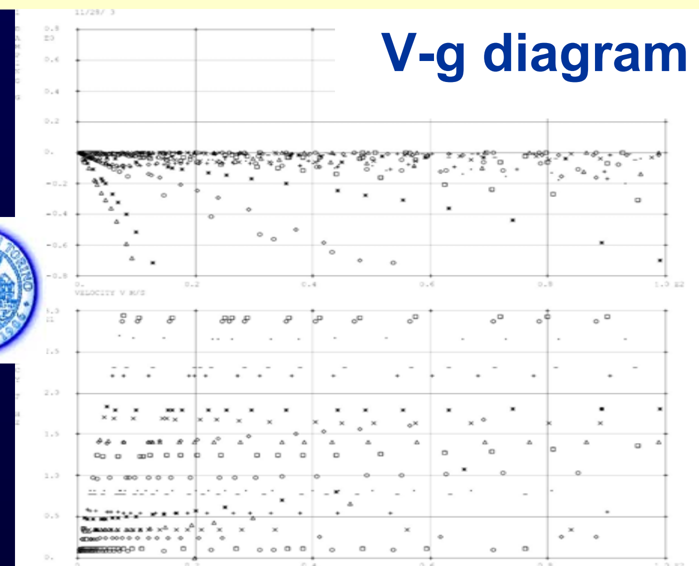
There are defined some coupled modes, and the torsional modes are pushed up to higher frequencies.

Higher critical velocities are expected.

The V-g plot for the linear case is reported. No critical speed is detected up to 100m/s (at 17000m). The normative requirement is fulfilled.



1st linear mode

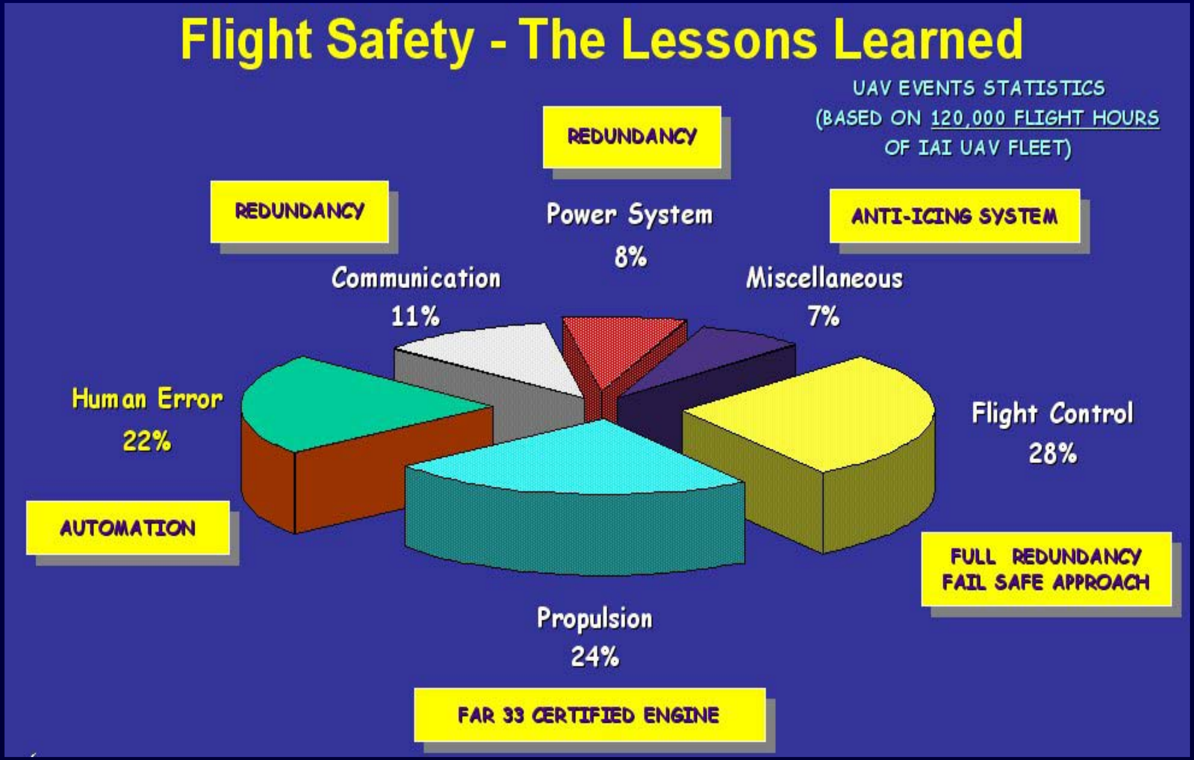


V-g diagram

SHAMPO SOLAR HALE UAV

Preliminary Reliability

80 Predator: 28 crashed - 7 Global Hawk: 3 lost.
Mishap per 100,000 h: Predator: 32; Hunter: 16
- **AV-8 Harriers: 10.5 - F-16s: 3.5 - General aviation: 1**
- **Regional/commuter: 0.1 - Larger airliners: 0.01.**



