Elettrico + Digitale = SMART product nei sistemi di trasporto.

Dal powertrain Elettrico&Ibrido al veicolo/velivolo con guida autonoma :

Innovazione Tecnologica & Rivoluzione Sociale !

Rotary - Gemona del Friuli – Martedì, 19.5.2020

Tecnologie Elettriche-Digitali Trasporto

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- Automobilistico
  - ADAS
    - Advanced Driver Assistance Systems
  - «The United Kingdom plans to eliminate all emissions from on-the-road vehicles by 2050, and France hopes to end sales of gas and diesel powered vehicles by 2040. Norway is one of the most ambitious countries of all, with a goal of having all new passenger cars and vans sold in 2025 be zero-emission vehicles.»
  - Propulsione Elettrica-Ibrida
- Aeronautico
  - Propulsione Elettrica-Ibrida
  - SMART-Avionics / AutoPiloting

Industria Automobilistica

Tecnologie Elettriche-Digitali Trasporto

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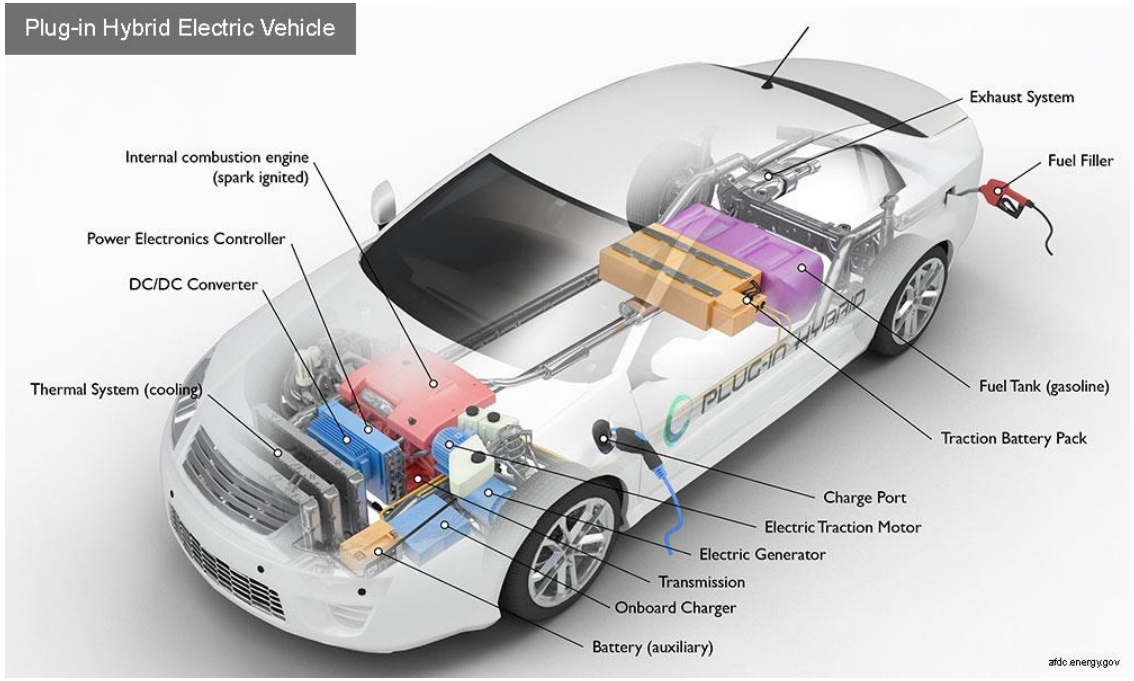
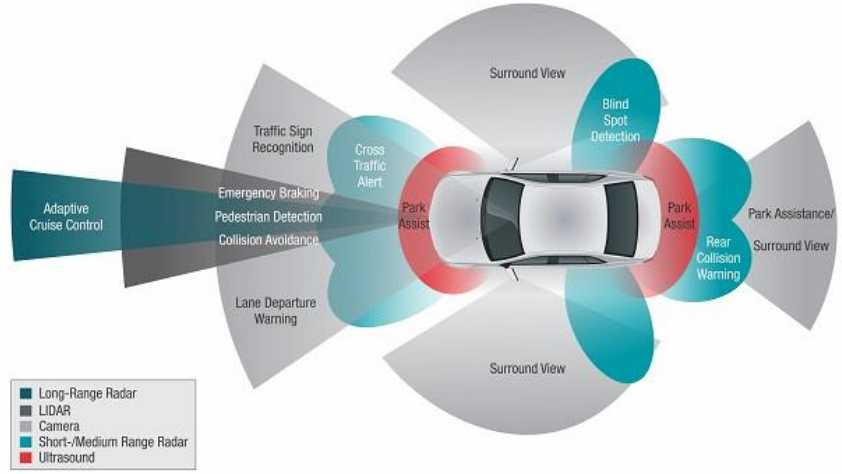
- Automobilistico
  - Propulsione Elettrica-Ibrida
  - ADAS - Advanced Driver Assistance Systems





