

ANULOID

Innovative Vertical Take-Off and Landing aircraft (VTOL) for civil urban transport

Historic evolution of VTOL concepts

1490
First VTOL concept by Leonardo da Vinci
 • Tilting wings w/ ducted rotors
 • Military prototype
 • Complex stability control
 • Limited payload and range

1959
Avrocar
 • Military VTOL aircraft
 • Single engine set for lift/cruise
 • Jet-based propulsion
 • Ducted airflow & Coanda effect
 • Not flyable: project cancelled

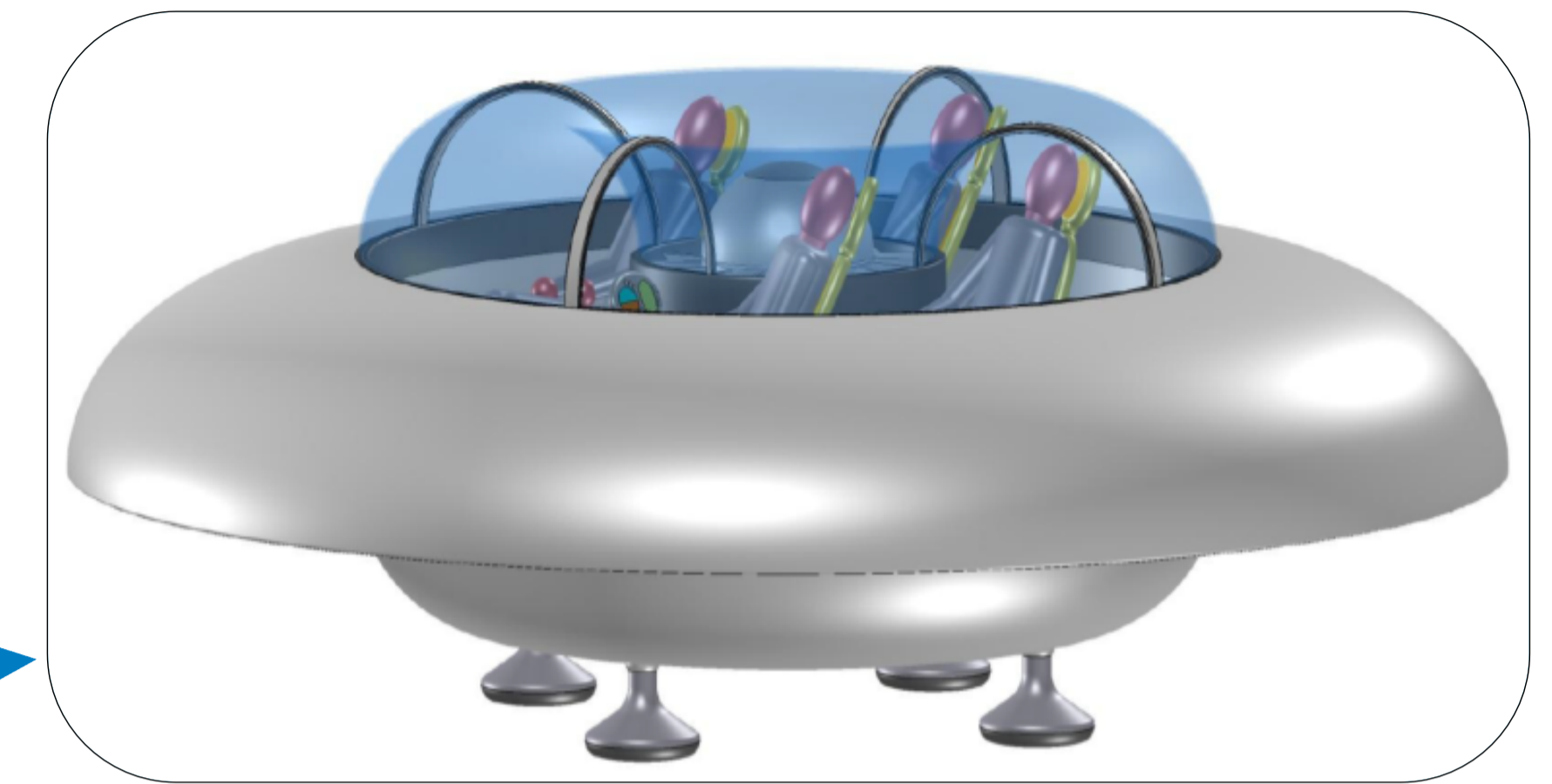
1966
Bell X-22 A
 • Tilting rotor aircrafts
 • Military (series product)
 • Civil applications (test)
 • Composite materials
 • Complex flight control

