Mini-Bee

Hybrid Octocopter, Beginning of TRL2

(Technology concept and/or application formulated)

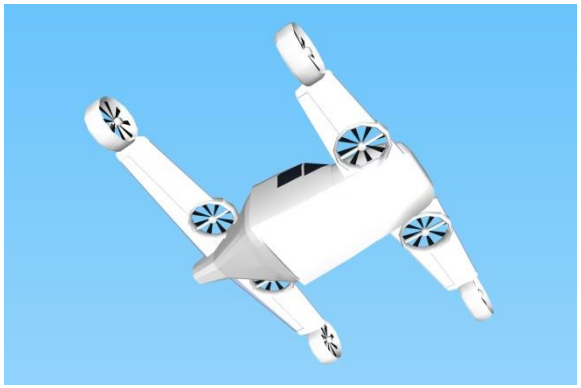
Agenda

- Mini-Bee description
  - Concept and technical description
  - SWOT analysis
- TRL1 project
  - Partners and project history
  - TRL1 Tasks
  - Aerodynamic studies
- TRL2 project launch

  - Annexes : State of the art, Other innovative projects

Mini-Bee description

- Project state : beginning of TRL2
  - Electric octocopter : 4 vertical + 4 tilt rotors
  - Hybrid energy : fuel + batteries
  - 2 seats, VIP configuration
- Characteristics :
  - VTOL capacity, short wings, 1.2 ton
  - Range 600km, max speed 300km/h
  - Electric controls and engines
- Goals and market
  - VIP and Business Individual Air Vehicules
  - Estimated price 450k€



Architecture

External tilt quadcopter

Central vertical quadcopter

Rear electric generator

Gullwing doors

Fuel generators

Biplane

Battery kits

Electric flight controls

Tailwheel-type landing gear

Low noise nacelle

Retractable front landing gear

3D printed metallic structure

Technical description

Aircraft characteristics

2 seats, VTOL, Short wing for cruise flight
MTOW 1200 kg, Range 800km , Cruise speed 220 km/h
Wing surface 15m², no control surface

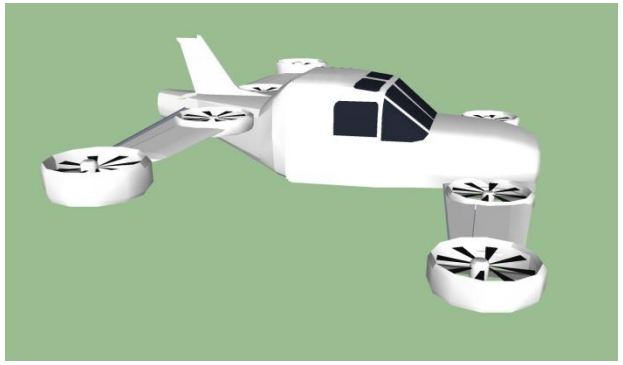
Engines

Central vertical quadcopter + External tilt quadcopter
4 hybrid fuel generator for central quad copter
4 electric engines for external tilt quadcopter
Electronic control of engines power and tilt angles