Tecnologie Elettriche-Digitali Trasporto

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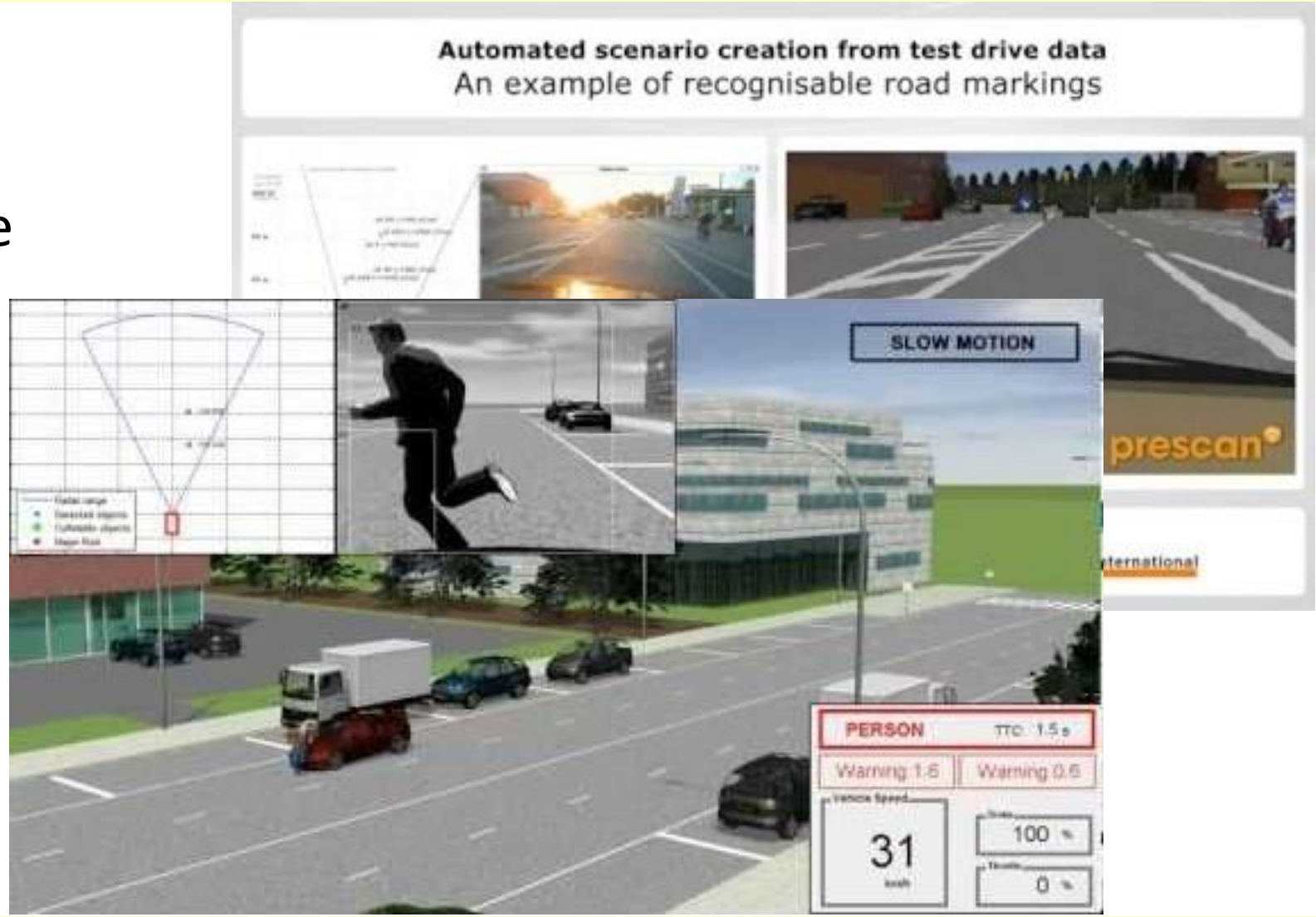
- ADAS
  - Simulazione di scenario
  - Riconoscimento strada e ostacoli
  - Guida automatica
  - Condizioni meteo-esterne diverse/critiche



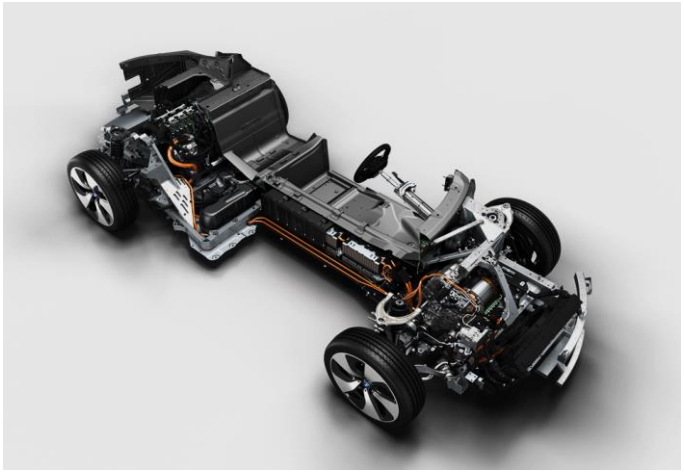
Tecnologie Elettriche-Digitali Trasporto

