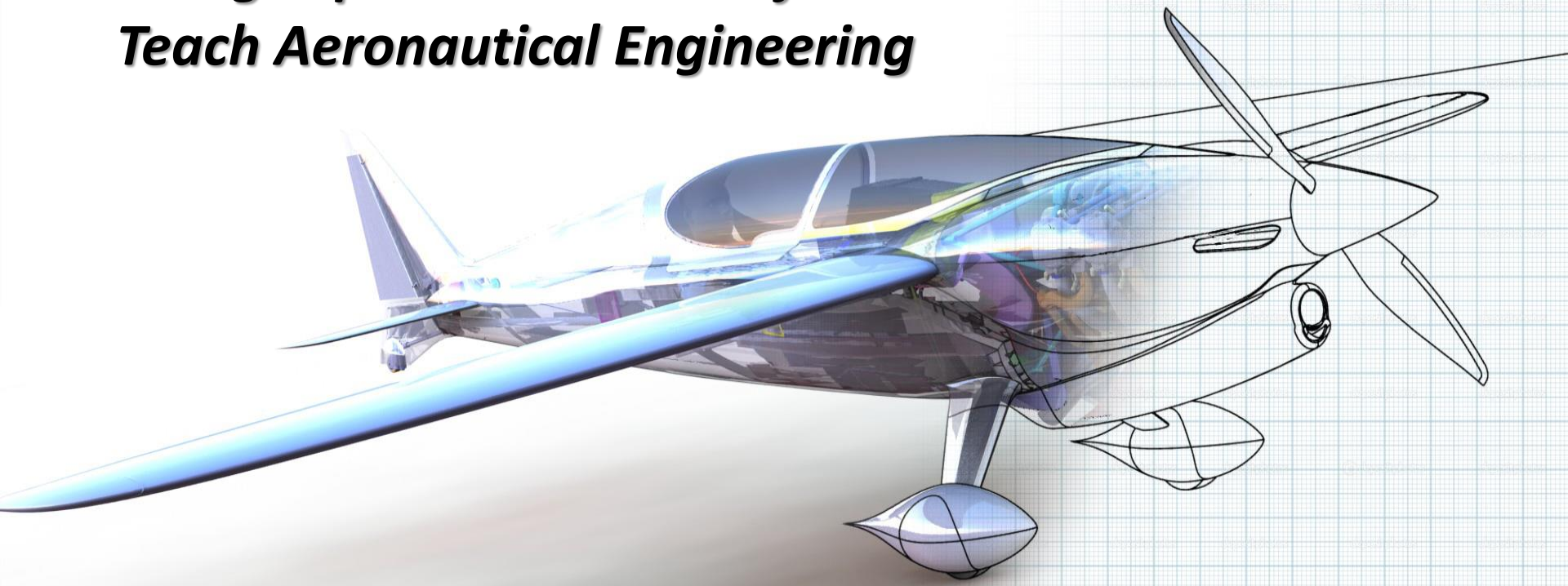
Using Experimental Aircrafts to Teach Aeronautical Engineering



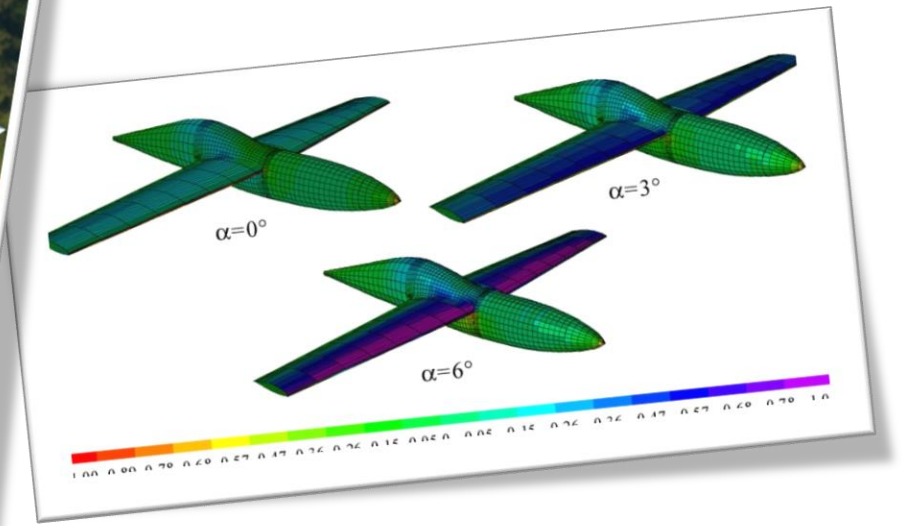
Prof. Paulo Iscold

Cal Poly San Luis Obispo

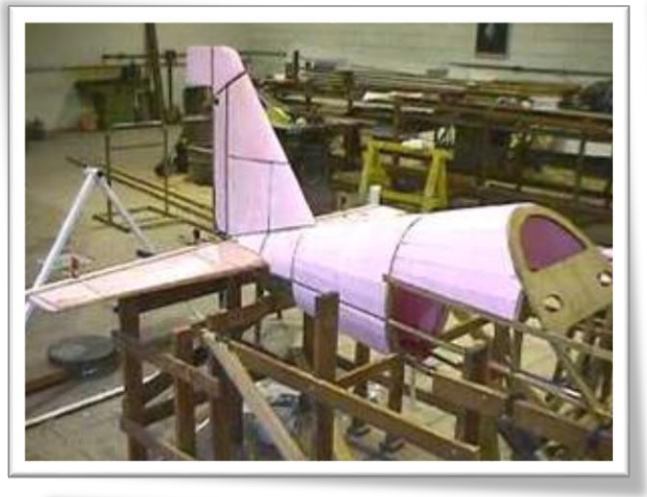
CEA-308

1999

Development of the racing airplane **CEA-308** takes place. In an attempt to develop a low cost high performance aircraft, CEA rises up to the challenge of building the **fastest aircraft** in the smallest category certified by FAI (FAI C1a0, take-off weight of less than 300kgf). In this project, new knowledge was acquired in topics such as: drag minimization, computer aerodynamics analyses, and composite materials construction.



CEA-308



CEA-308

2010

CEA-308 broke **four** world records on the FAI C1a0 category:

Speed over 3km with restricted altitude	223.77 mph
Speed over 15km course	204.49 mph
Speed over 100km course	203.04 mph
Time to climb up to 3000m	8min 51sec

CEA-308

CEA-308

CEA-309

2003

CEA309-Mehari is a single seat unlimited aerobatic aircraft designed to have a **high performance** with **low cost** operation. Making use of a 210hp four-cylinder Lycoming engine, **Mehari** has a high power-weight ratio with low fuel consumption. This is the first unlimited aerobatic airplane fully developed in Brazil.

