



Apollo's Virtual Environment: A Connection with VI-CarRealTime

20-05-2026

Simulation & Modelling
Vehicle Dynamics





Content

- **Apollo's Simulation Platform**
- **Virtual Tyre Modelling**
- **Vehicle Dynamics via VI-CRT**
- **Conclusion**



Virtual Tyre Development – Simulation Platform

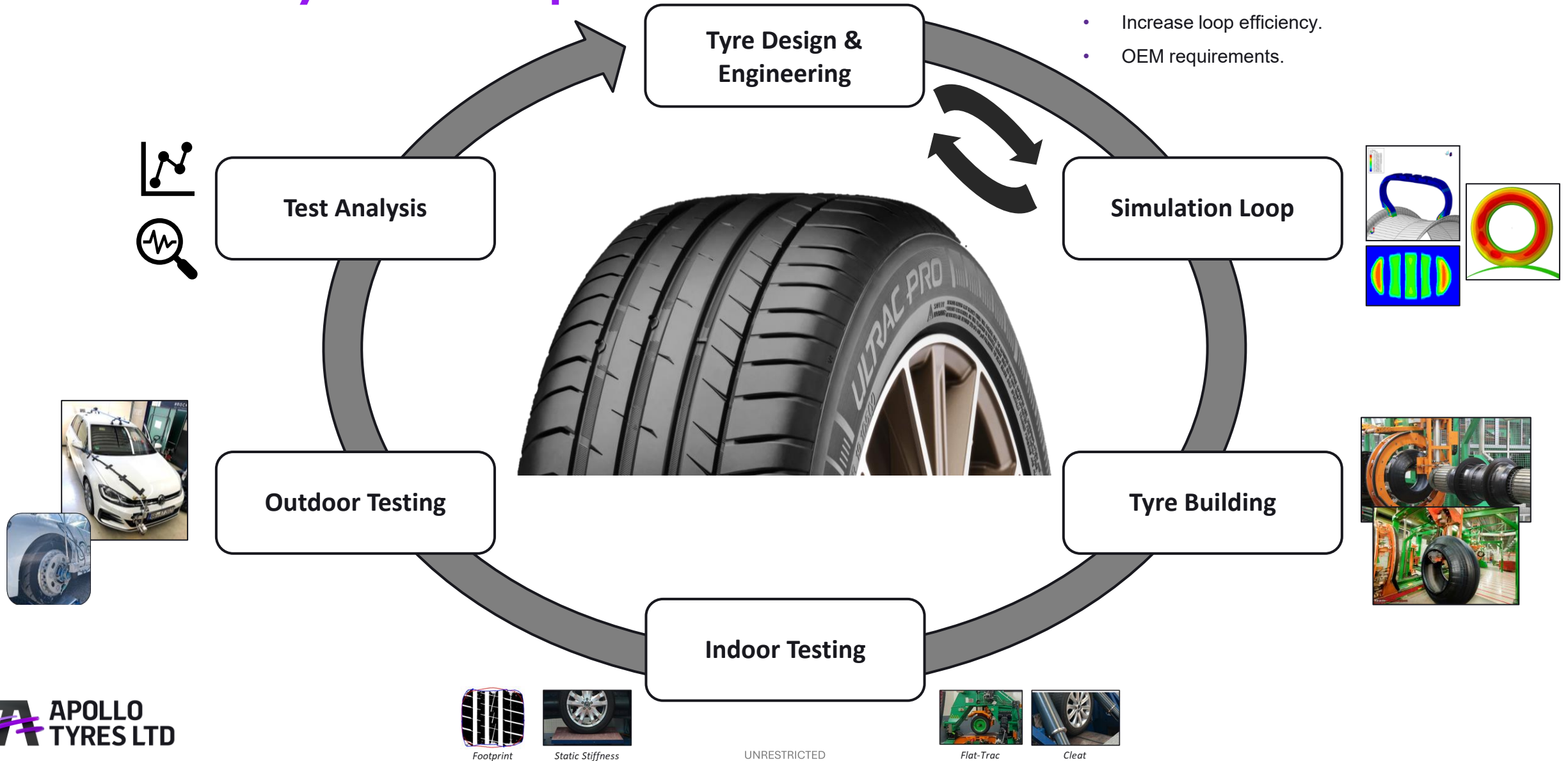


Tyre Development

Virtual to Physical Loop

Virtual Prototyping Loop

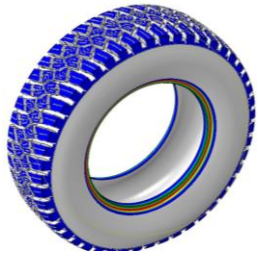
- Lead time reduction.
- Increase loop efficiency.
- OEM requirements.