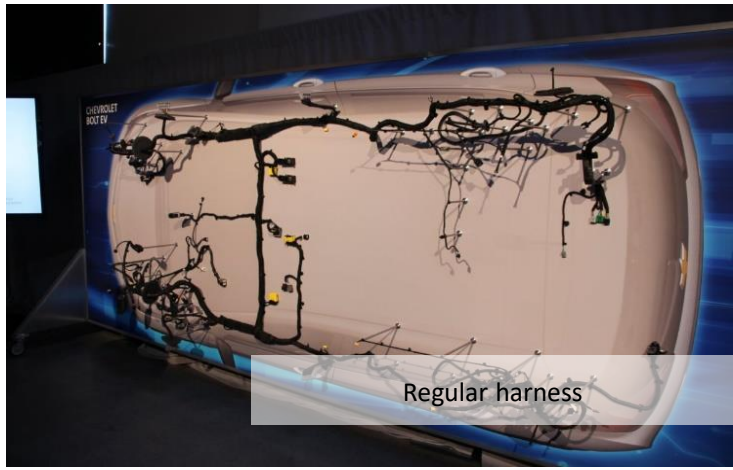
- Il SW diventa estremamente potente
  - Riconoscimento segnali stradali

- Anche solo su un iPhone

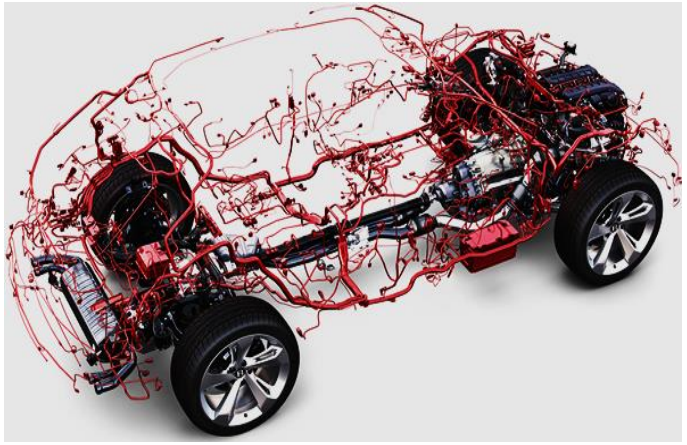
Tecnologie Elettriche-Digitali Trasporto

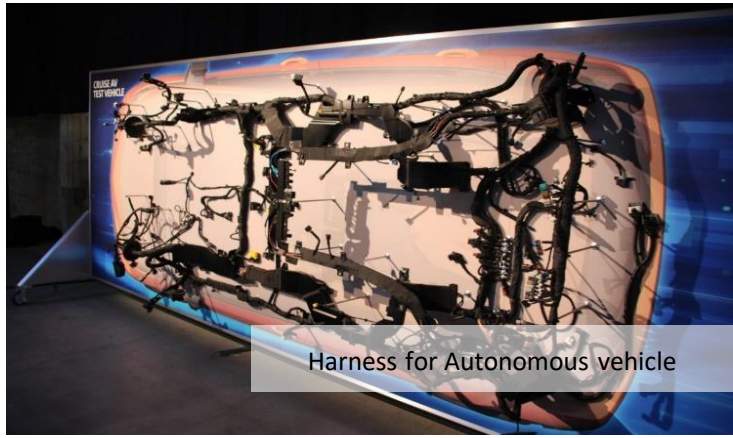
- La complessità «elettrica» dell'auto oggi





Regular harness





Harness for Autonomous vehicle

- Può attivare sistemi di emergenza «vitali» come il AEBS :
  - Advanced Emergency Braking System

Courtesy of DAF

Industria Aeronautica

Tecnologie Elettriche-Digitali Trasporto

- Airbus says it has the technology to fly planes with no pilots, but the challenge will be convincing people to get on them
- Its chief commercial officer, Christian Scherer, said that the barriers which remain are human: convincing regulators and passengers to accept the planes.

Tecnologie Elettriche-Digitali Trasporto

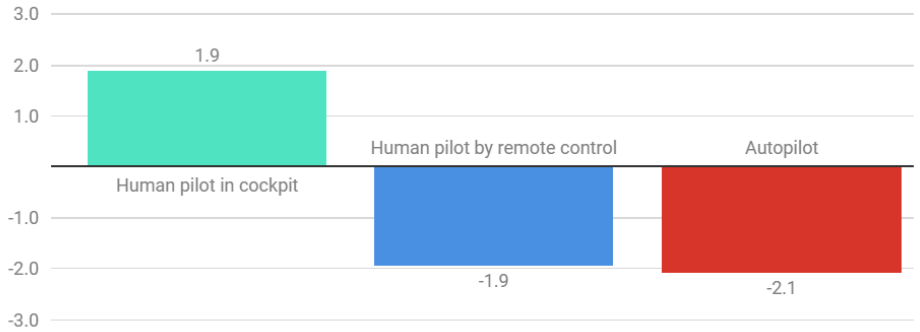
- GARMIN
  - AutoLand per velivolo Aviazione Generale

Tecnologie Elettriche-Digitali Trasporto

- Airbus says it has the technology to fly planes with no pilots, but the challenge will be convincing people to get on them
- Its chief commercial officer, Christian Scherer, said that the barriers which remain are human: convincing regulators and passengers to accept the planes.