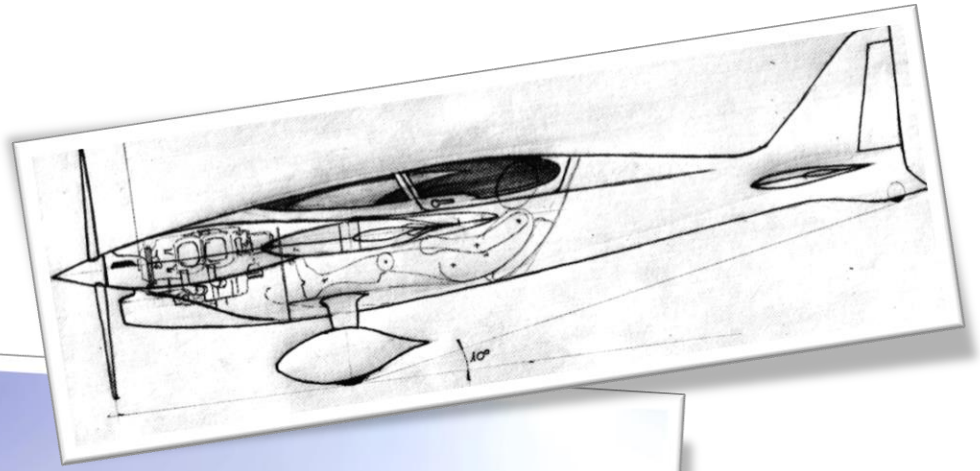
CEA-309

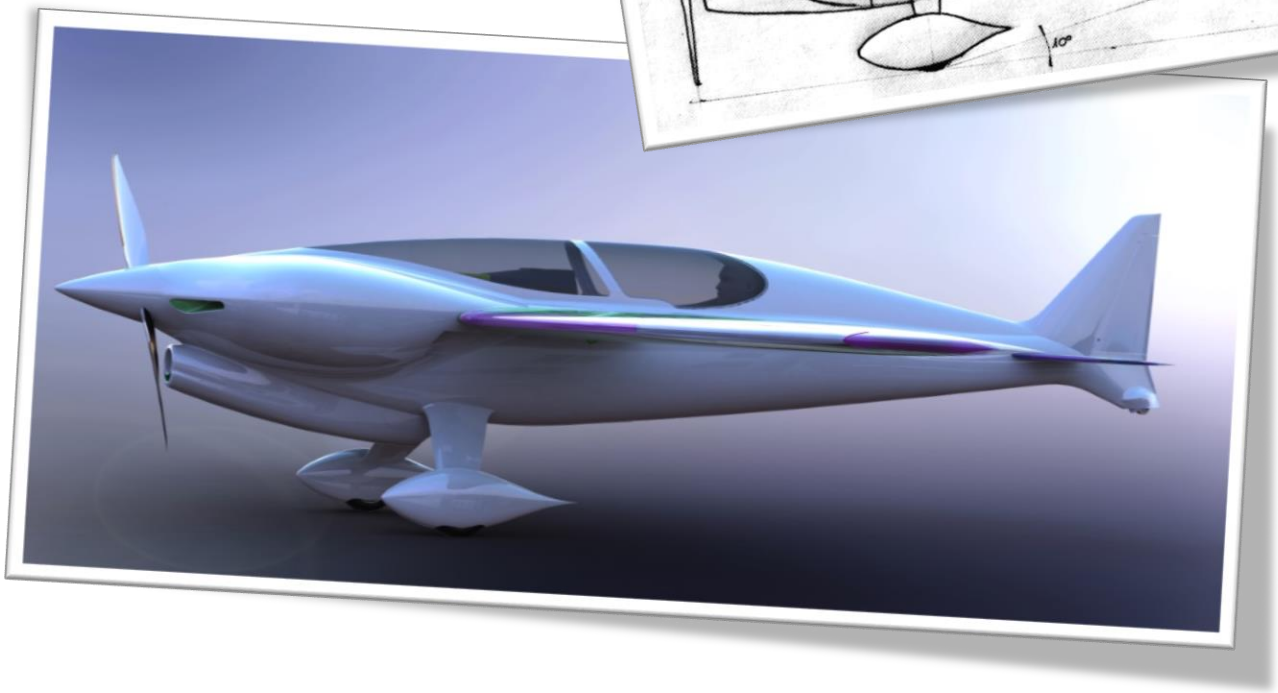
CEA-309

CEA-311 Anequim

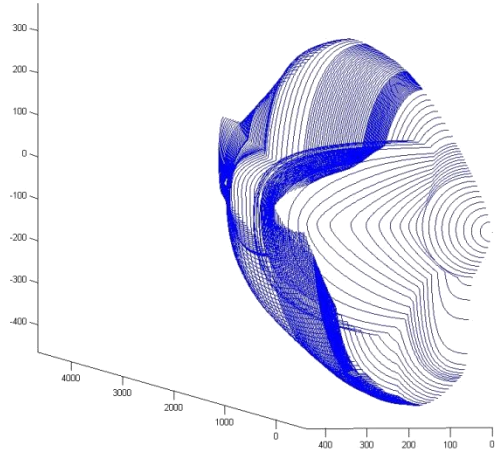
Development of a new racer airplane looking for new knowledges:

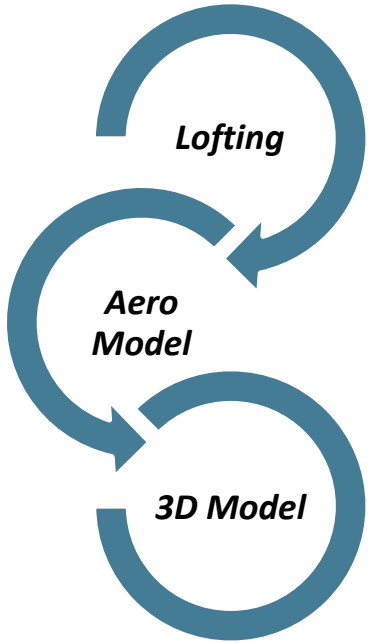
- Full Carbon Fiber Structures
- Prototype fabrication techniques based on CNC
- Mach 0.5 at sea level
- Internal Aerodynamics and Cooling
- Flow control
- Flutter analysis and tests