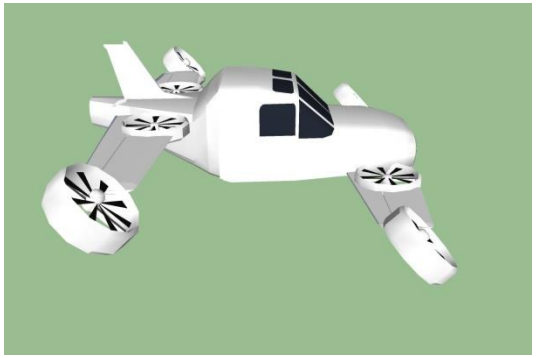
Cockpit interface

« Car like » pilot interface : Steering wheel, foot pedals, central screen

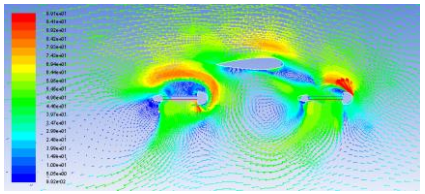
Take-off and flight transition

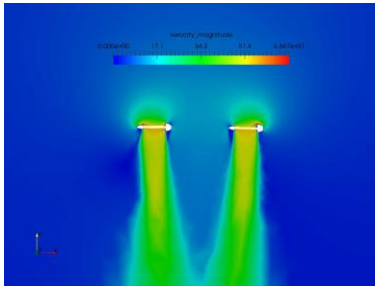


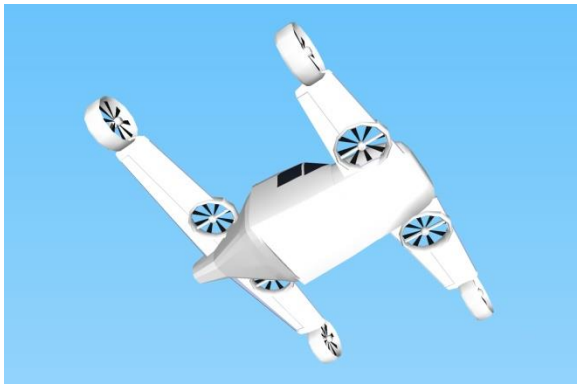
Vertical take-off



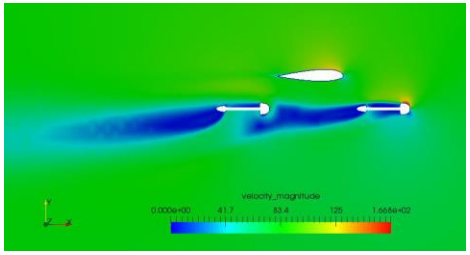
Tilt transition







Cruise flight



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Take-off and tilt transition