How willing are you to fly with a particular type of pilot?

A survey asked 104 Americans how comfortable, trusting and willing they would be if flying with a human pilot in the cockpit, a human pilot on the ground flying by remote control and using an autopilot on board the plane. Only a human pilot in the cockpit made people feel comfortable.



The scale ranged from +3 (extremely willing) to -3 (extremely unwilling).

Chart: The Conversation, CC-BY-ND • Source: Rice et al., 2014. • Get the data

Hybrid powertrain VoltAero Aircraft

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- Follows first Airbus electrical A/C experience (E-Fan) with

Cassio

Cross channel flight with E-Fan performed by Jean Botti and Didier Esteyne, founders of VoltAero (in 2015)

Hybrid powertrain VoltAero Aircraft

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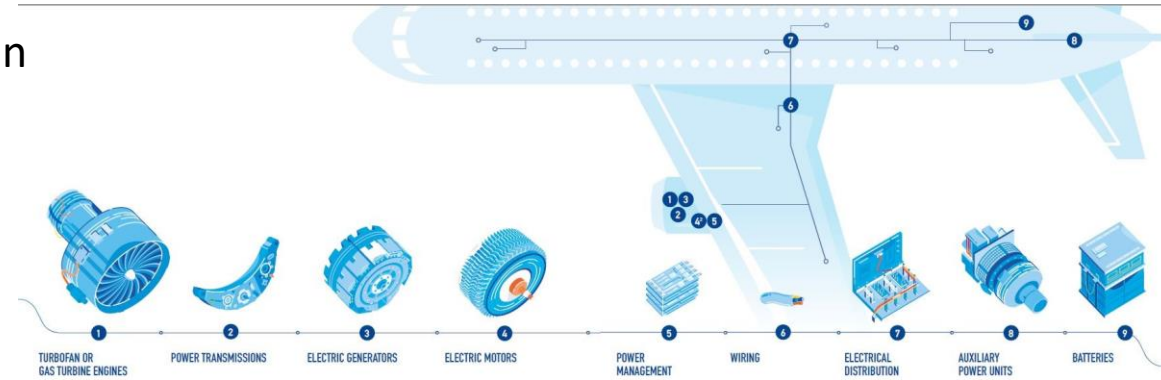
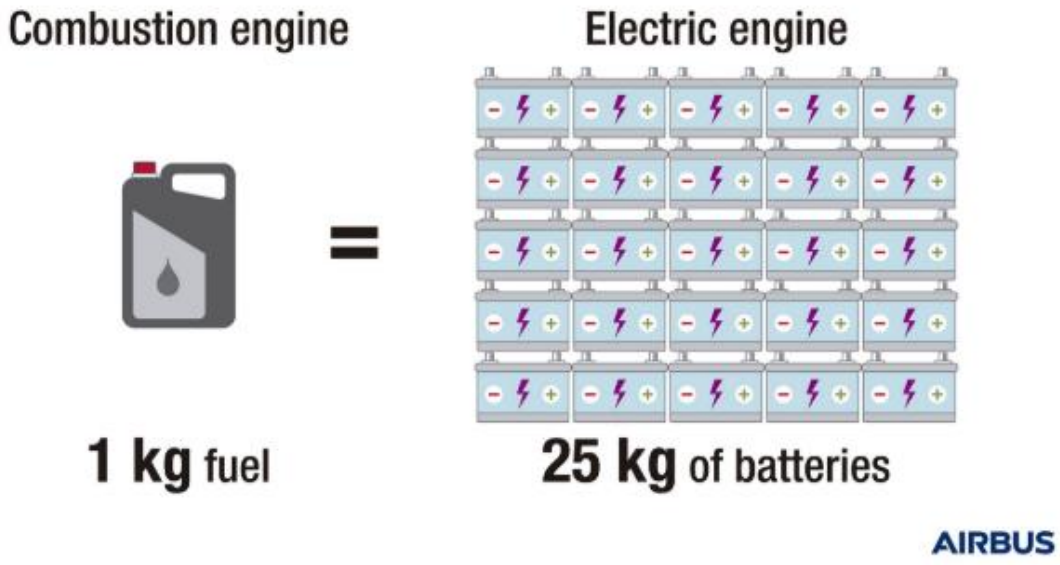
- Electrical energy used for
  - Safety
    - Thermal **+ / OR** Electrical powertrain system available jointly (max power of about 600kW) or as separate/independent energy sources
    - Further “redundant flight power” safety configuration
  - Environmental friendly : Pollution / Noise reduction
    - City Airports / Short Airfields, close to habitants
    - Short Distance commuter PPT
  - Efficient fuel usage with different type of Energies