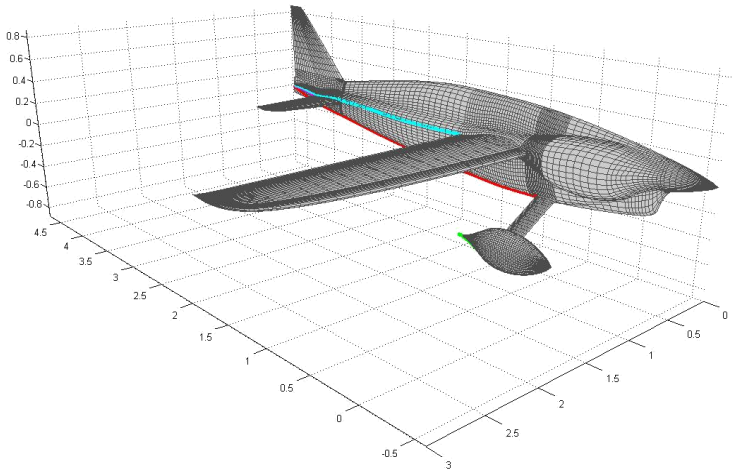


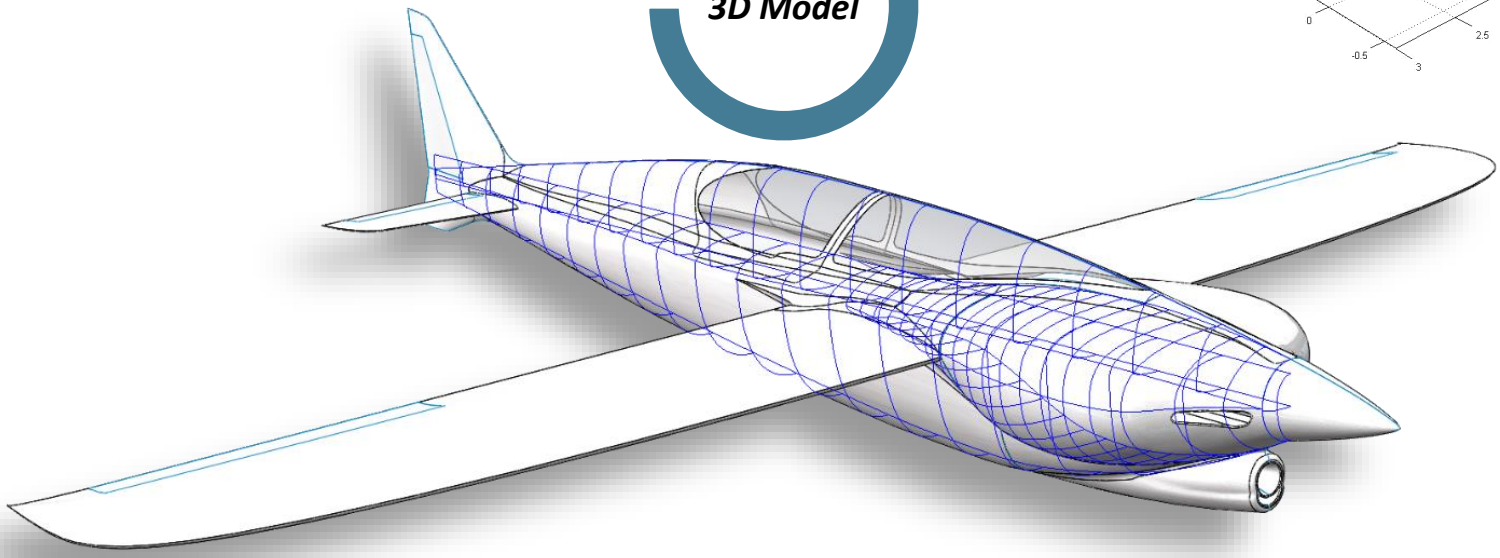


Lofting and Aerodynamics

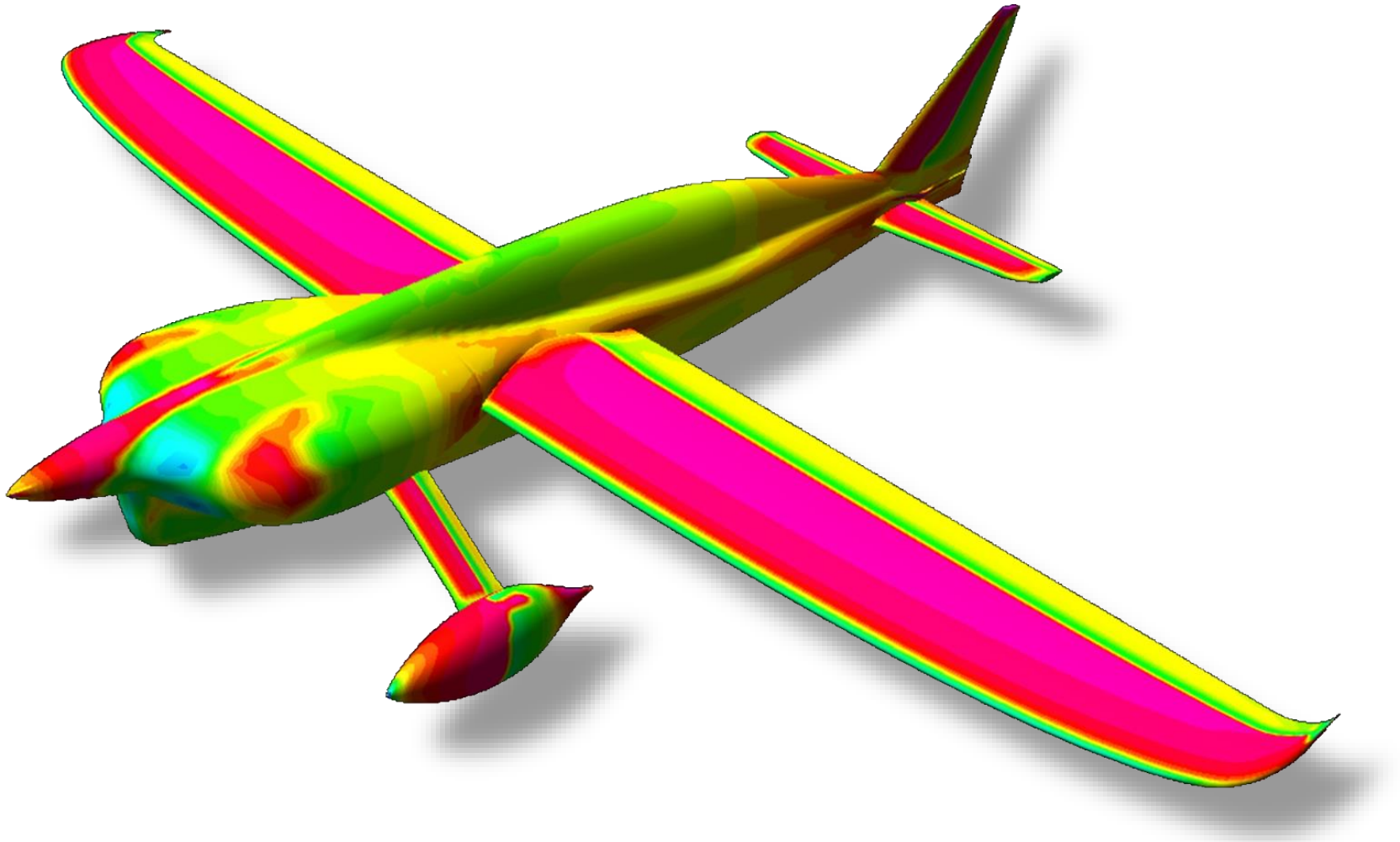




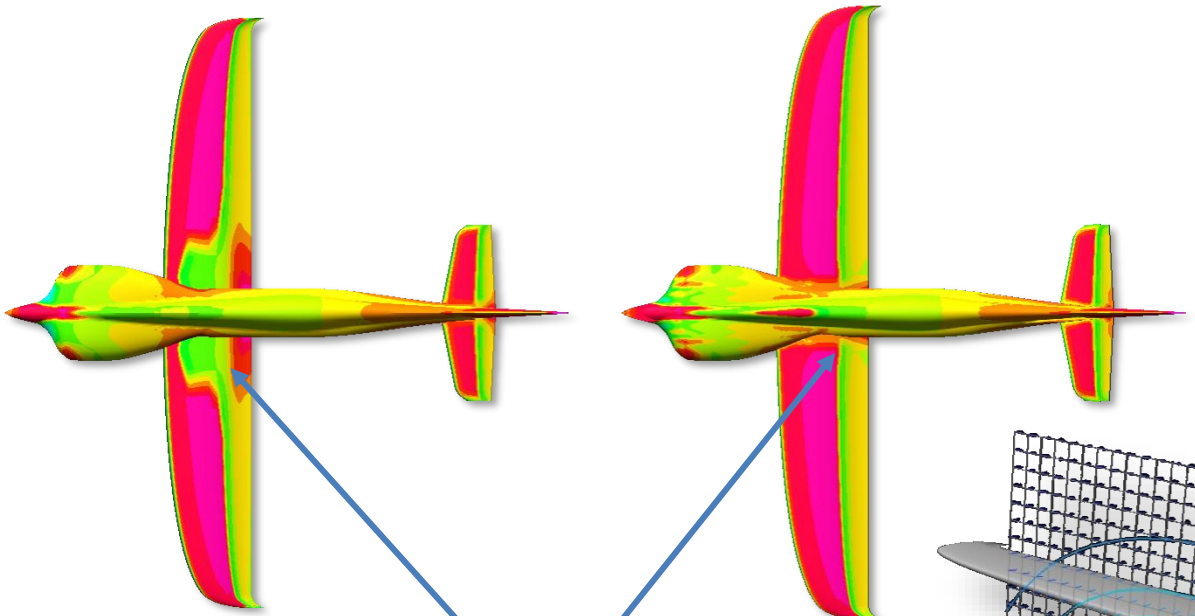




Lofting and Aerodynamics