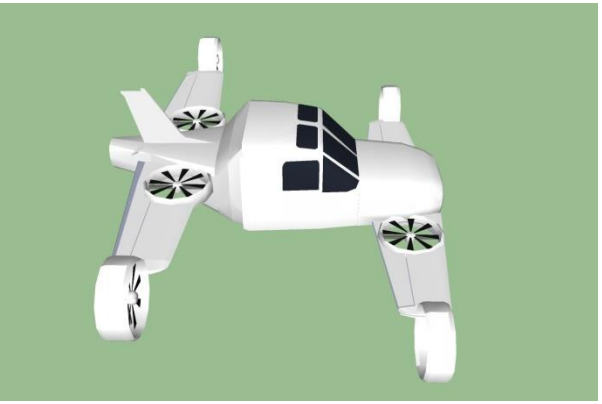


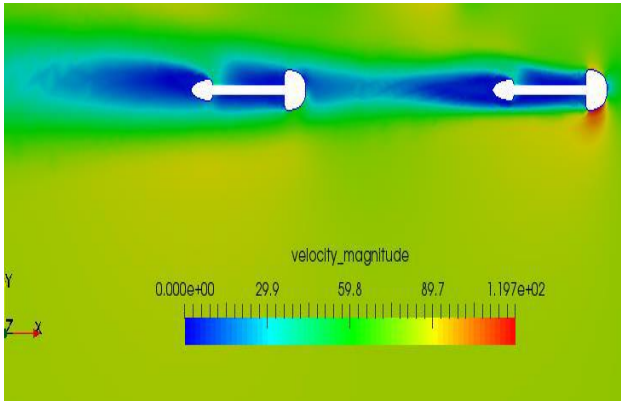


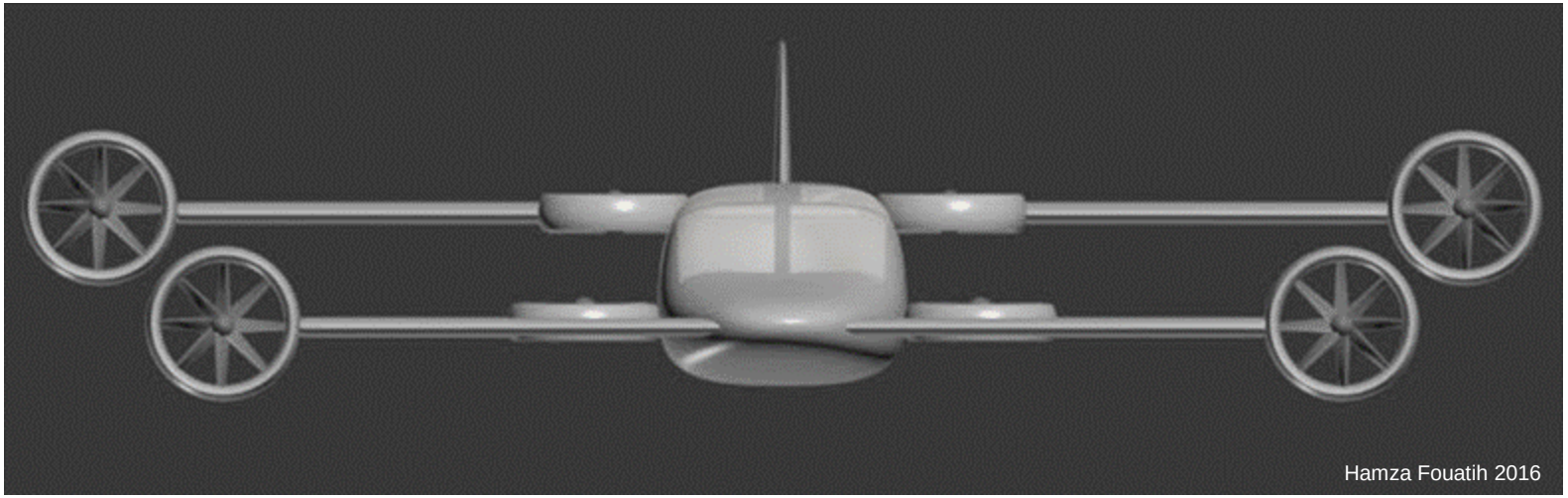


By Estaca 2016

Cruise flight







Technical data

MTOW : 1200 kg

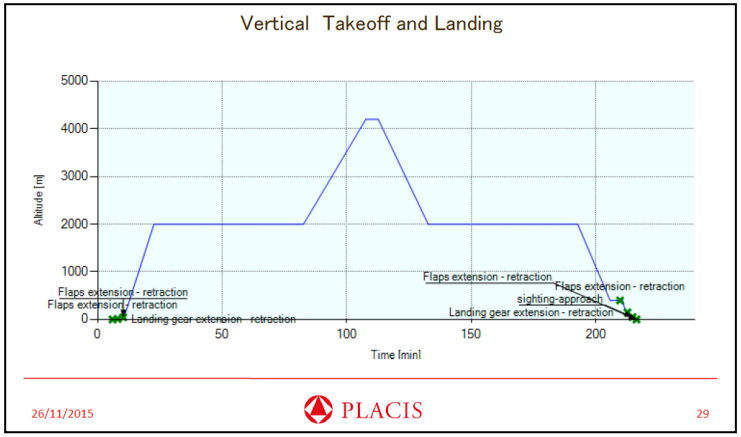
- Structure : 320kg
- Fuselage : 80kg
- Payload : 220 kg (2 PAX)
- Systems : 125 kg
- Engines : 236 kg (4 turbotech 160kg + 4 Yuneec 76kg)
- Batteries : 80kg
- Fuel : 140kg

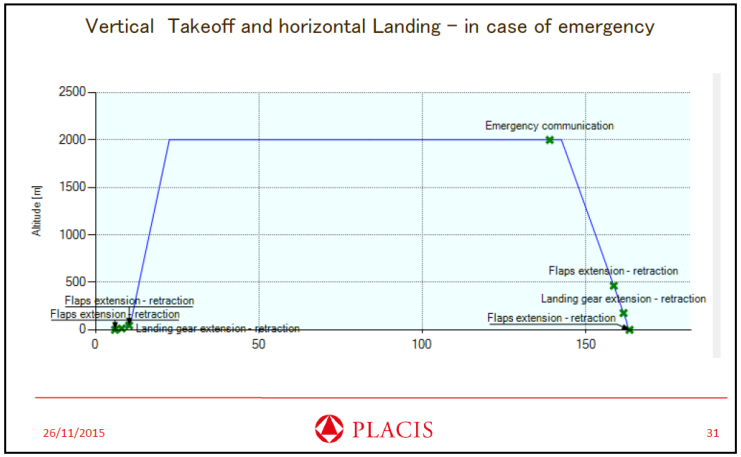
Costs

Total costs : 400k€

- Wing : 60k€
- Fuselage : 90k€
- Landing gear : 10k€
- Engines : 60k€
- System : 180k€