Tyre Development

Virtual to Physical Loop

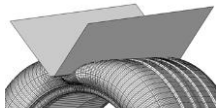
Simulation and Modelling Pillars



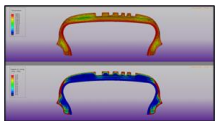
Finite Element Analysis



Hydroplaning



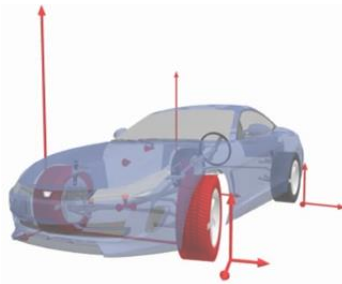
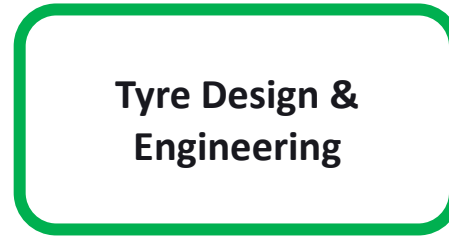
Robustness



Curing



Virtual FlatTrac



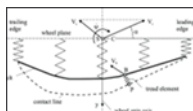
Vehicle Dynamics Group



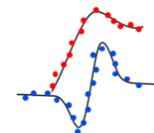
Vehicle Simulation



Driver-in-the-Loop



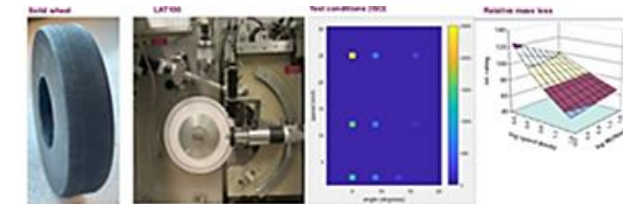
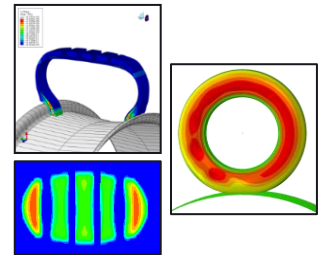
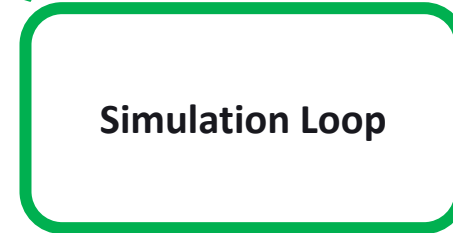
Internal Models



Tyre Modelling

Virtual Prototyping Loop

- Lead time reduction.
- Increase loop efficiency.
- OEM requirements.

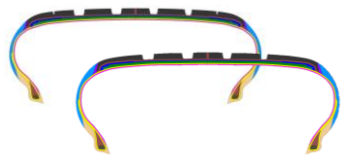


Physical Models

Tyre Development

Virtual <-> Physical

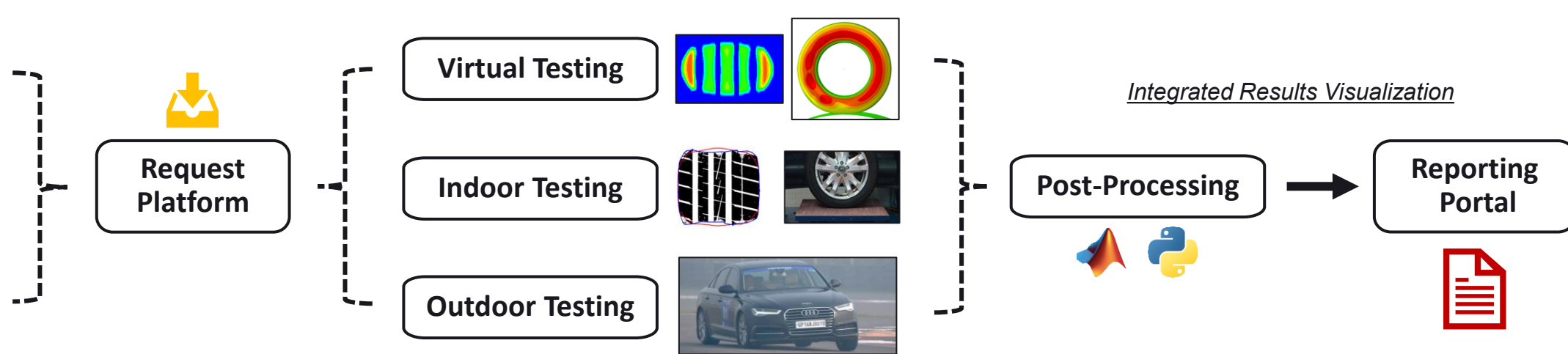
Unified Virtual/Physical Testing Structure