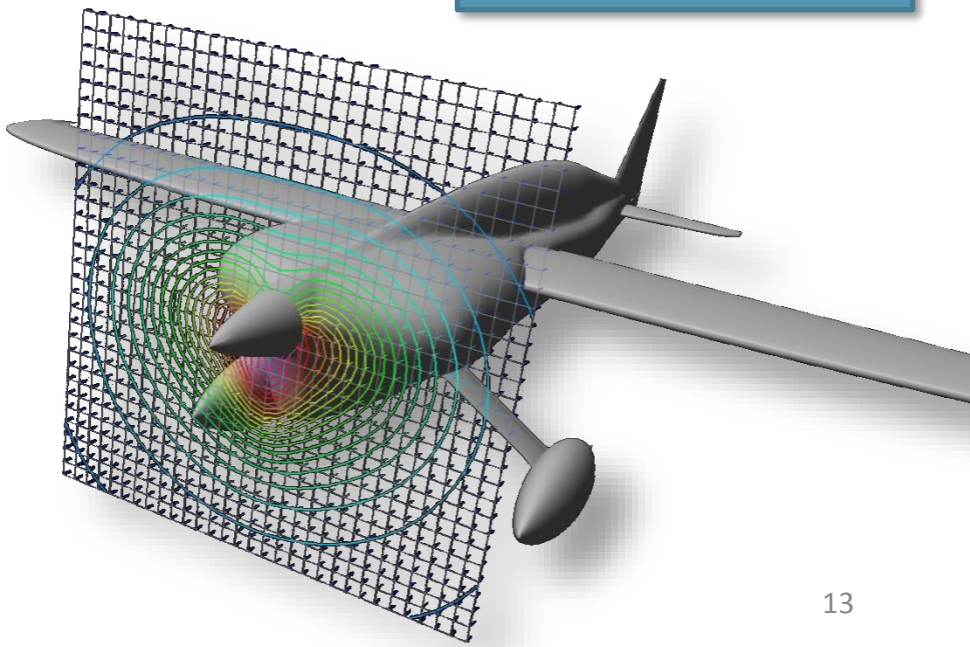


Lofting and Aerodynamics

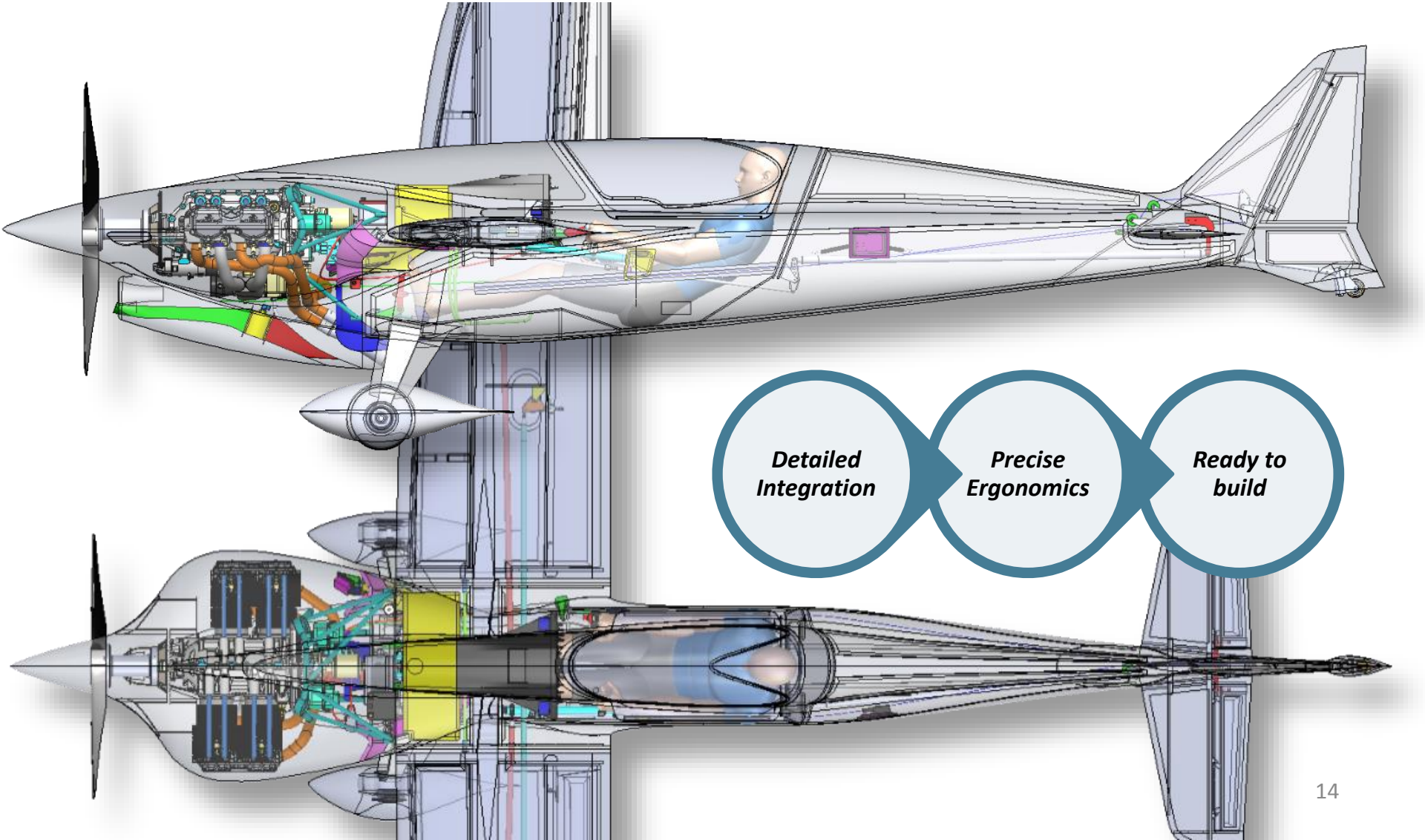


Effects of fuselage optimization

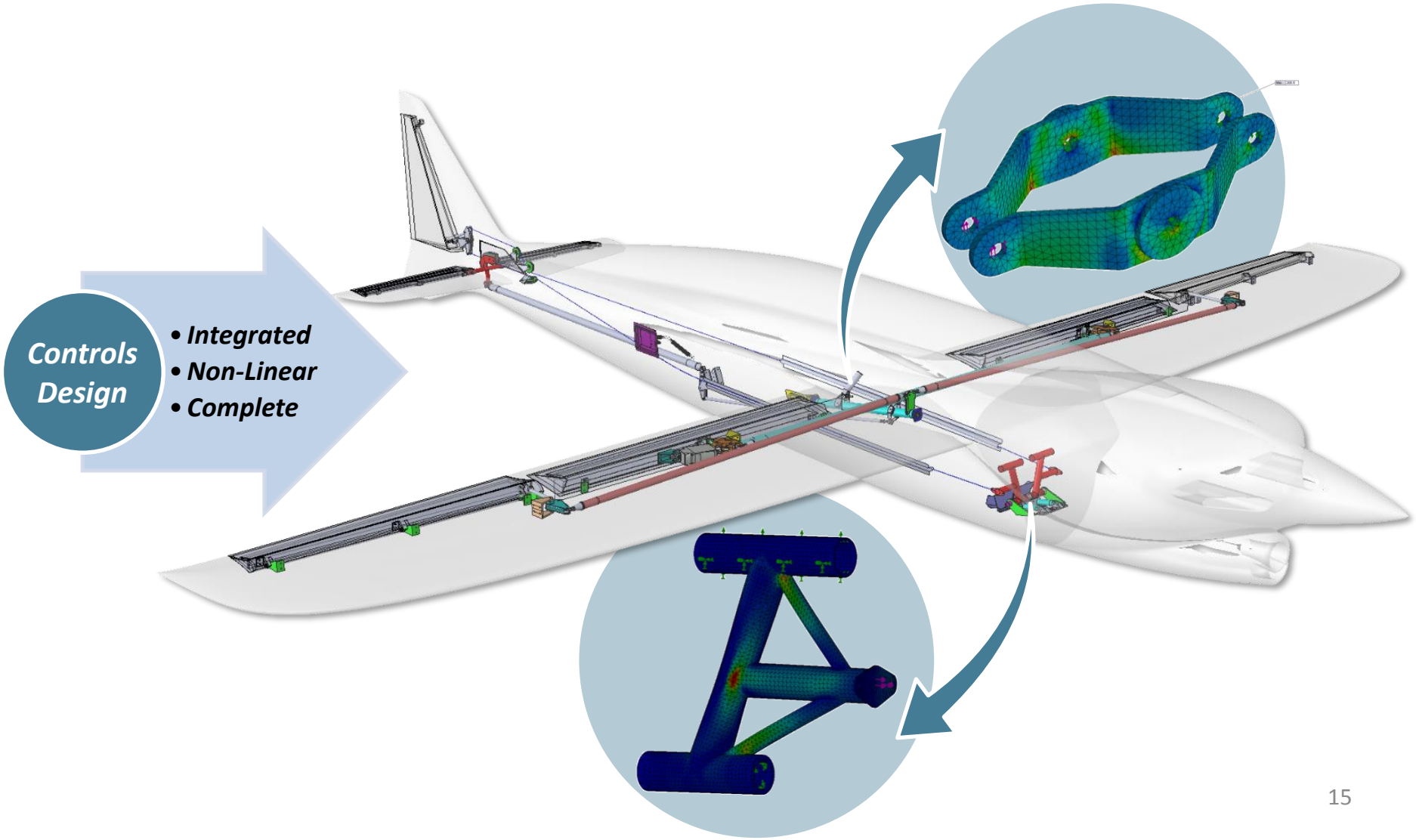
Propeller optimiztion



Mechanical Design