Mission profile





Phase	Duration		Altitude (start)	Altitude (end)	Speed	Climb rate	Specific Consuption
	hour	Min	m	m	km/h	m/s	lb/Hp/h
Engine start-up	0	0,3	0	0	0	0	0
Taxi out	0	4,5	0	0	60,0001	0	0,44
Flaps extension - retraction	Start time	60	-	-	-	-	-
Vertical Take off	0	0,8	0	45	0	0,9375	0,46
Landing gear extension - retraction	Start time	25	-	-	-	-	-
Rotors orientation	0	2	45	45	100,0001	0	0,45
Flaps extension - retraction	Start time	85	-	-	-	-	-
Climb	0	12	45	2000	200,0002	2,7153	0,45
1° cruise	1	0	2000	2000	299,9999	0	0,4299
obstacle deviation (climb)	0	25	2000	4200	249,9998	1,4667	0,45
Mini-cruise	0	5	4200	4200	249,9998	0	0,44
obstacle deviation (scent)	0	20	4200	2000	270	-1,8333	0,435
2° cruise	1	0	2000	2000	300	0	0,4299
Descent	0	13	2000	400	240	-2,0513	0,435
Holding	0	5	400	400	200	0	0,4331
Flaps extension - retraction	Start time	80	-	-	-	-	-
2° rotors orientation	0	1	400	200	100	-3,3333	0,45
Vertical Landing	0	4	200	0	20	-0,8333	0,447
Landing gear extension - retraction	Start time	25	-	-	-	-	-
sighting-approach	Start time	75	-	-	-	-	-
Taxi in	0	2	0	0	60	0	0,44
Flaps extension - retraction	Start time	30	-	-	-	-	-
Engine shutdown	0	0,2	0	0	0	0	0

26/11/2015 PLACIS 30

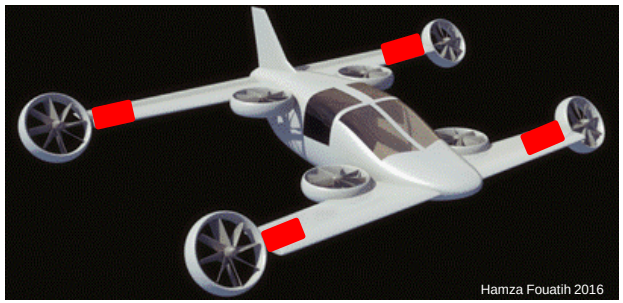
Engines for vertical rotor

Equipement proposed : 4 electric engines Yuneec Power Drive 40

		Yuneec Power Drive 40 [11]
Dimensions	Length	163 mm
	Width	240 mm
	Height	240 mm
Weight		19 kg
Power		40 kW at 2400 rpm
Power to weight ratio		***2,1 kW/kg***

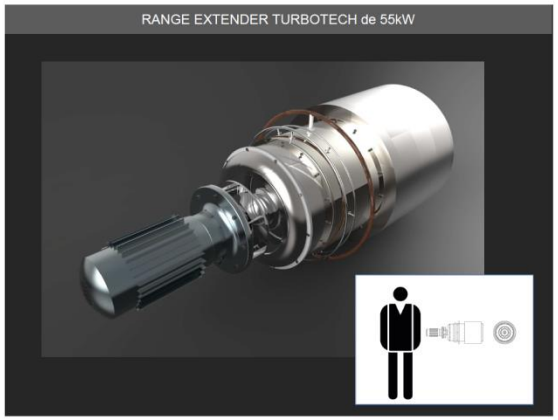
Power 160 kW

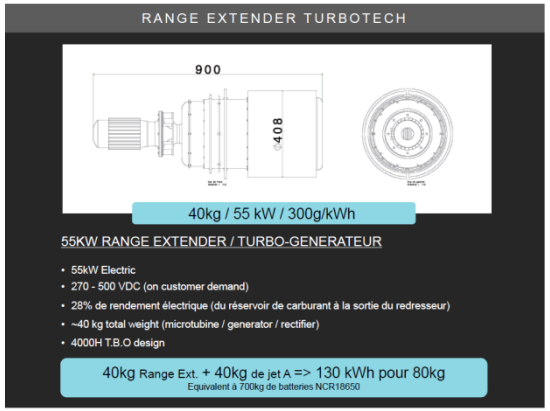
- provided by 80kg of batteries (at 150kW/kg) during take-off
- and by fuel generator during cruise flight