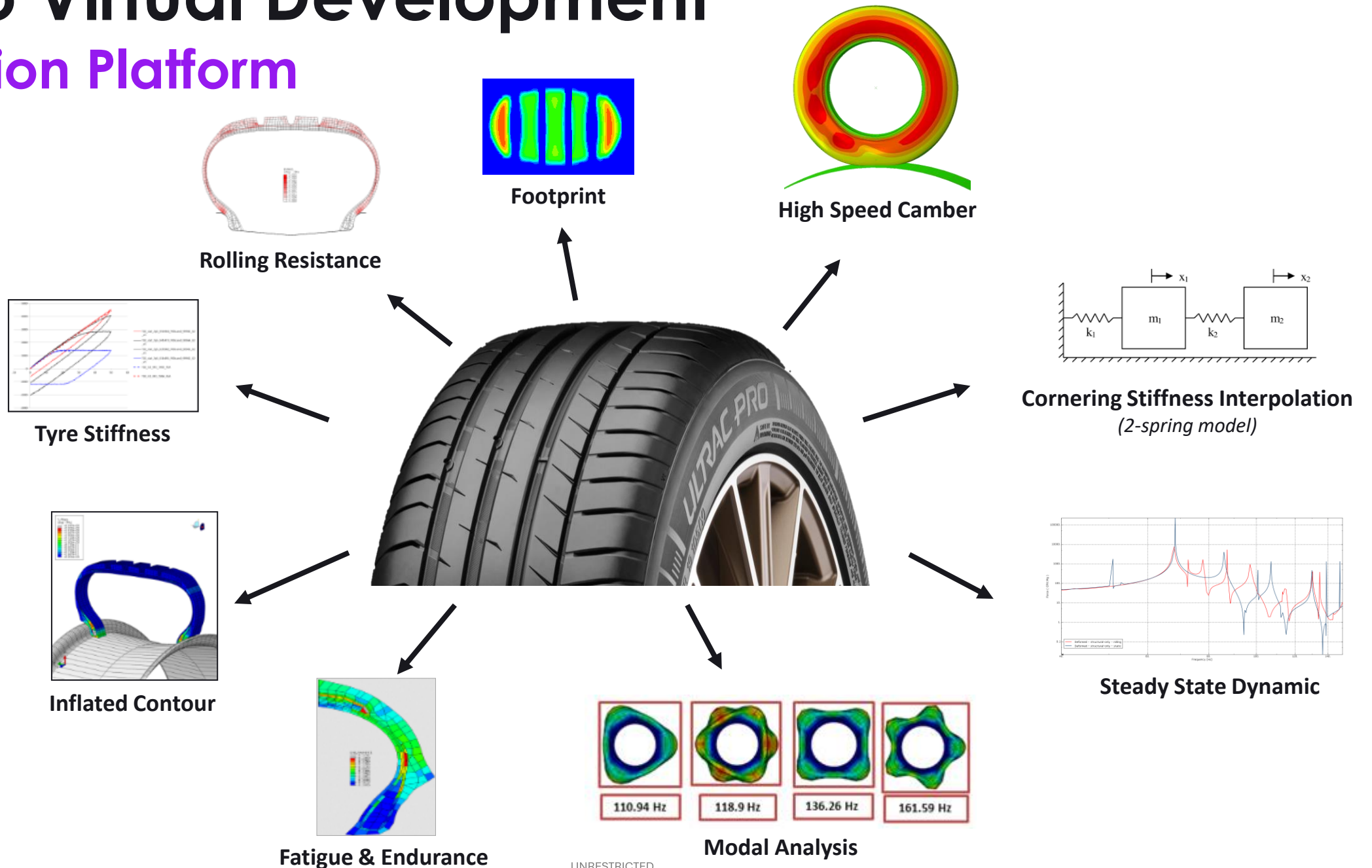
Cured Tyre Layout - Design



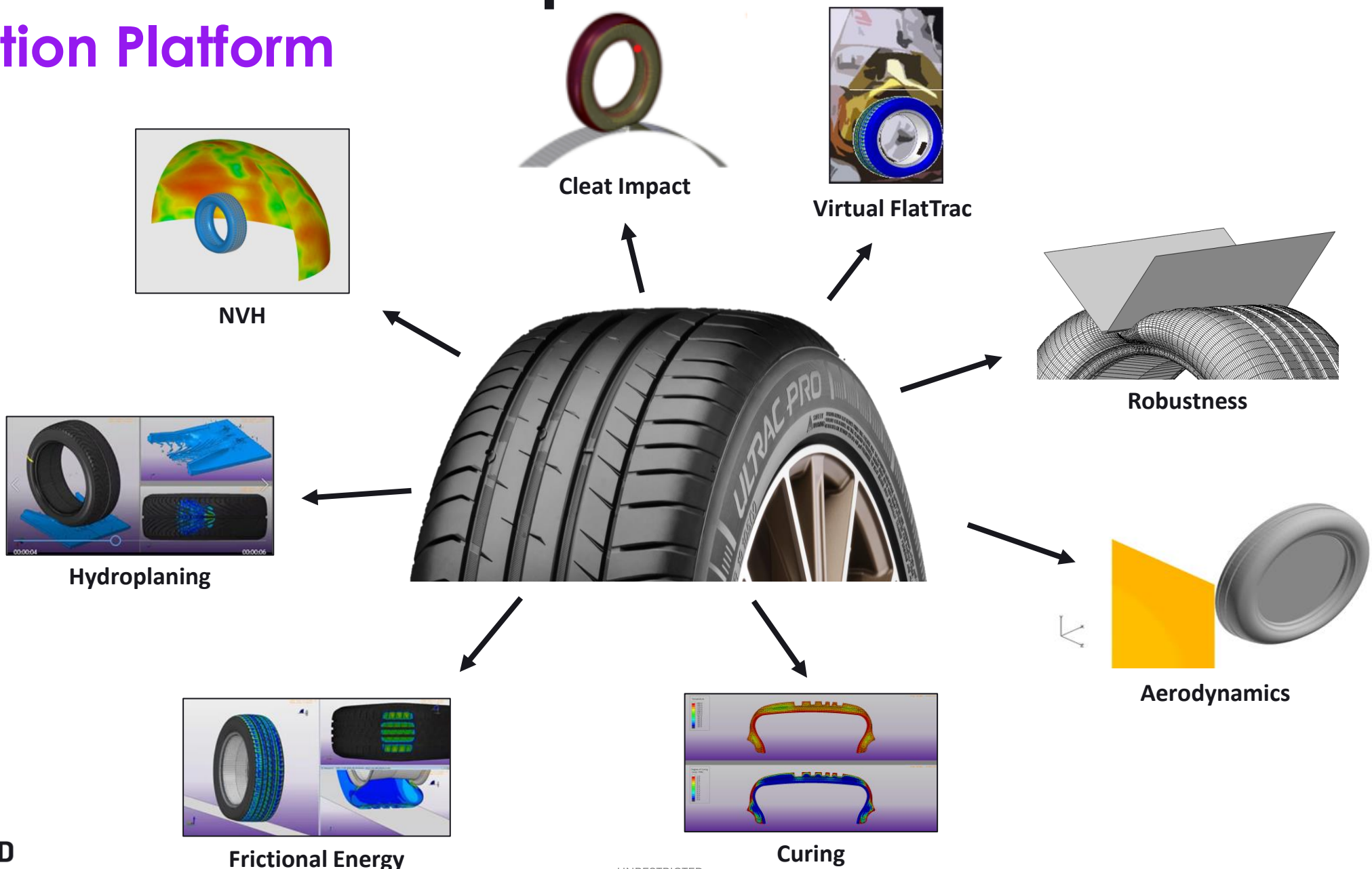
Prototype Tyres - Building



Apollo Virtual Development Simulation Platform



Apollo Virtual Development Simulation Platform