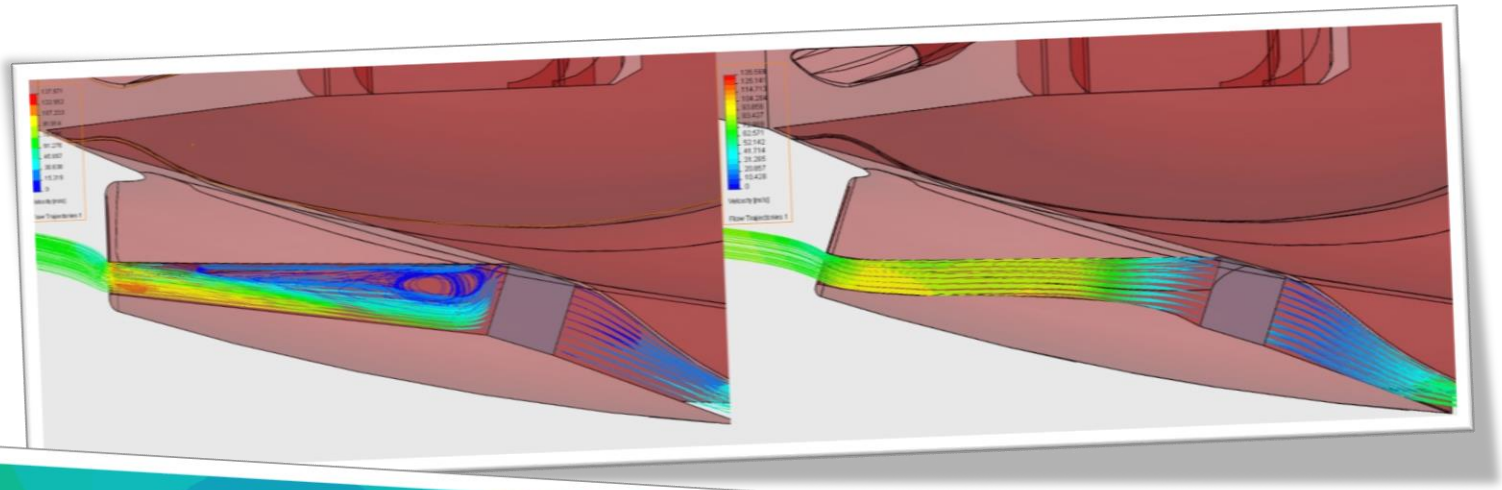
Mechanical Design

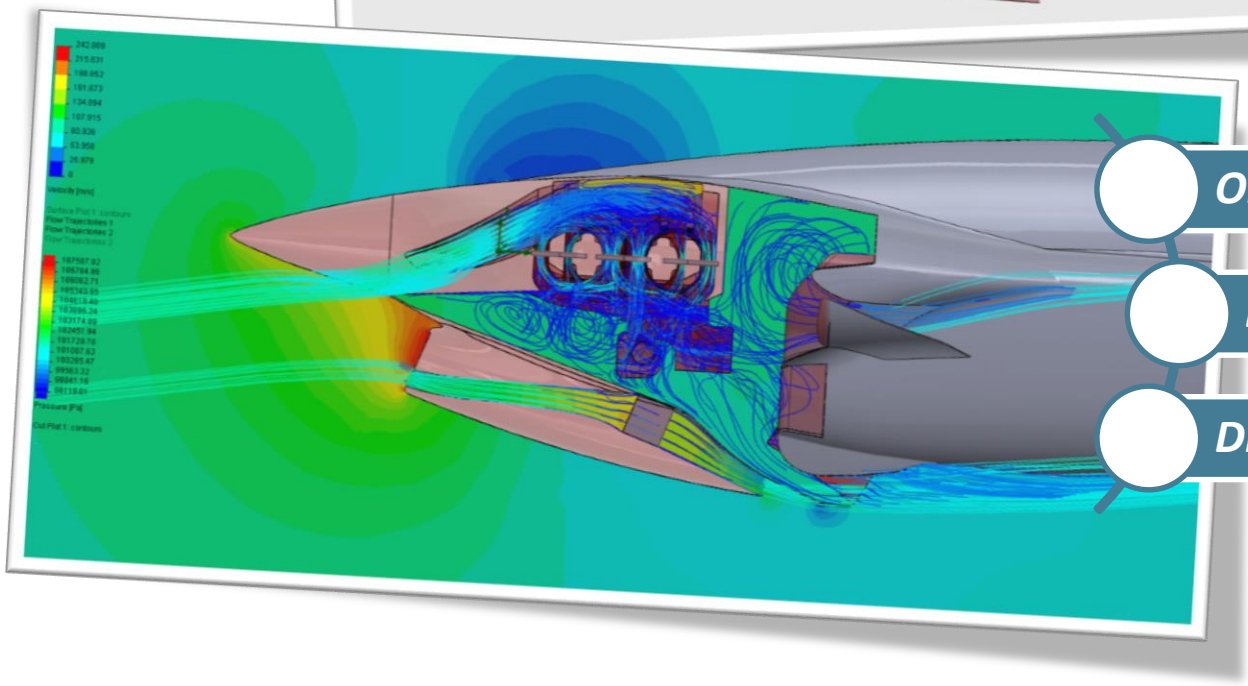


Building

Building

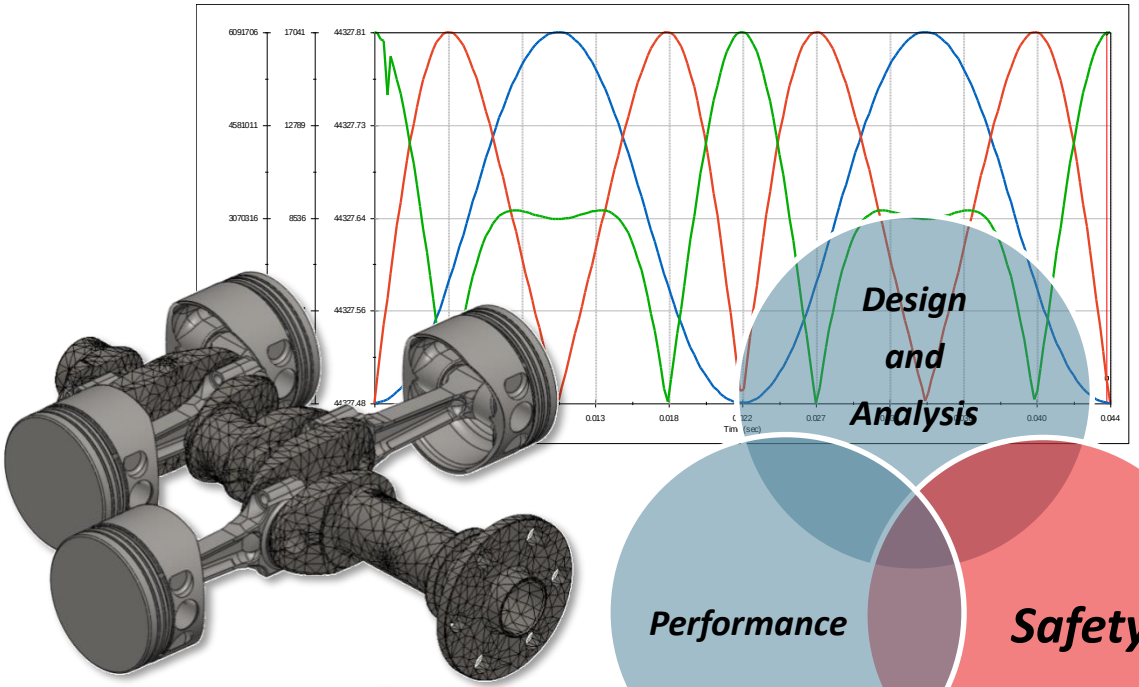
Cooling System

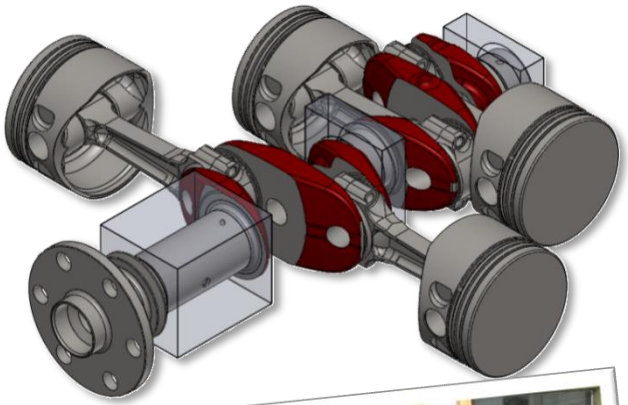


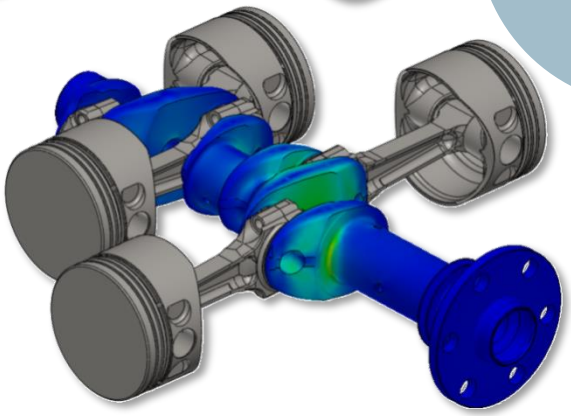