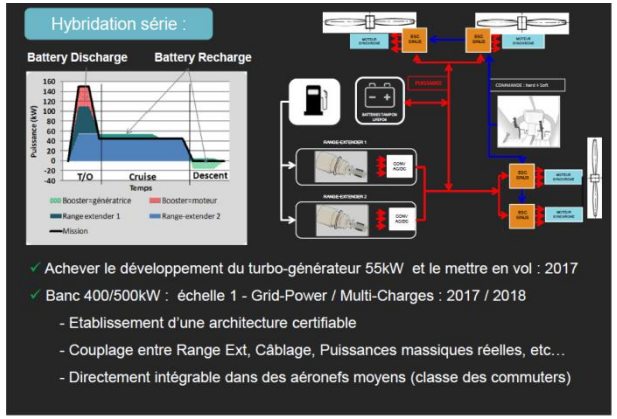


Electric generator for vertical quadcopter

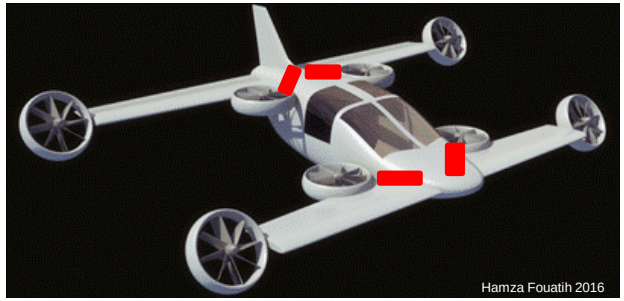
Equipement proposed : 4 Turbotech 55kW for central quad copter







Fuel energy : 220 kW for take-off and low speed flight



SWOT analysis

Strengths

- VTOL capacities
- Speed of an aircraft
- Double quadcopter back-up in case of engine failure
- Fuel energy range

Weakness

- New configuration
- Project at low TRL
- Aerodynamic and leight weight structure
- Propulsion and energy storage
- Project implementation
- Project funding

Opportunities

- Cost reduction :
  - Overall flight cost reduction compared to helicopter
  - Low purchasing & maintenance cost of engines
- New design space: tilt, octocopter
  - Weight / VTOL
- Project investment

Threats

- All electric helicopter
- All electric aircraft
- Tilt rotor (bi and quadri)
- Hybrid energy

Partners for R&D

Project coordinator

TECHNOPLANE
AERONAUTICAL INNOVATION

TRL1 Basic Definition

supméca

POLITECNICO DI TORINO

ESTACA
ÉCOLE D'INGÉNIEURS
Groupe ISAE

PLACIS

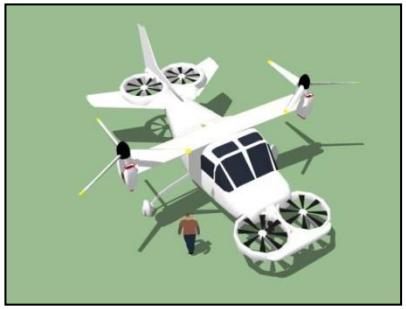
TRL2 Detailled Definition

To be launched

Project history

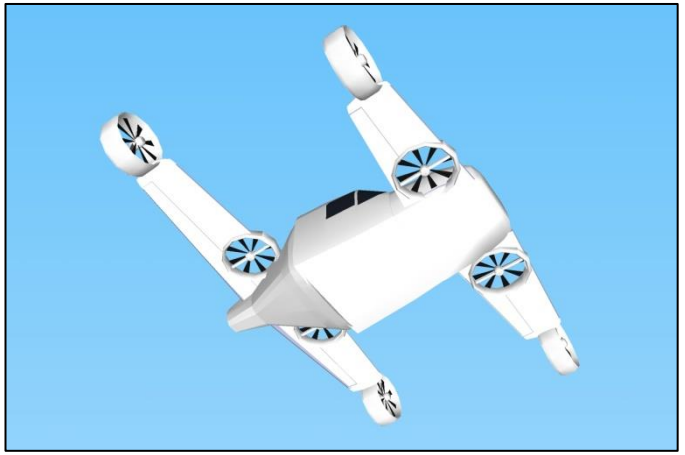
TRL0 Project Launch (2015)

TECHNOPLANE



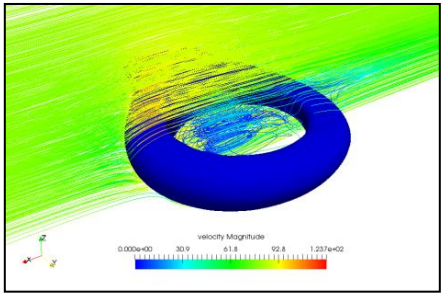
Studies 2015/2016

TRL1 Basic Definition (2016)