1980
AV-8B Harrier II
 • First series produced VTOL
 • Military aircraft
 • Single engine set for lift/cruise
 • Jet-based vectored thrust
 • Composite materials

1989
V-22 Osprey

2003
AW609 TiltRotor

2009
AirMule
 • Unmanned flying ambulance
 • Civil & military
 • Composite materials
 • Ducted rotors (lift)
 • Ducted fans (propulsion)

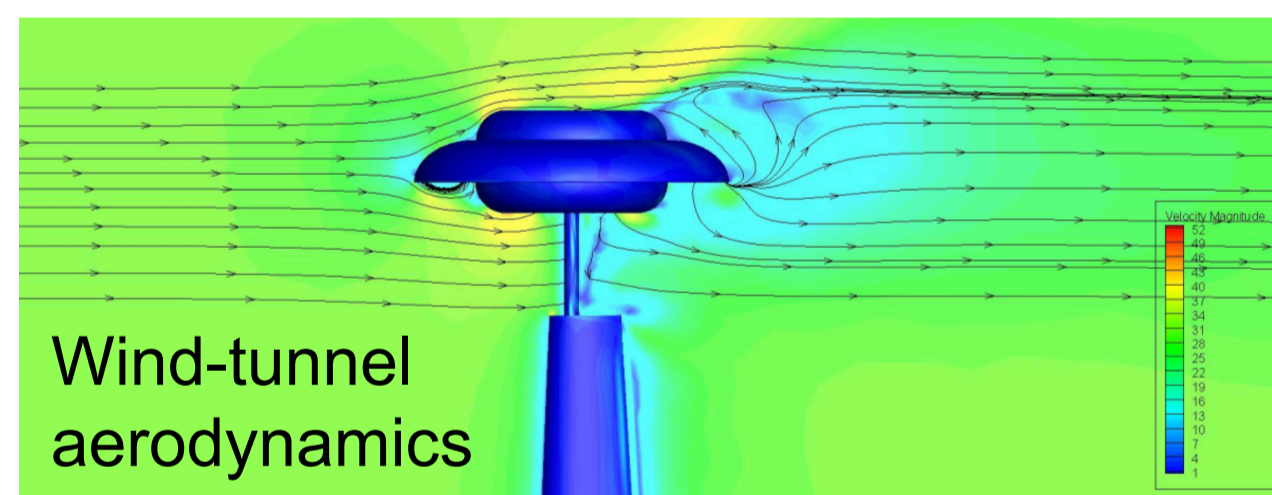
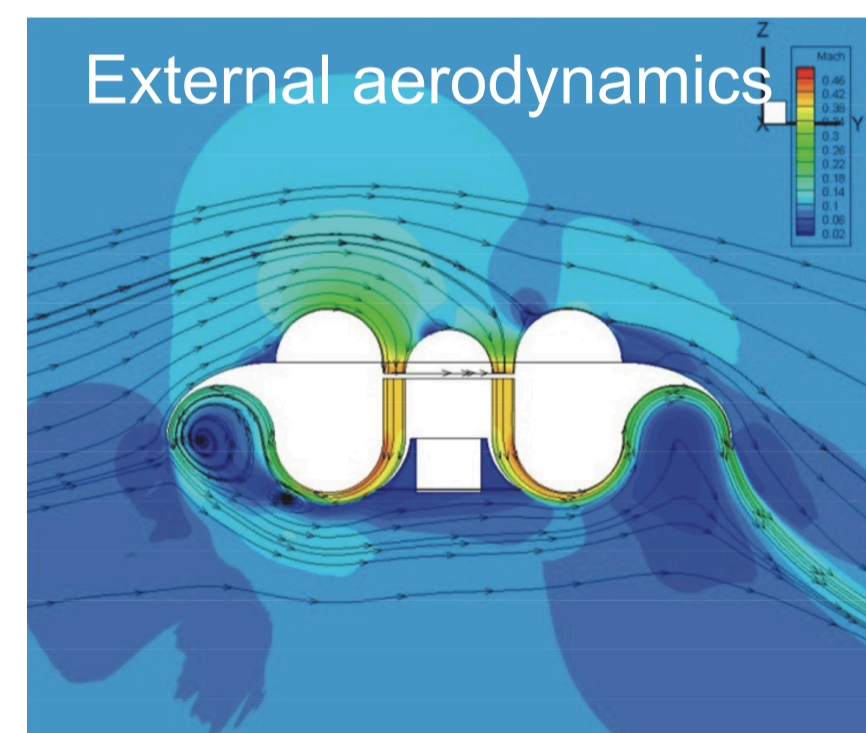