- Oil Cooler flow improvement
- Engine Cooling optimization
- Drag Reduction

Engine







Sky Dynamics
www.SkyDynamics.com
540.297.6754

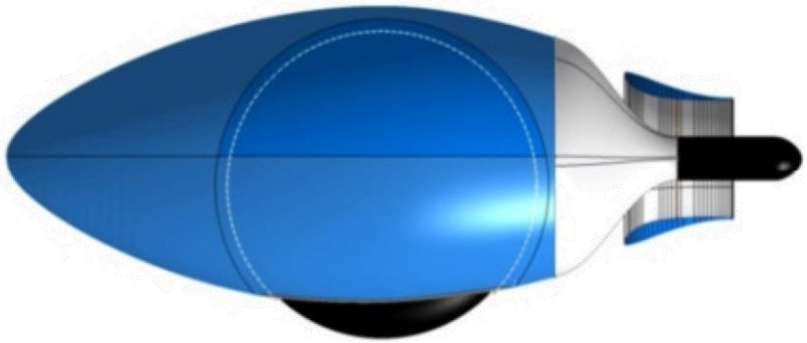
ECi

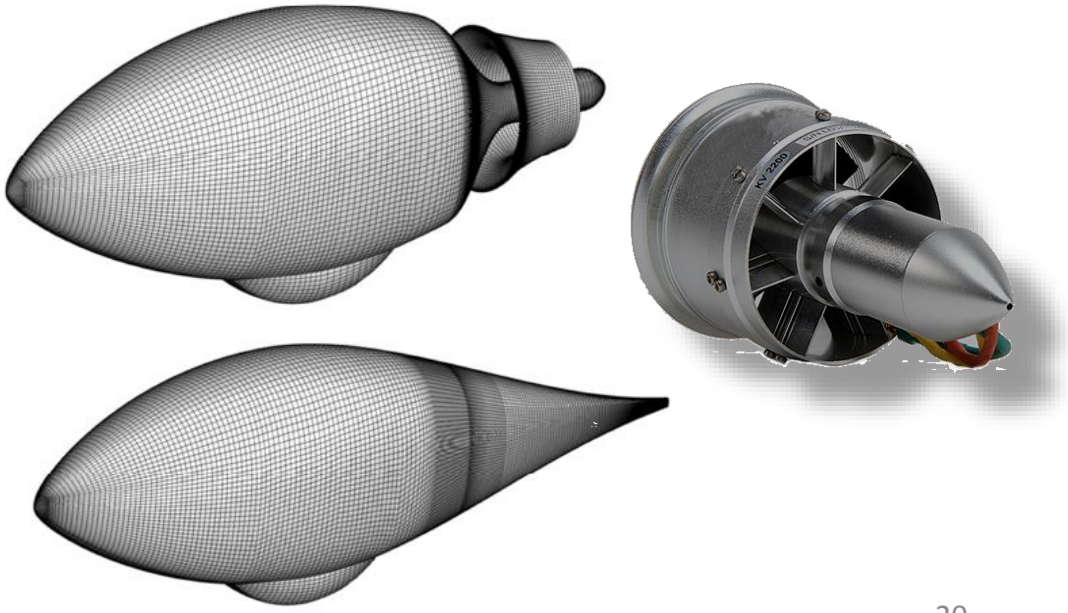