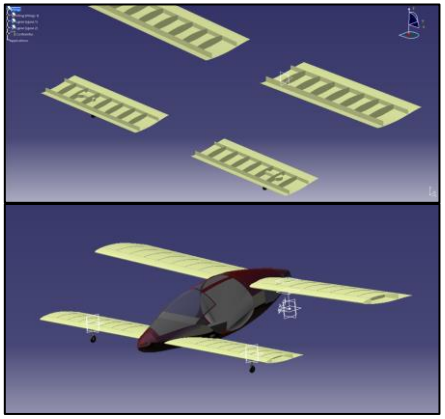


TRL1 project tasks

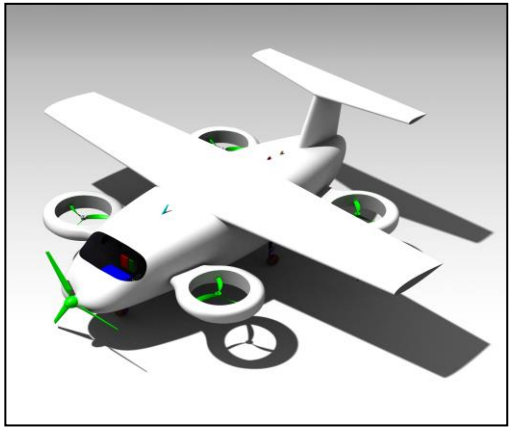
Polito 2015



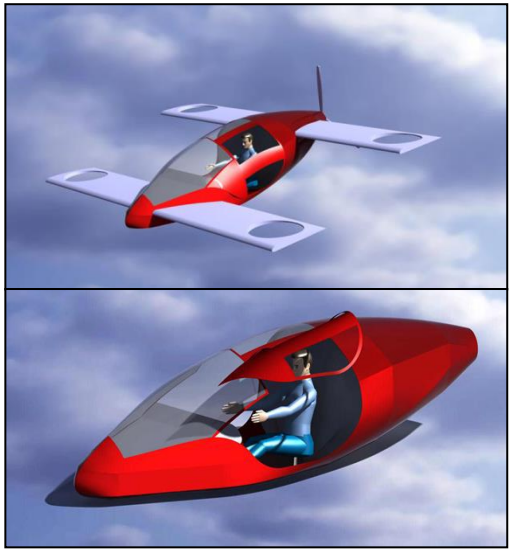
Supmeca
2016



Estaca
2016 group1

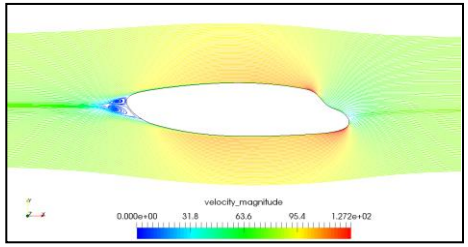


Supmeca & Polito
2016 (Placis)