The intention is to attain the objectives set below:
· MTBL: 100 000 hours
Mean Time Between Loss
· MTBUCL: 1000 000 h
MTB Uncontrolled Landing
· MTBCF: 1000 hours
MTB Critical Failure

SHAMPO SOLAR HALE UAV

Preliminary Reliability

The platform has to have a very long endurance flight (4-5.000h)

It is supposed to fly continuously without failure

the loss of a platform must not cause damage to the service.

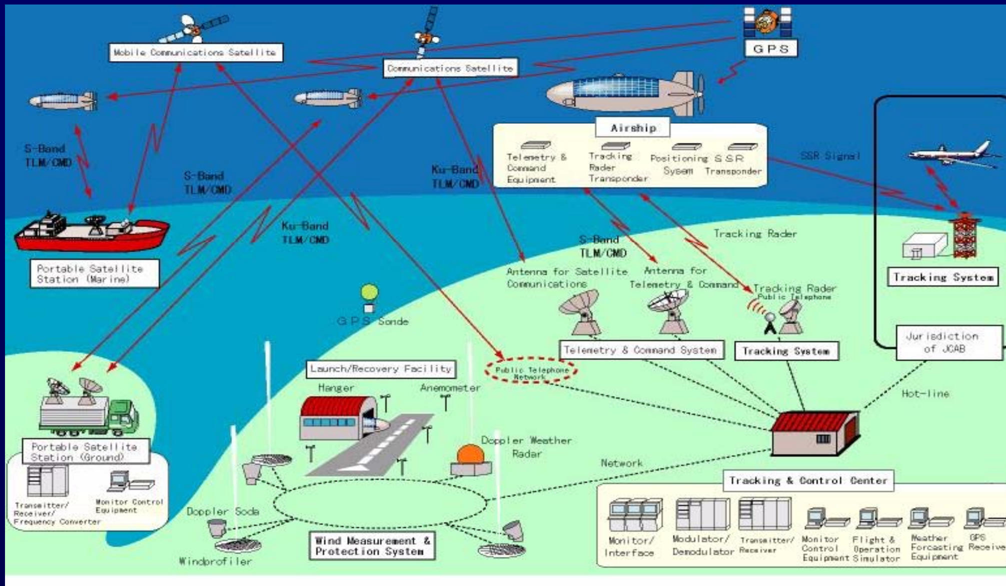
Catastrophic failure conditions must be extremely improbable, i.e.:

The probability that a failure condition would occur maybe assessed on the order of 10^{-9} or less.

"The safety standard that should be maintained is one in which UAVs are operated as safely as manned aircraft, insofar as they should not present or create a hazard to persons or properties in the air or on the ground greater than that created by manned aircraft conducting similar operations" (FAA Advisory Circular 8/5/96).

A MTBF=40000h for each motor and a MTBF=100000h for each propeller is assumed for the reliability analysis obtaining a 0.991.

DIASP



- To explore the grounds for the development and operation of a European stratospheric platform based on a sound analysis of possible service areas (main in the area of telecom or GMES).
- To perform a conceptual design for the best suited platform concept answering the needs of future telecom markets.

STRATOS

Stratospheric Platforms:
A definition study for an ESA system

airobotics

Fraunhofer Institut Integrierte Schaltungen

UniS

Booz | Allen | Hamilton

Sept. 2002.

FLIGHT MODEL

SUPER DIMONA

DIASP HELIPLAT

FLIGHT MODEL

FLIGHT MODEL

DIASP

CONCLUSION

- Possible realisation of HAVE-UAV at least for low latitude sites in Europe and for 4-6 months.
- Forest Fire Early detection and Border Patrol monitoring would be possible at much cheaper cost and higher resolution than actual systems, and it would be obtained continuously.
- Airfoils with high Lift coeff. and small Drag coeff. and at low Reynolds numbers should be obtained.
- The aerodynamic performances of HELIPLAT are being implemented by VSAERO software, obtaining high efficiency.
- Showed feasibility of very light CFRP structural elements.
- Good correspondence between experimental analytical and FEM analysis is verified and expected.
- Showed feasibility of brushless electric motors and fuel cell systems.
- Preliminary flight tests of few critical items were carried out successively.

DIASP

Thanks a lot for your kind attention

Politecnico di Torino, DIASP, is partner of EC – ESA funding projects:

CAPECON UAVNET STRATOS