Flow Control

The airplane will incorporate flow control systems using boundary layer suction through electric brushless turbines.

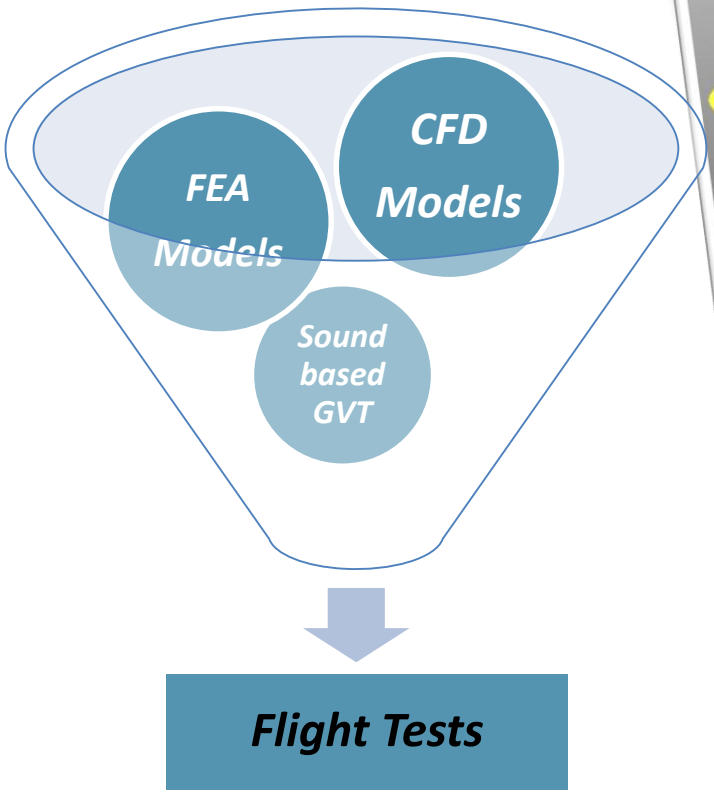
This solution isn't focused in energy, but only in drag reduction.