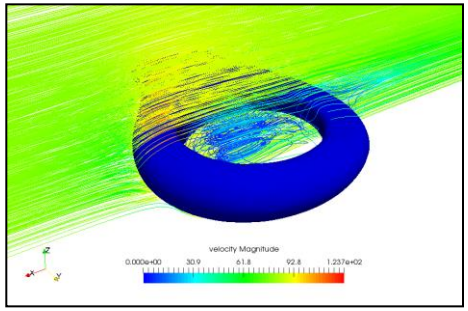


Estaca
2016 group2

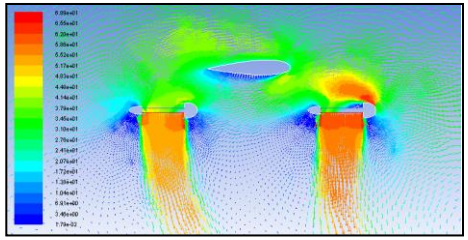
Aerodynamic studies



Cockpit shape optimization
Supmeca 2016

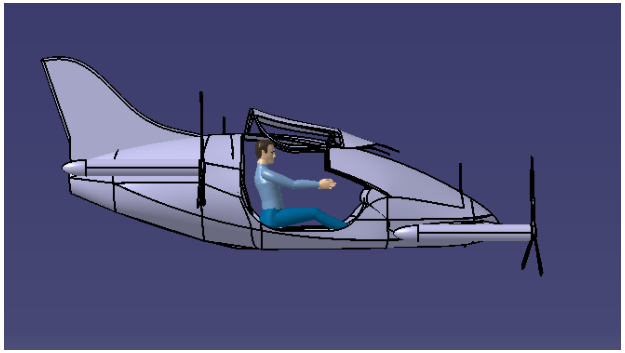


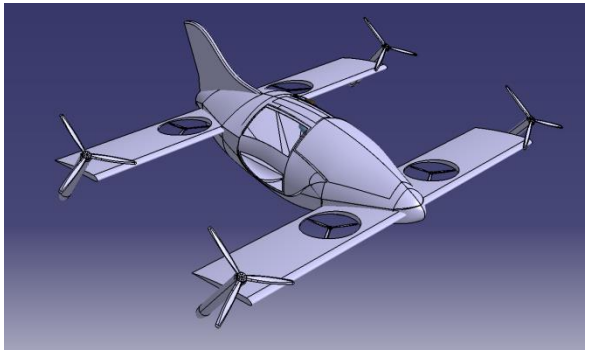
Rotor shape optimization
Supmeca 2016

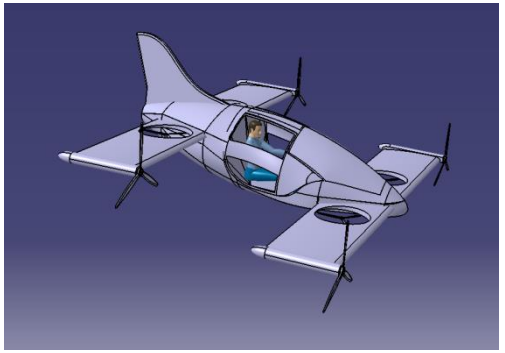


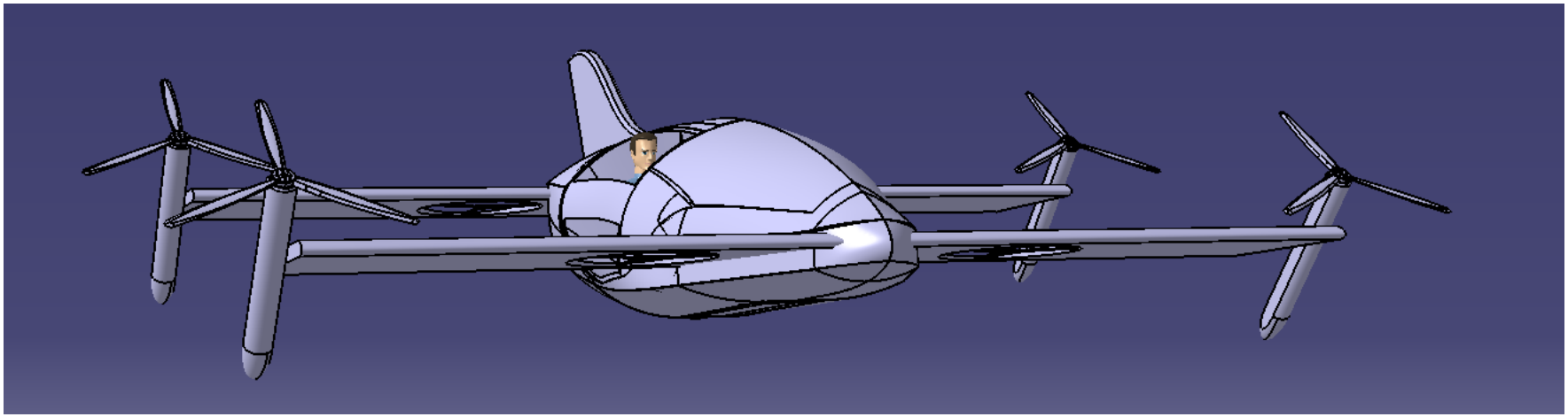
Vertical rotor air flow studies
Supmeca 2016