Key features of ANULOID

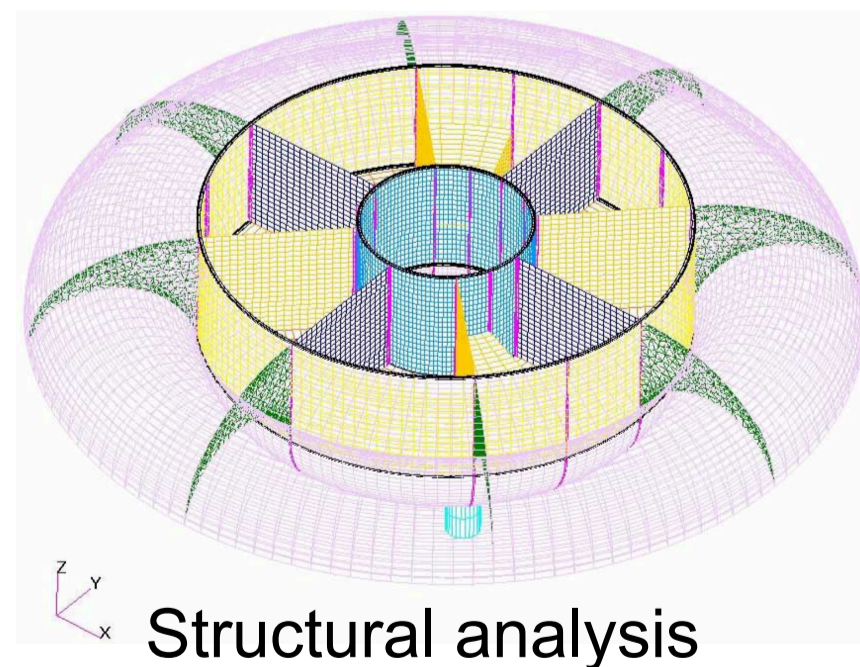
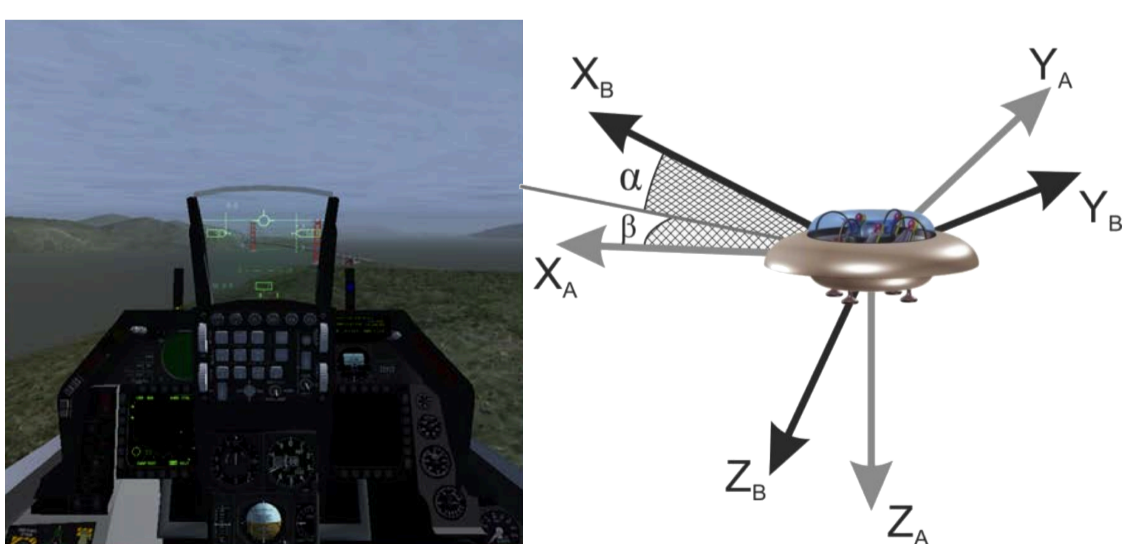
- Axisymmetric geometry (external diameter 5m)
- Composite materials: reduce weight & required control forces
- One engine, ducted fan: reduce noise & improve performance
- Fixed and swivelling vanes: Coanda effect & flight control