- Hybrid configuration leverage best compromise
  - Liquid-fossil Fuel energy
  - Electrical / Battery energy
  - Also Airbus CTO, Grazia Vittadini, said (May 2019) :
    - ***“…we should not expect electric aircraft anytime … realistic is hybrid developments, not battery-based designs.”***

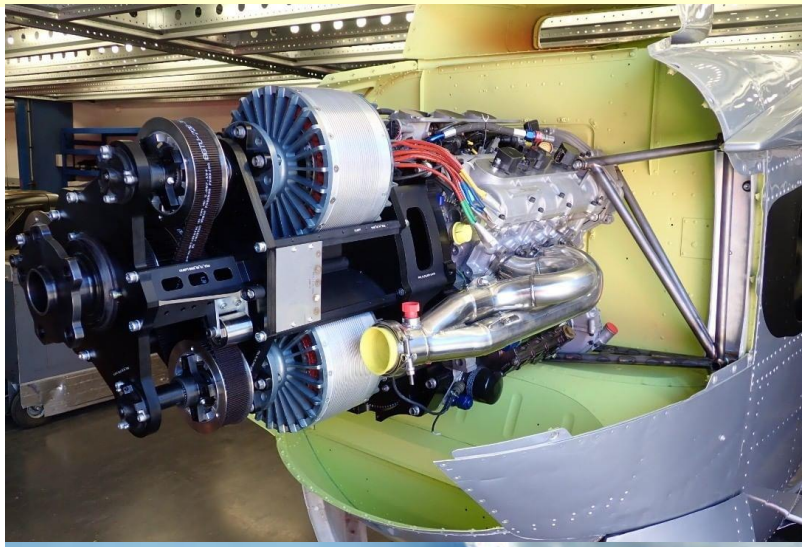
Technical problems – 1

- Due to Energy/Power Density problem :
  - Liquid fossil fuel (for thermal engine) → 45MJ/Kg
  - Battery (for electrical motors) → 1,5MJ/Kg
- A/C Power/Weight to optimize
  - Hybrid solution with OnBoard :
    - Thermal Electrical Fuel-Generator
      - used also for peaks prop-power needs
    - Batteries loaded by Electrical Fuel-Generator
    - Electrical motors/propellers moved by batteries electricity
- HENCE →
  - Optimize weights respecting A/C aero-balancing
    - Batteries most critical