Configuration at end of TRL1



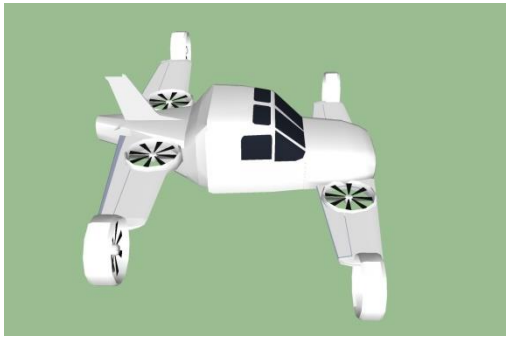


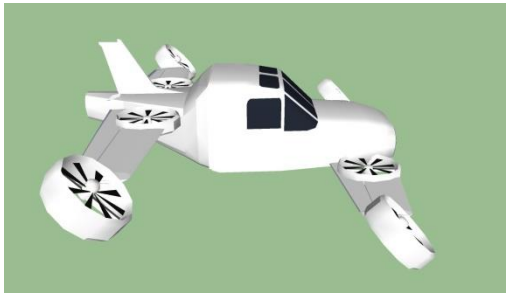




Estaca Laval 2016

Mini-Bee project for TRL2





Mini-Bee (at end of TRL1)
2 PAX VIP
Electric Octocopter
Tilt quadcopter & vertical quadcopter
Hybrid energy : batteries & fuel

Project partners

Lesser Open Bee License 1-3

Coordinator : TECHNOPLANE AERONAUTICAL INNOVATION

Universities : CentraleSupélec, supméca, POLITECNICO DI TORINO, ESTACA ÉCOLE D'INGÉNIEURS Groupe ISAE

Institution & financial partners :

NAE Normandie AeroEspace à la hauteur des défis de demain
PLACIS
seinari AGENCE DE L'INNOVATION EN RÉGION HAUTE-NORMANDIE
REGION HAUTE NORMANDIE
oséo Prêt à la Création d'Entreprise
CCI EURE
CCI NORMANDIE
CCI International Normandie
NORMANDIE-SEINE Le bon sens a de l'avenir
BGE Vos initiatives ont un avenir
pole-emploi.fr
iNOCÉANE
enterprise europe network
HAUTE-NORMANDIE ACTIVE FINANCEUR SOLIDAIRE POUR L'EMPLOI

Design: HAMZA FOUATIH

Actions for Mini-Bee TRL2 Project

- Launch Mini-Bee TRL2 project :
  - Assess detailled technical configuration
  - Evaluate market opportunities, production and flight costs
  - Define partnership for TRL2 and TRL3
  - Draw project financial path

Partners to be defined

Project sponsors

Electronics and equipement integration

Aircraft flight management control

Aircraft manufacturer

Cokpit interface and project integration

Structure 3D printer

Annexes

Individual Air Vehicules

State of the art

Cessna Skylane

- Height: 2,84 m
- Wingspan: 10,97 m
- Lenght: 8,84 m
- Max Take-Off Weight: 1406 Kg
- Power: 230 hp
- Engine: lycoming IO-540-AB-1A5
- Maximum speed: 269 Km/h
- Range: 1695 Km
- Price: 277 300 $

Cessna TTX

- Height: 2,74 m
- Wingspan: 10,97 m
- Lenght: 7,68 m
- Max Take-Off Weight: 1633 Kg
- Power: 310 hp
- Engine: turbo TSIO-550-c
- Maximum Speed: 435 Km/h
- Range: 2315 Km
- Price: 733 950 $

Aeromobil 3.0

- Height:1,50 m
- Wingspan: 8,32 m
- Lenght: 6 m
- Power: 81 hp
- Engine: rotax 912
- Maximum speed: 200 Km/h
- Range: 700 Km

Robinson R44

- Height: 3,3 m
- Rotor diameter: 10,1 m
- Lenght: 11,7 m
- Max Take-Off Weight: 1089 Kg
- Power: 248 hp
- Engine: lycoming IO-540-AE1A5
- Maximum speed: 240 Km/h
- Range: 560 Km
- Price: 456 000 $

Agusta Westland AW609

- Height:5,1-6,6 m
- Wingspan: 11,7 m
- Lenght:13,3 m
- Max Take-Off Weight: 7200 Kg
- Power: 1900 hp
- Engine: Pratt &Whitney Canada PT6C-67A
- Maximum speed: 616 Km/h
- Range:1390 Km
- Price: 10 000 000 $

Other innovative projects

SoloTrek/Springtail

http://www.trekaero.com/

Xplorair (2016)

Airbus E-fan (all electric)

E-volo

eHang (fin 2015)

Mini-Bee

TECHNOPLANE
AERONAUTICAL INNOVATION

2PAX VIP Hybrid Octocopter