Feasibility analysis: Model – Simulation - Experiments

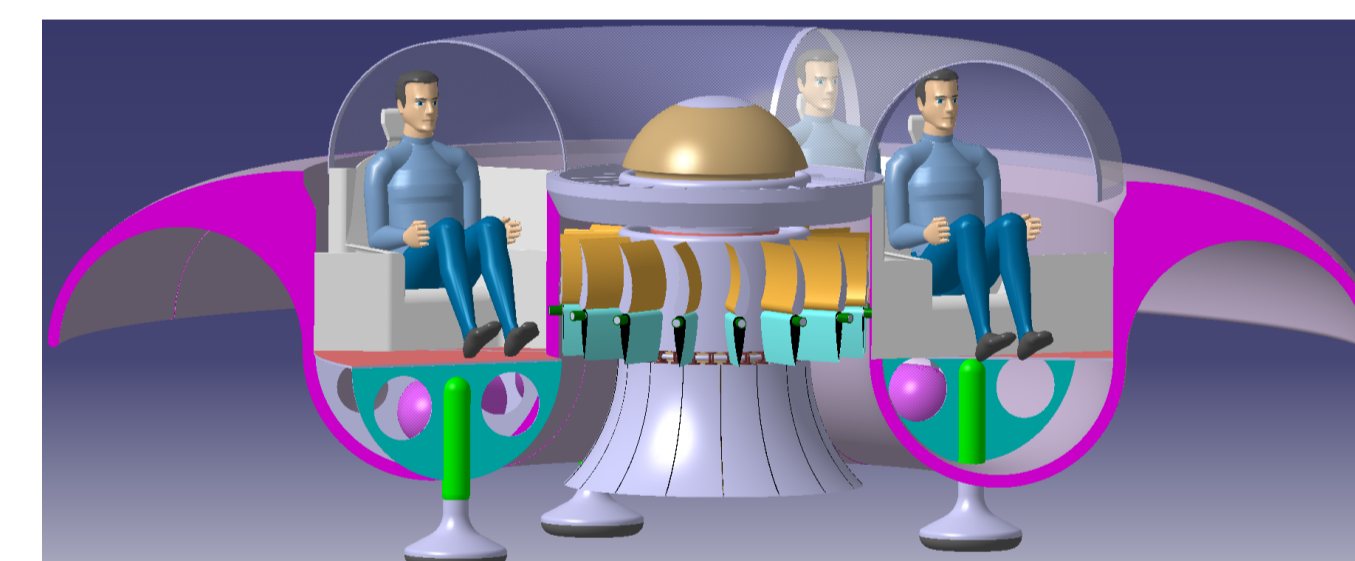
Numerical Simulations