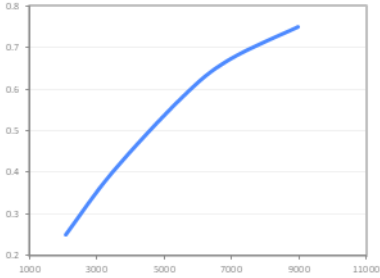


Tyre Characterization

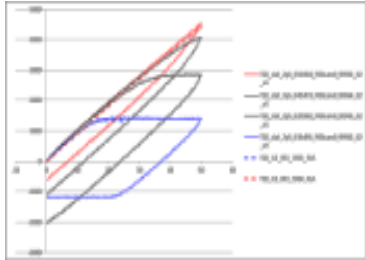


Tyre Modelling

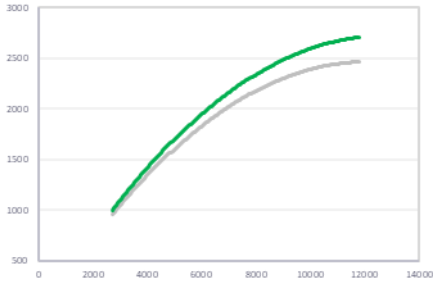
FEA Deliverables



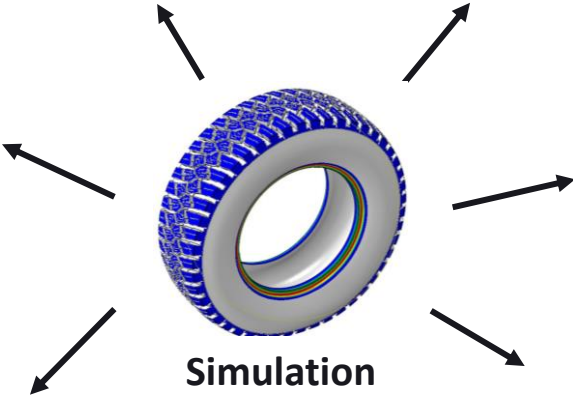
Lateral / Longitudinal Relaxation Length



