evs 27

The 27th INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM & EXHIBITION.

Barcelona, Spain
17th-20th November 2013

Control Systems for High Performance Electric Cars

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Control Systems for High Performance Electric Cars

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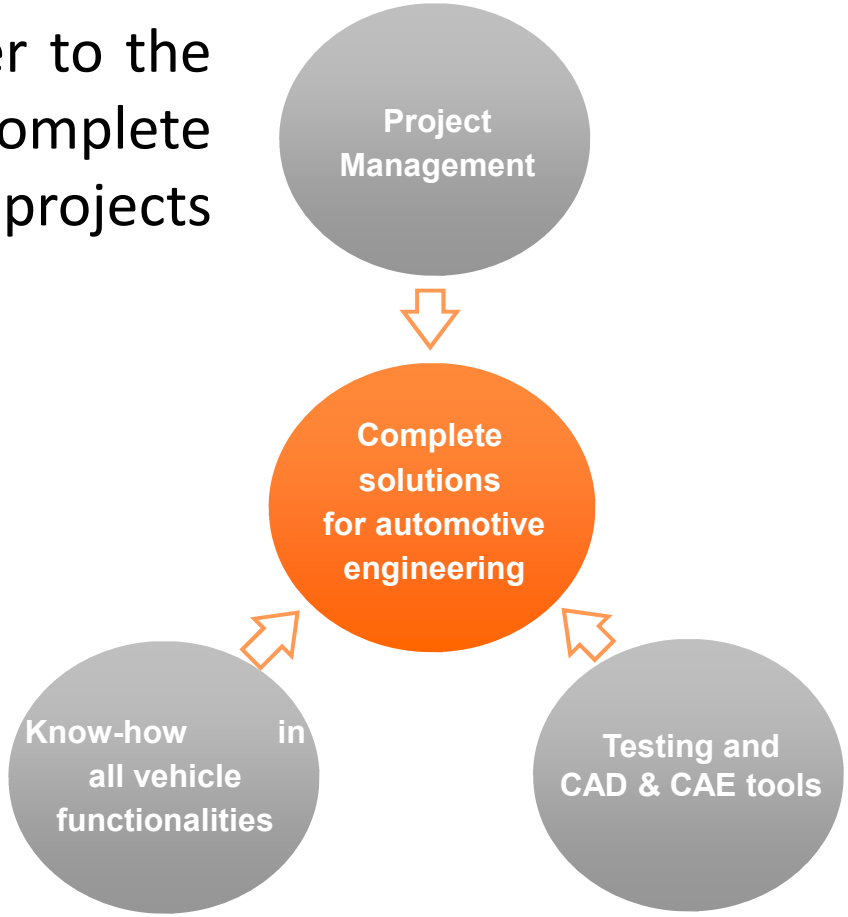
IDIADA ,Who we are & what we do

Applus IDIADA is an engineering partner to the automotive industry providing complete solutions for product development projects worldwide.

Our assets:

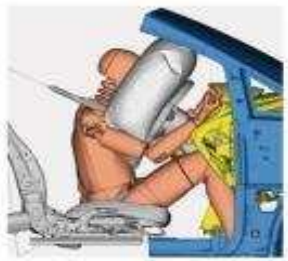
- Team of more than 1.600 professionals
- First class state-of-the-art testing facilities
- International presence in 22 countries
- Innovation in new services and technologies



IDIADA ,Who we are & what we do

- Engineering
- Homologation
- Proving ground testing
- Testing facility design



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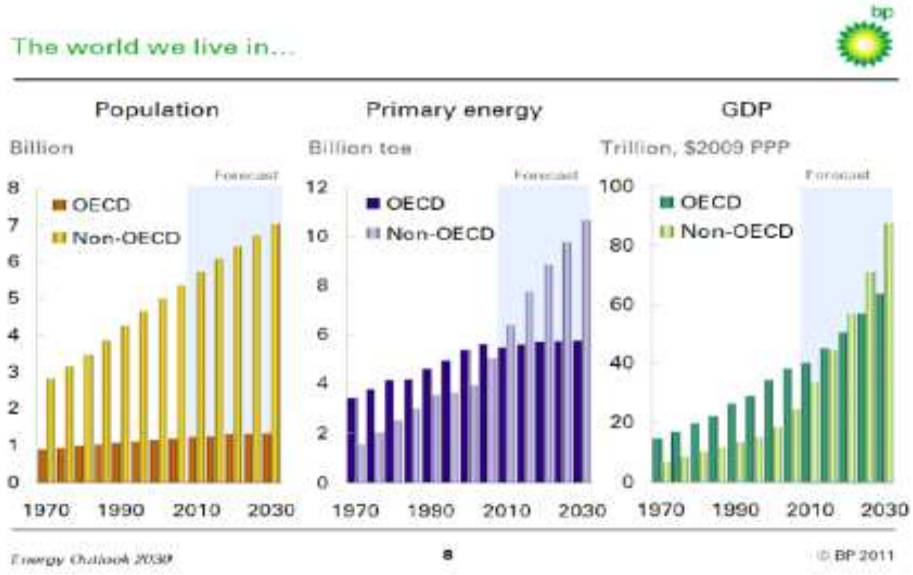
The problem is presented

Background, the challenge ahead:

- In 2009 EU and G8 leaders agreed that global warming cannot exceed an increase of 2ºC.
- And therefore CO_2 emissions must be cut by 80 % by 2050



The problem is presented

- Electric Vehicles have been proven to be a benefit regarding decarbonisation of the road transport sector.
- Nonetheless, society is still reluctant to believe in EV's potential.