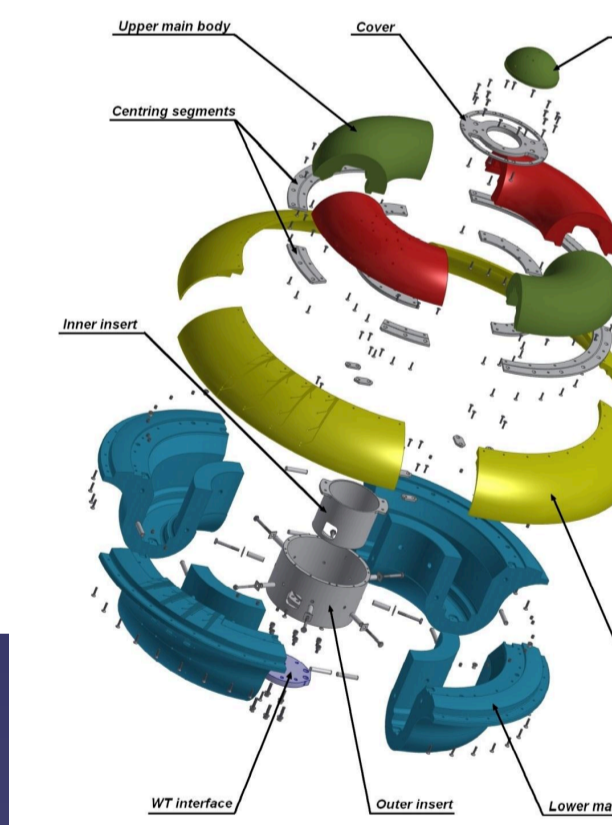
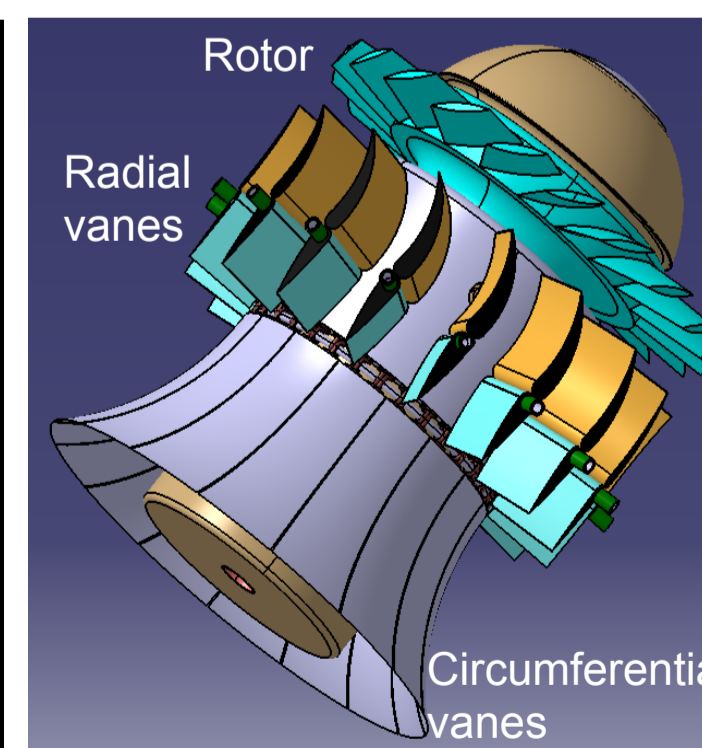
Flight mechanics & flyability