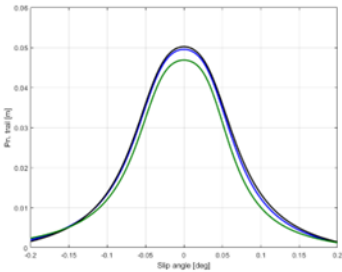
Tyre Static Stiffness



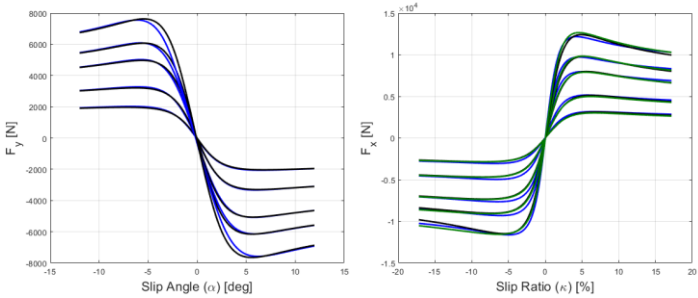
Cornering/Braking Stiffness



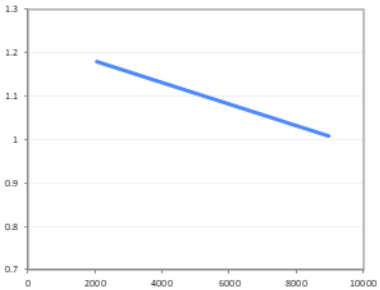
Simulation Platform



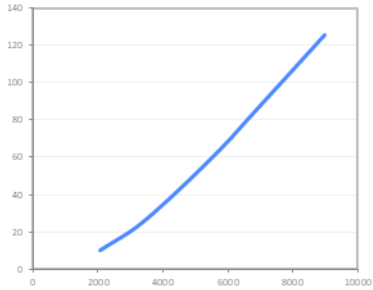
Pneumatic Trail



FnM Curves



Peak Friction Values

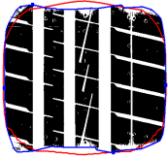


SAT Stiffness

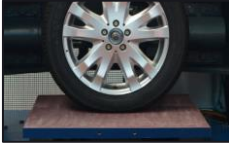
Tyre Modelling

Virtual Predictions

Physical Testing



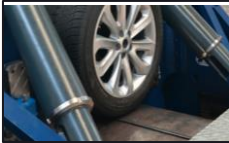
Footprint



Static Stiffness

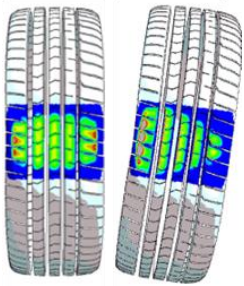


Flat-Trac



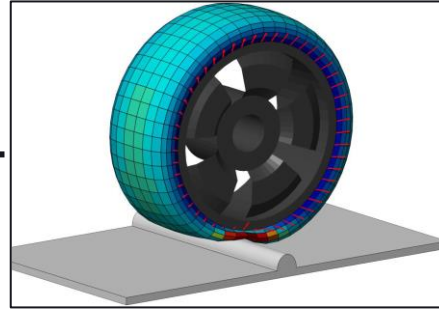
Cleat

Virtual Testing



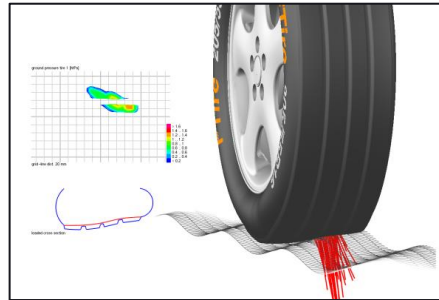
FEA / Internal Models

Fitting / Virtual Modelling



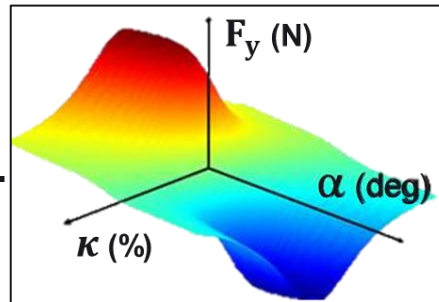
CD-Tire

Source: Fraunhofer



FTire

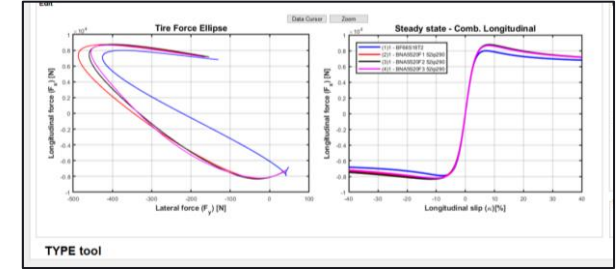
Source: cosin



MF-Tyre

Source: VI-Grade

Applications

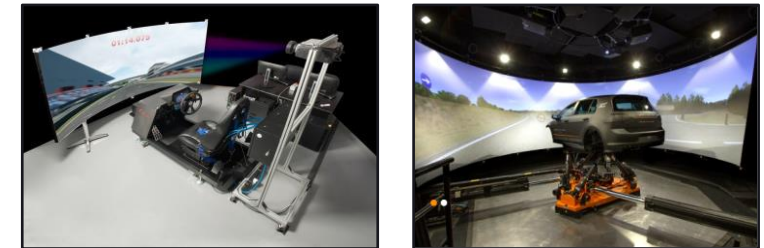


Tyre Performance Visualizer (F&M)