A solution is proposed

A solution is proposed

High Performance Electric Vehicle:

- Overcoming technological barriers
  - Highest range possible while being very powerful.
  - Dimensioned to handle an ultra-fast charge .
- Erasing social prejudices
  - Attractive so the public will react to it.
  - Competition format to challenge the perception of EV role.

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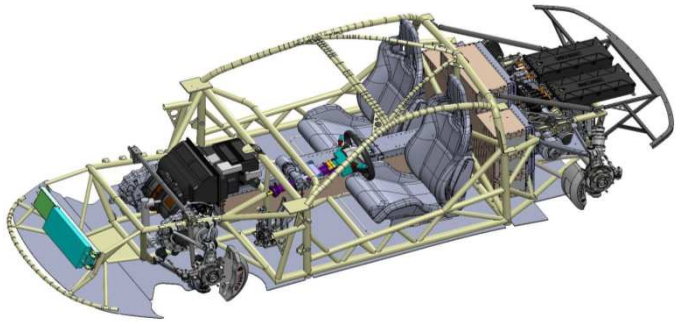
Volar-e, a High Performance Electric Vehicle

- **Racing Battery -** High energy density and power delivered
- **150kW Ultra Fast Charge** (15mins) using bespoke charger
- **4WD Powertrain** - High Torque e-motor combined with high top speed to achieve the best race performance
- **Torque Vectoring** - Handling control strategies including adaptability to race and driver and modes for Endurance race and Gymkhana
- **Energy recovery -** Full regenerative braking integrated with torque vectoring strategy
- **Advanced HMI -** including wireless transmission for race engineers and event attendants
- **Smartphone applications –** Android & iPhone applications



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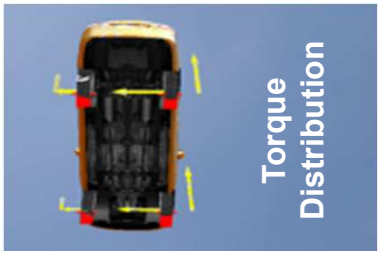
Control Systems

- Volar-e incorporates four active systems so as to become a referential high performance EV:

Control Systems

Torque vectoring: iTORQ+ & iTORQ-

- Volar-e incorporates an adapted and adjusted version of iTORQ, IDIADA's Torque Vectoring technology for electric vehicles, to properly distribute the torque among the four wheels .
- Both systems enable to vary the amount of power sent to each wheel during acceleration (iTORQ+) and braking (iTORQ-).



Traction Control & Launch Control

- With the Traction Control system, all four wheels are controlled independently to ensure Volar-e has a high level of control and stability.
- Launch control aims to optimize the response of Volar-e at a hard acceleration action carried out from a stationary position .

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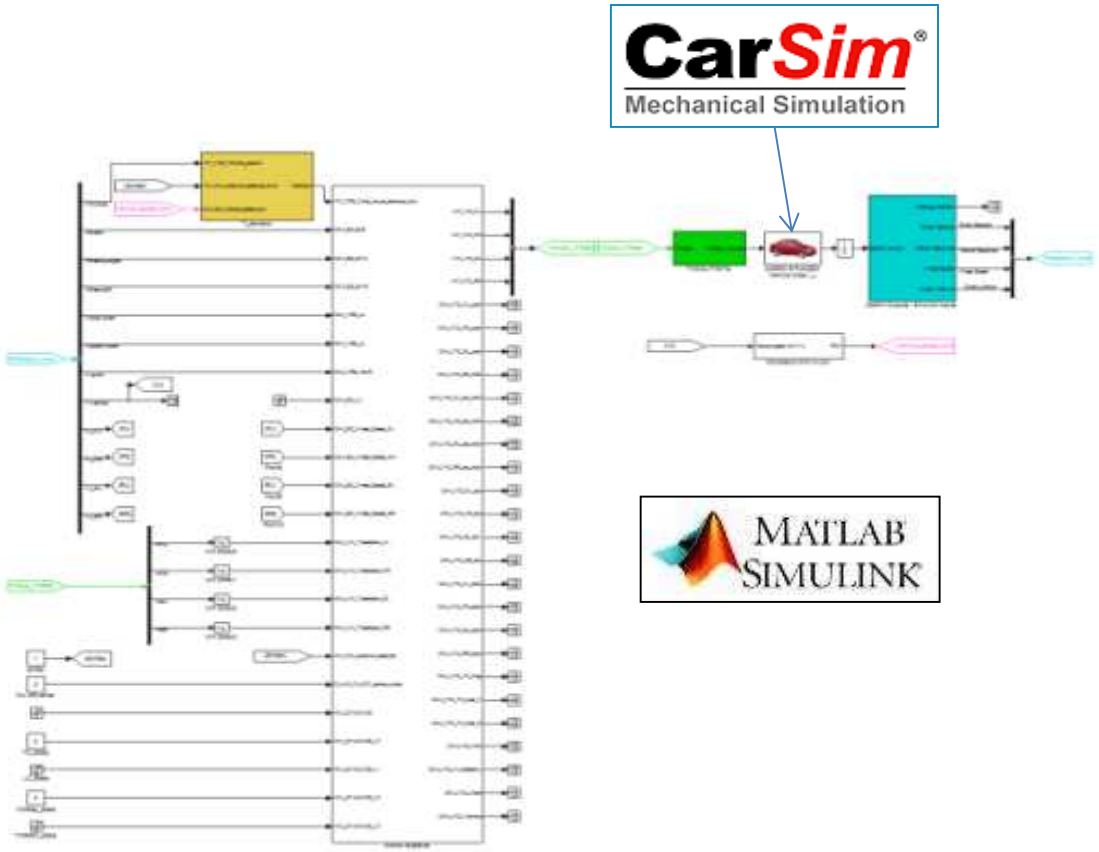
Simulations