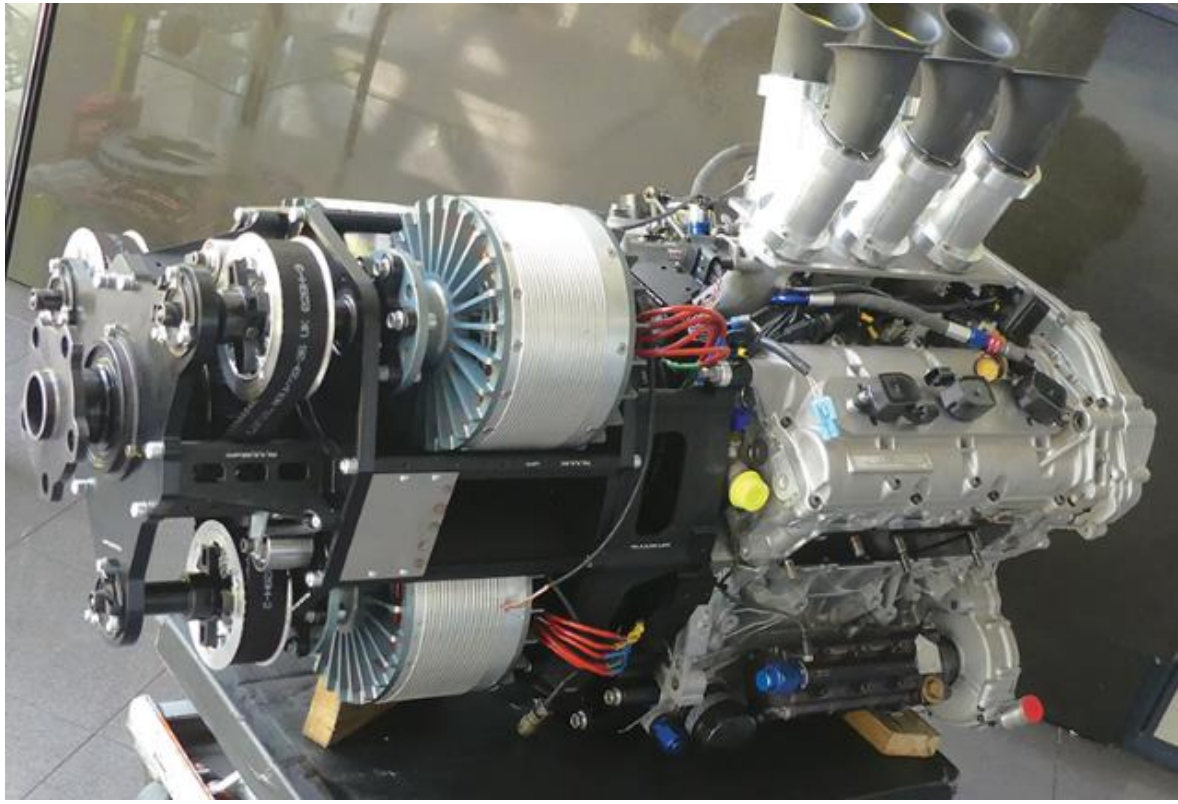
Technical problems – 2

- Loads & Moments A/C balancing analysis and optimization in order to get :
  - Optimal Electrical/Thermal equipment positioning considering all weights (especially batteries)
    - On the wings for front/wing pull-prop electrical motors
    - On the nose for rear hybrid powertrain push-prop
  - Perfect aerodynamics balancing



Technical problems – 4

- EMI/EMC critical points simulation also on Hybrid powertrain installation (on the test-rig used) :
  - High voltage harness and control-box optimization also on the test-rig used to tune-up electrical motor control systems
  - ECU optimization on EMI/EMC
  - Simulation used to optimize test-rig harness routing as well