Offline Vehicle Dynamics

Source: IDIADA



Online Vehicle Dynamics – DiL

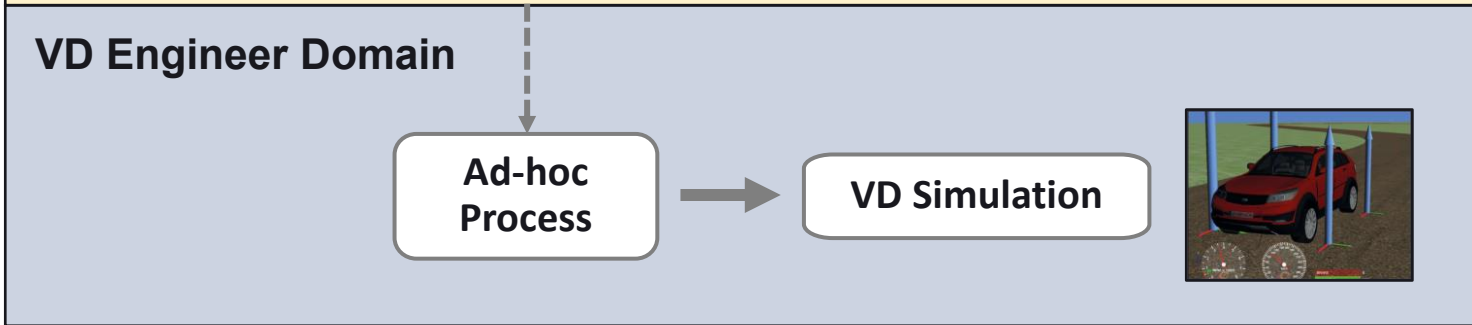
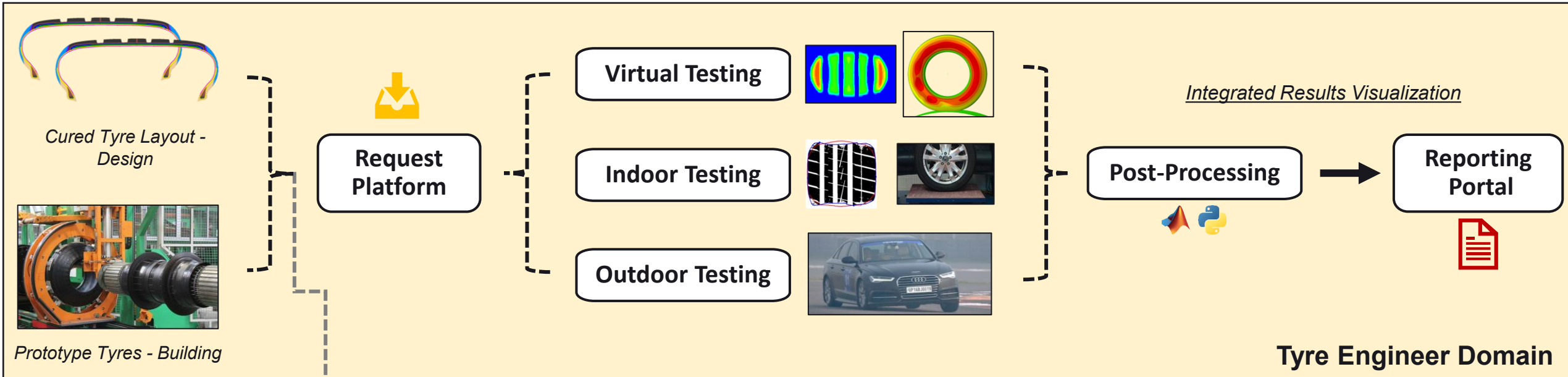


Vehicle Dynamics via VI-CRT



Vehicle Dynamics

Previous Approach



Vehicle Dynamics Desktop Tool

Connection with VI-CarRealTime

Objectives

- Autonomy to the tyre engineers – democratization of VD Simulations.
- Evaluation of vehicle-tyre interaction – vehicle-centric analysis with objective KPIs.
- Increase in efficiency – time reduction and report standardization.

Frontend – Tyre Engineers

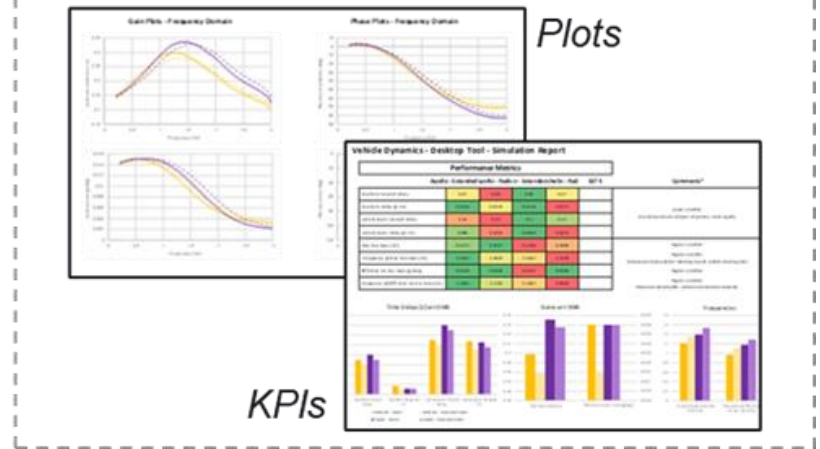


Solver – VI-CRT



Backend - Automatic

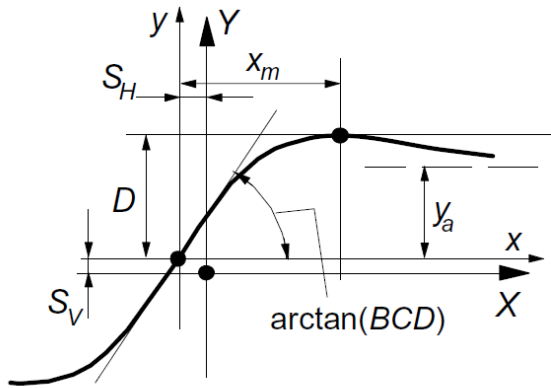
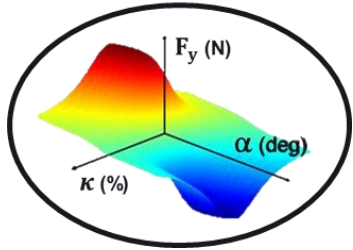
Standardized Report