- Control systems have been designed using MatLab and Simulink and Volar-e has been developed and parameterized in *CarSim* in order to obtain the most reliable vehicle simulation model.

- Simulations have been carried out with the objective of assessing the behaviour of the previous mentioned systems and, thus, to see how they affect the performance of Volar-e.



Simulations

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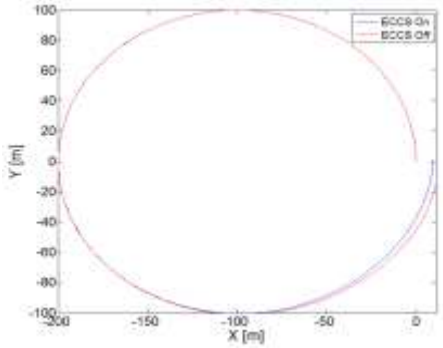
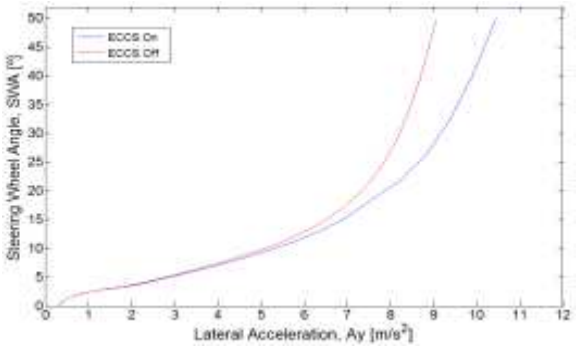
Results & Conclusions

Constant Radius Manoeuvre



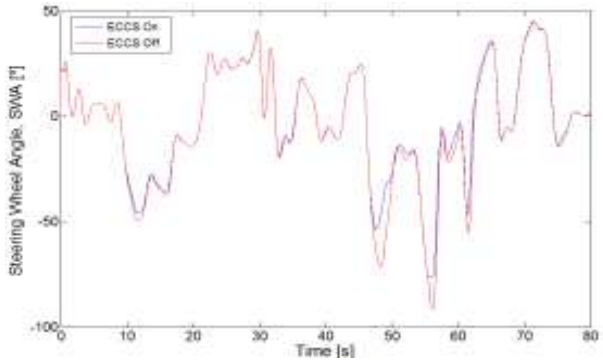
Trajectory resulting from the Constant Radius manoeuvre with ECCS on and off



SWA vs. Ay resulting from the Constant Radius manoeuvre with ECCS on and off

- The under-steering limit of Volar-e is modified favourably.
- A higher limit Lateral Acceleration (Ay) and better linearity up to 8m/s^2 can be obtained .

Lap around IDIADA's Dry Handling Track



SWA during a lap along IDIADA's Dry Handling track with ECCS on and off

- SWA needed along the lap is smaller when the ECCS are on
- Such result can be considered as a remarkable milestone bearing in mind that Volar-e is a racing vehicle.

Results & Conclusions

- Volar-e is more predictable and behaves better with iTORQ+, iTORQ-, LC and TC implemented in it.

- Thanks to these four control systems, Volar-e's performance and handling are improved up to an exceptional good extent:

  - Improvements measured by SWA and lateral acceleration
  - Enhanced vehicle handling by reducing the SWA needed.
  - With iTORQ+ on, under-steering is decreased.

- Improvement of Volar-e's safety by preventing the wheels from slipping.

Results & Conclusions

- Volar-e = Changing public perception of electric vehicles through the development of a high performance vehicle concept.

- Raise the level of social awareness about high performance of electric vehicles and the benefits of their utilization.
- Enables to address to specific aspects that may have created a certain degree of public reluctance about the purchase of vehicles based on electric powertrains.
- Appealing to general public, specific groups of interest, car enthusiasts and the media.

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