EM Simulation on Cassio 1

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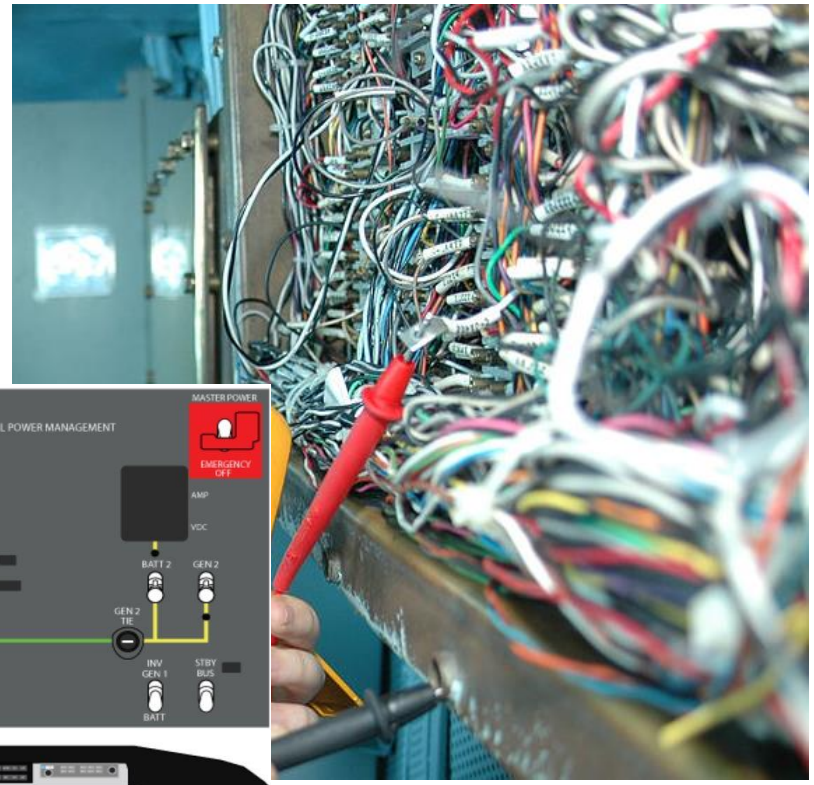
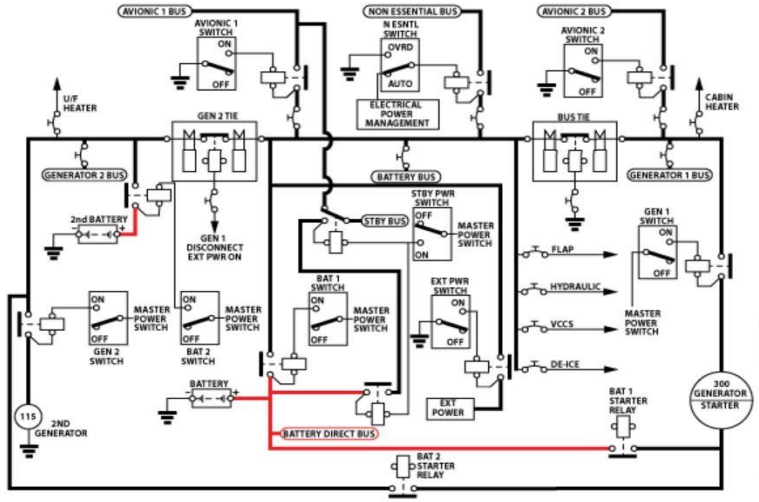
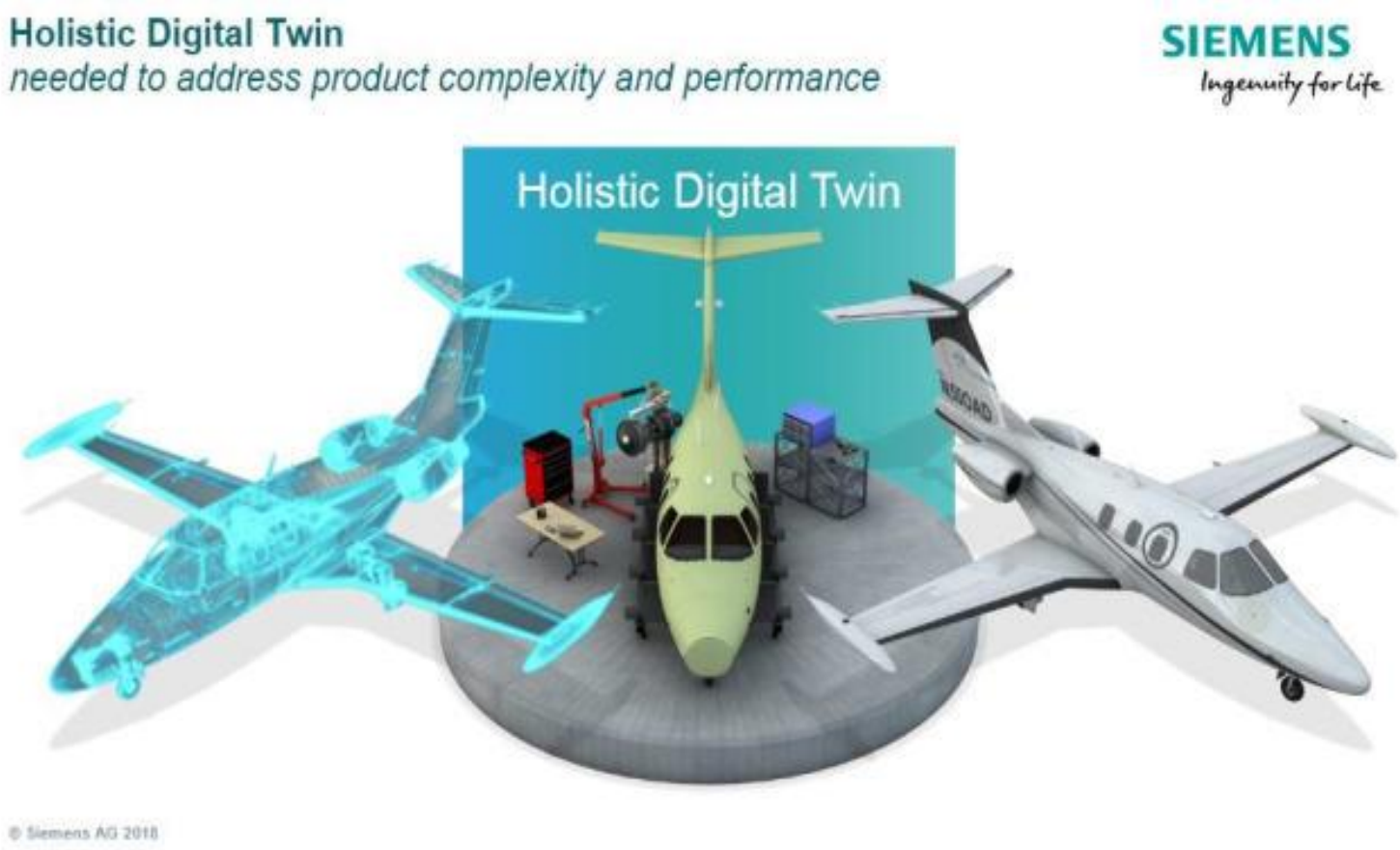
- Powertrain / Avionics EMI/EMC (on Cassio 1)





Other developments (Virtual & Physical)

- And likely more :
  - HIRF & Lightning
    - Virtual+Physical testing
  - Further capabilities towards “Autonomous”
    - EMI on DataLink signals (IoT concept…)
  - Integrate different engineering disciplines → PLM Integration :
    - Mechanical, Electrical, Controls, Thermal, CFD, etc.
    - EM CAE simulation
    - EM “physical” Testing



CONCLUSIONI

Benefici Sociali

- Mezzi autonomi possono essere solo «richiesti» per effettuare un viaggio, ma non devono essere «di proprietà», ma usati «OnDemand»
- Le strade si «svuotano»
- Energia Elettrica risolve molti problemi ambientali :
  - Perché non inquina
  - Perché è in grado usare quasi il 100% dell'energia fornita (Termico al max 30% !!)
- I velivoli atterrano… in città !!
- …