Vehicle Dynamics Desktop Tool

Simulation Tree – Properties

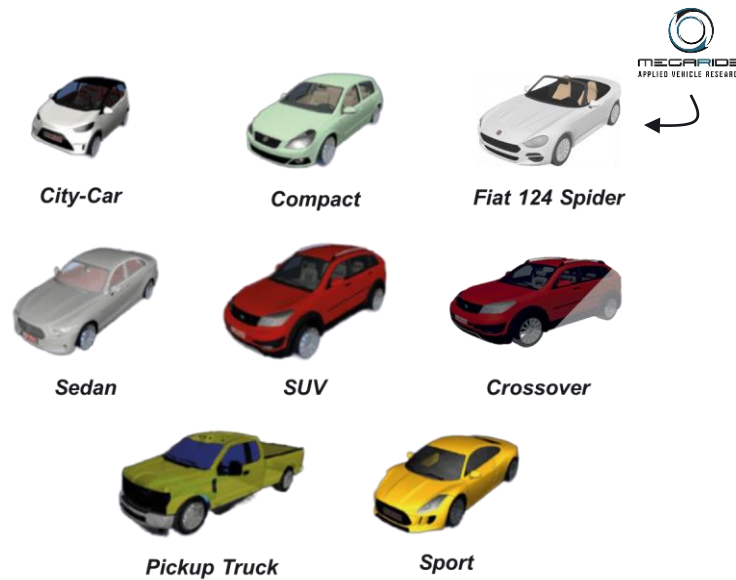
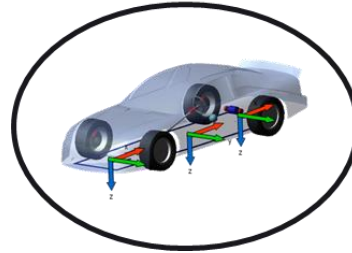
Tyre Model