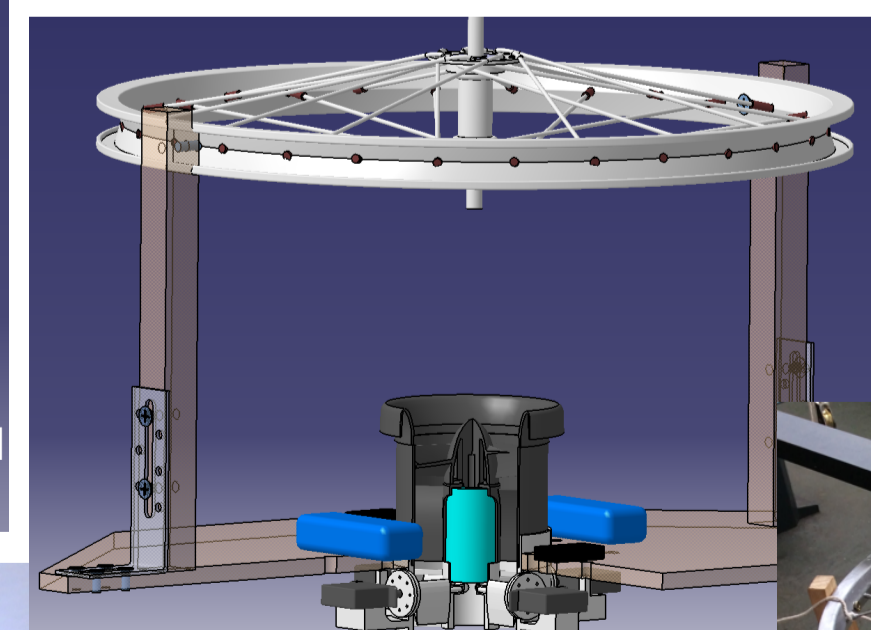
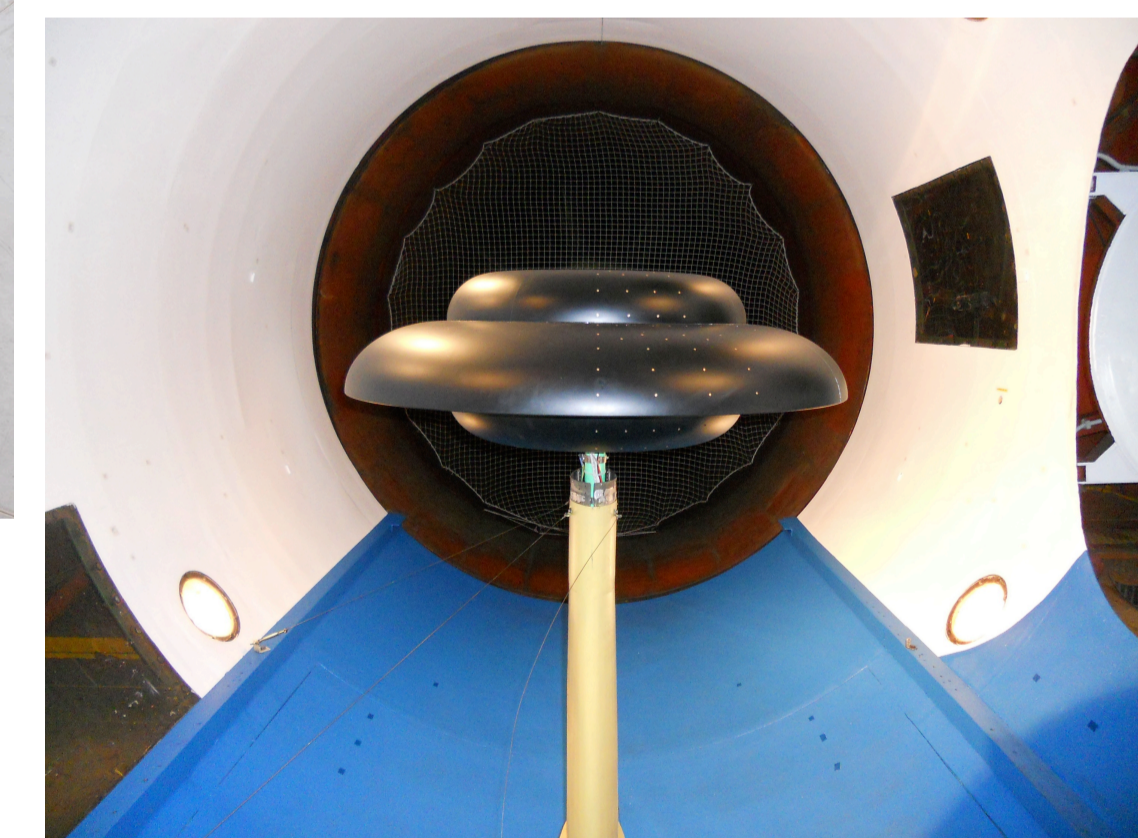
CAD models



| Component | Mass [kg] |
|--------------|-------------|
| Structure | 280 |
| Engine | 250 |
| Fuel | 200 |
| Systems | 90 |
| Payload | 380 |
| Total | 1200 |



Experimental investigation



Verification of Coanda effect