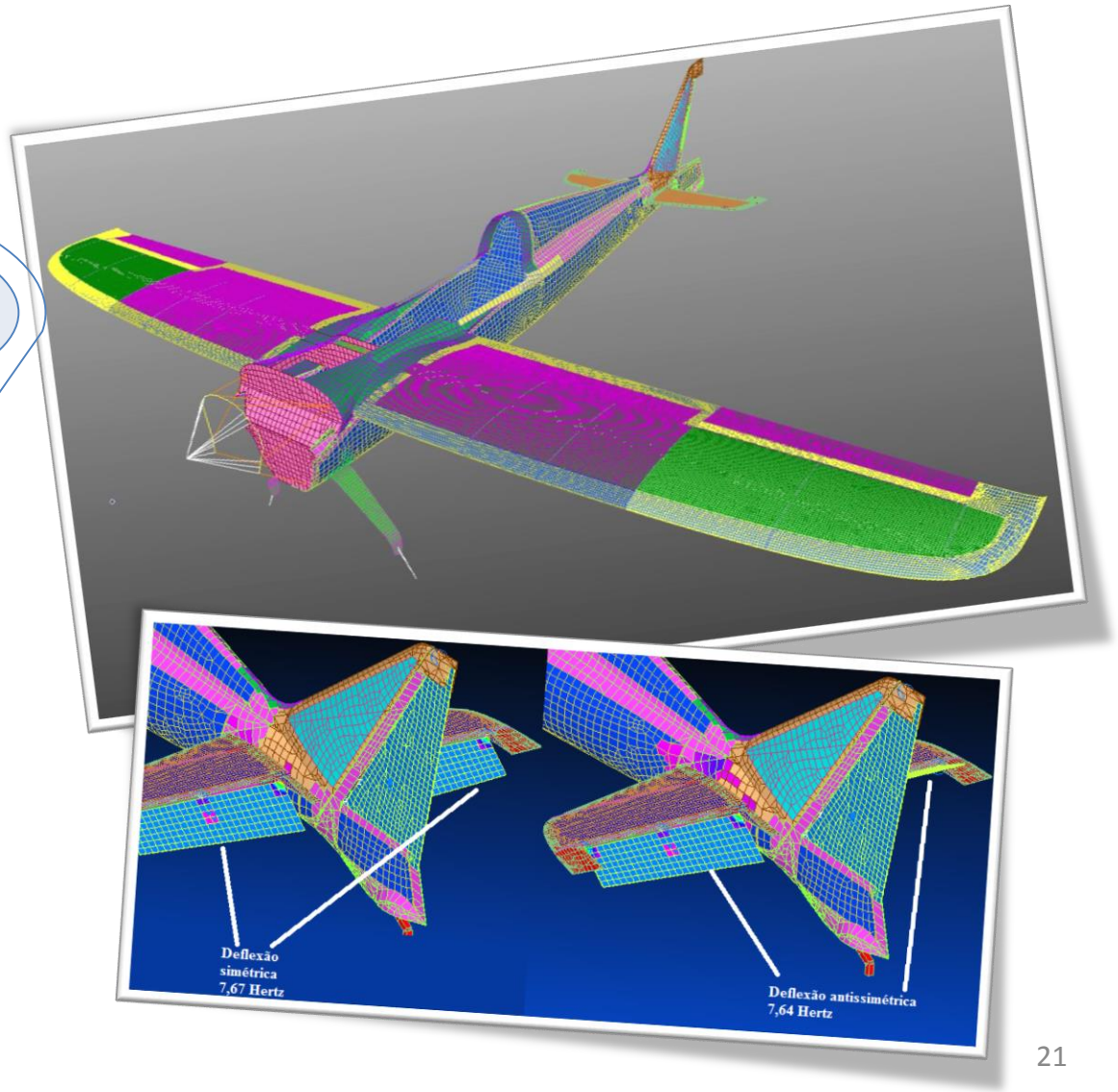
We are conducting wind tunnel tests prior to start with the flight tests.





Flutter


FEA Models
CFD Models
Sound based GVT
Flight Tests


Deflexão simétrica 7,67 Hertz
Deflexão antissimétrica 7,64 Hertz

Results

Five world records on the FAI C1a category:

Speed over 3km
325 mph
Speed over 15km course
319 mph
Speed over 100km course
306 mph
Speed over 500km course
312 mph
Time to climb up to 3000m
2min 20sec

Results

Red Bull Air Race

- 2008/9 – SA Team
- 2010-2015 – British Team
  Two world titles
- 2016 – Kirby Chambliss Team

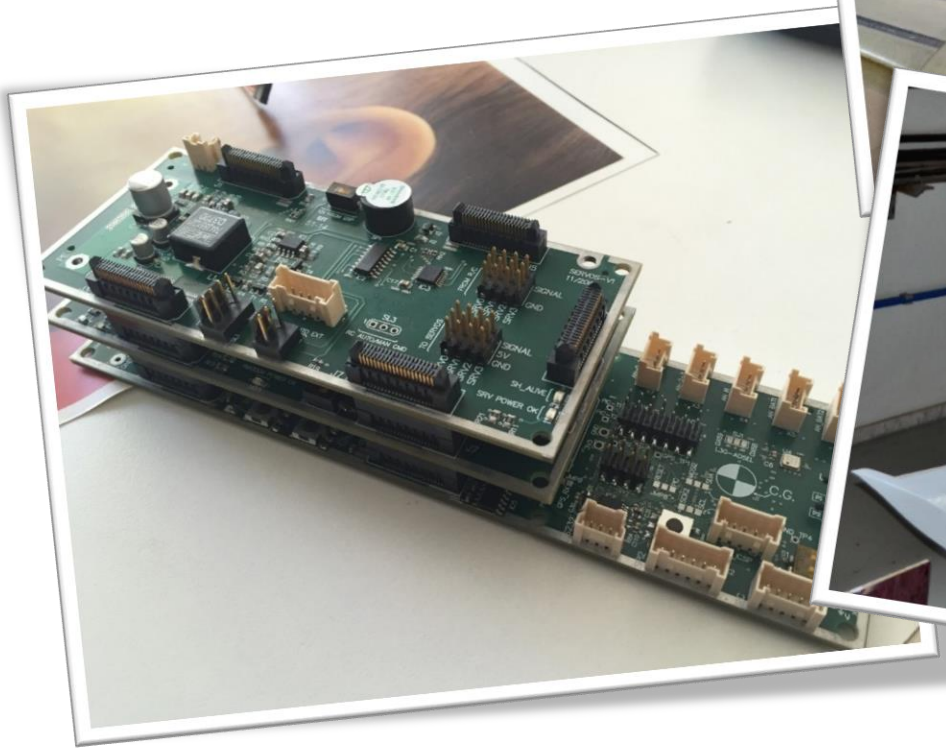
Red Bull Air Race

Red Bull Air Race

Red Bull Air Race

UAVs

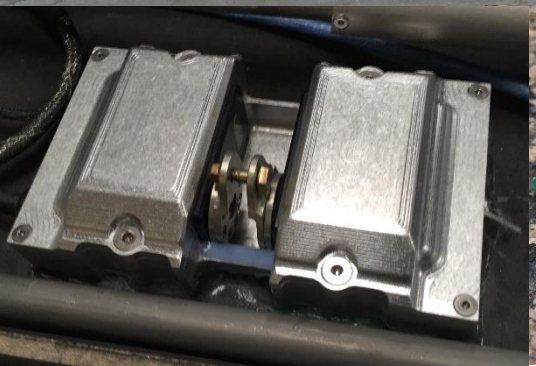
- Developing UAVs since 2004
- Spin-offs
- Multi-Disciplinary effort (4 departments)

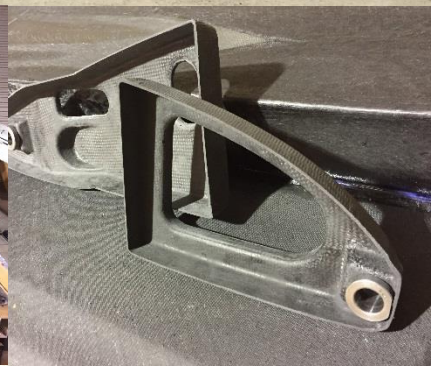


UAVs

Nixus

Nixus





Other projects

Challenges and Conclusion

The use of experimental aircraft development as a tool to improve the education quality has been proven to be **feasible and powerful**. Students that get involved in these activities present **life long learning** not only in **technical** areas, but also in **social** areas.

Some challenges must be recognized in the implementation of this type of activity in an academic environment:

- *"Plug'n Play"* culture is not adequate to aviation. This makes it difficult to motivate the younger generations to spend years on a single project.
- It's necessary to recognize each student's aptitudes and provide tasks that are more adequate to him. However, it is important to push boundaries.
- High performance airplanes are good to motivate, but are complex and require more supervision.
- Current *"publish or perish"* mentality is not compatible to this type of activity, so professors involved in this task must be able to work outside the University's usual paradigm.