IP Definition

Fitment Definition – All-Around or Mixed

Vehicle Model

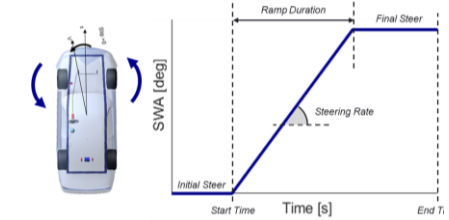


Vehicle Models Library

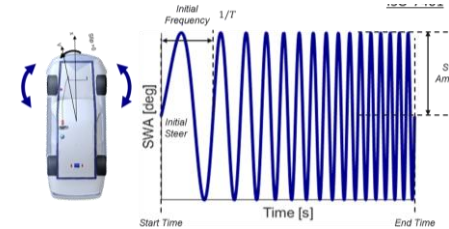
Driver Model



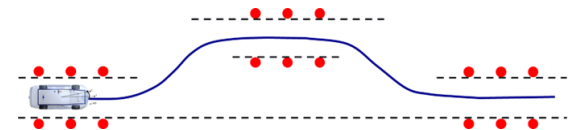
Ramp
Steer



Swept
Steer



DLC

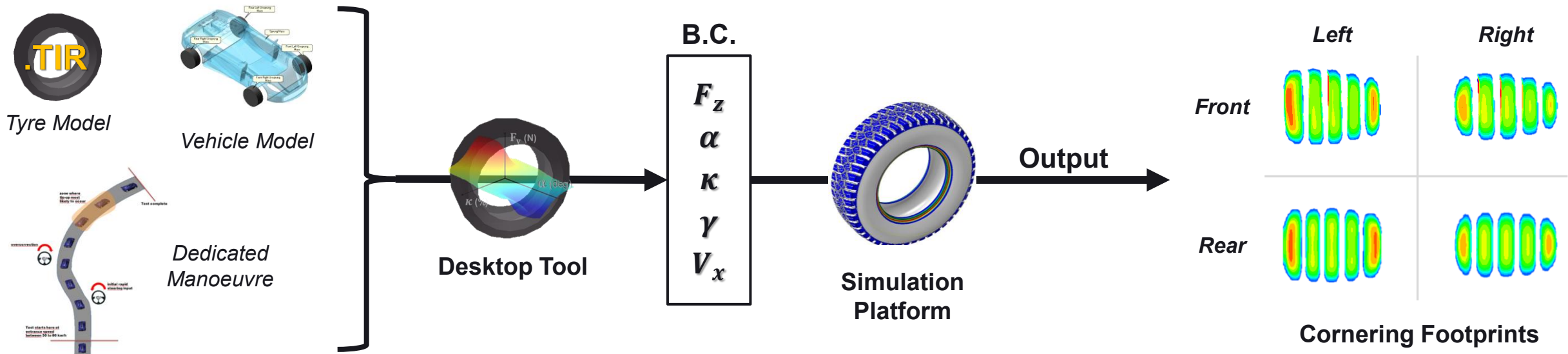


Dedicated OE-specific Batch Simulations

Events

Retro-feeding the Simulation Platform

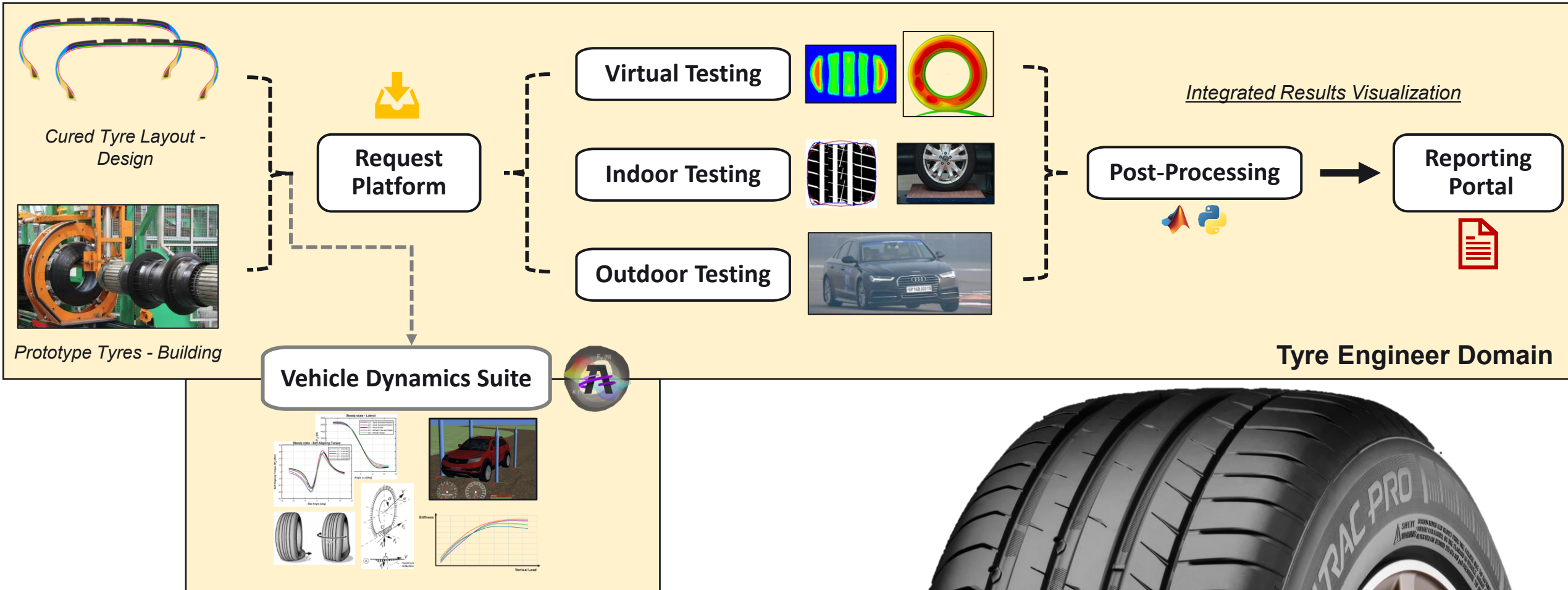
Connection with VI-CarRealTime



- Vehicle-dynamics simulation as a tool for defining the relevant operating conditions for tyre-focused FEA simulations.
 - Analysis of the dynamic loads and conditions to which the tyre will actually be subjected to.
 - Better boundary conditions for tyre modelling.

Vehicle Dynamics

Current Approach





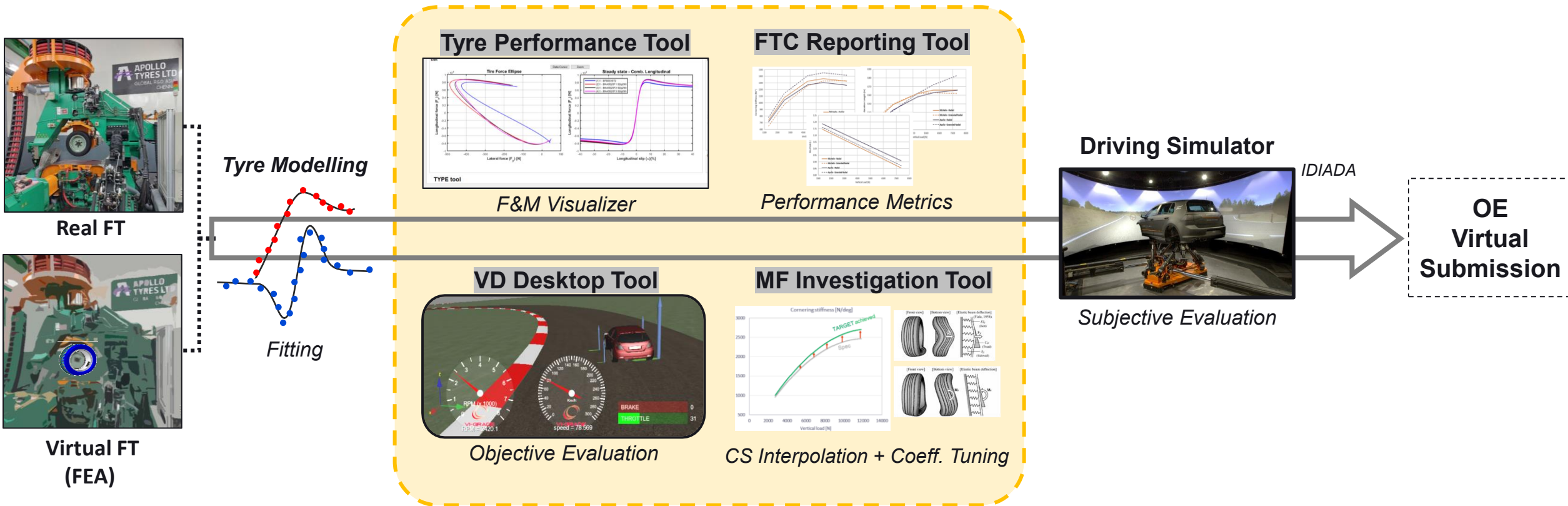
Conclusion



Conclusions

Connection with VI-CarRealTime

- **Objective, vehicle-centric methodology:** integration into Apollo's virtual tyre development workflow using VI-CRT, prior to any physical prototyping.
- **Streamlined specification freeze with the VDS:** optimizing driving simulator sessions, tyre building, and outdoor testing.
- **End-to-end virtual tyre development chain:** from tyre functional characteristics and KPIs to vehicle-tyre interaction analysis.



Thank you