BACKUP slides

EM Simulation

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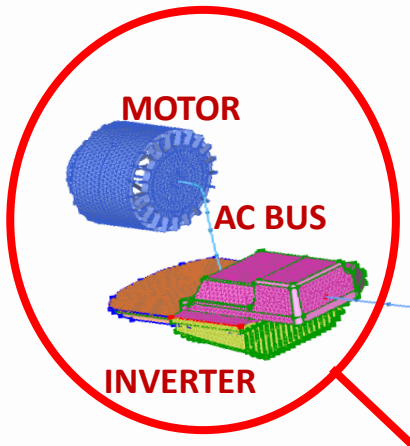
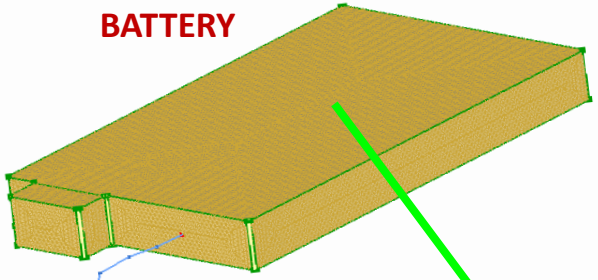
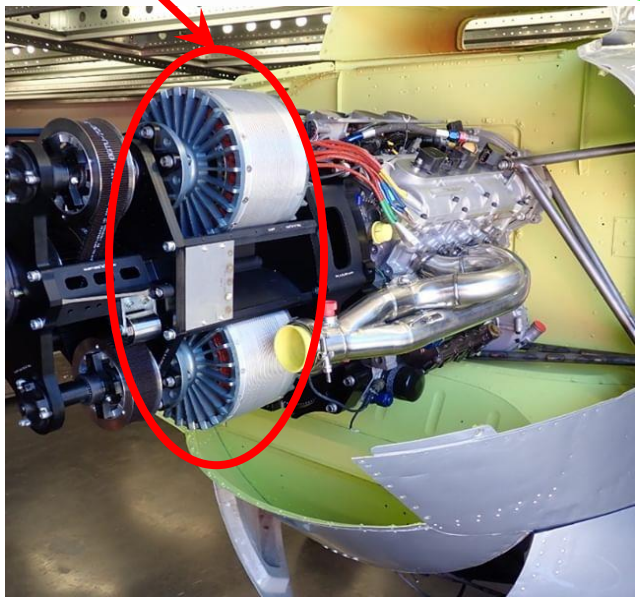


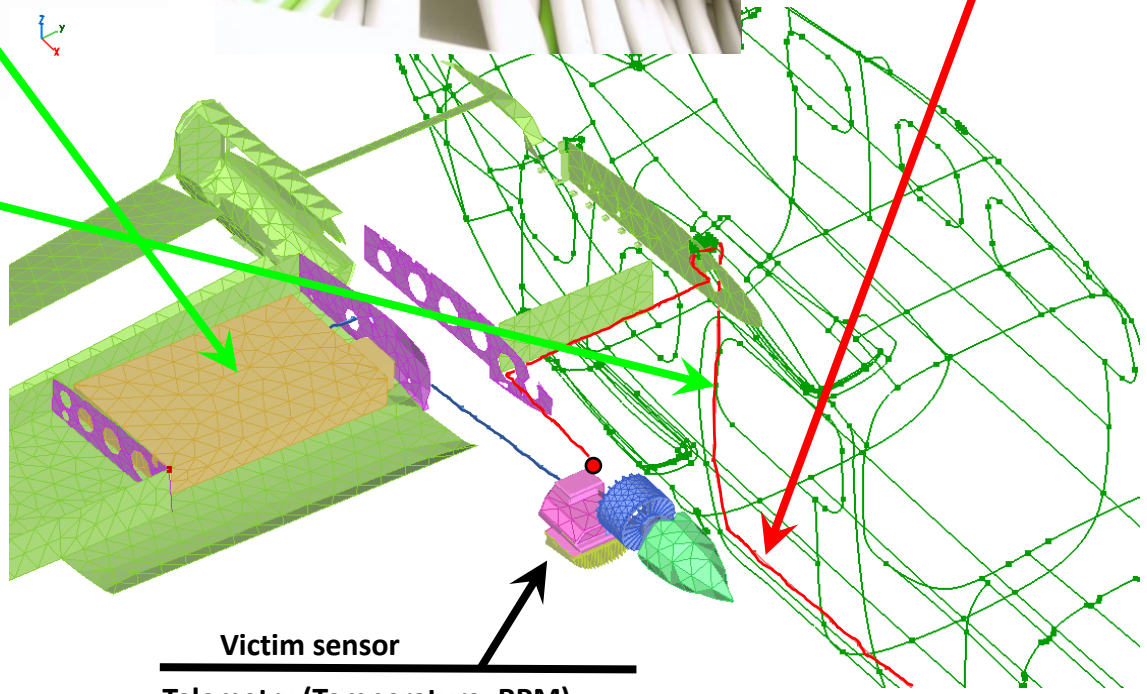


DC BUS

LV wiring EM Simulation

VS





Victim sensor

Telemetry (Temperature, RPM)

To ECU
(Cockpit)