MEGARIDE
APPLIED VEHICLE RESEARCH

powered by

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

MegaRide Tire Characterization and Modelling Technologies

8(+) PRODUCTS FOR A MODULAR TIRE SIM PLATFORM

3 PERFORMANCE TOOLS

T.R.I.C.K.
from vehicle onboard sensors to tire data

RIDElab
multiphysical tire data analysis and MF-ID

RIDEtool
getting the parameters for RIDEsuite physical modules

4 PHYSICAL MODELS (RIDEsuite)

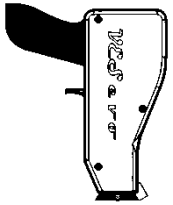
thermoRIDE
tire thermal model

adheRIDE
advanced MF

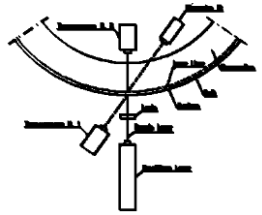
threedeeRIDE
multicontact model

wearRIDE
tire wear model

1 INNOVATIVE DEVICE + TESTBENCHES



VESevo
nondestructive tread compound analyzer



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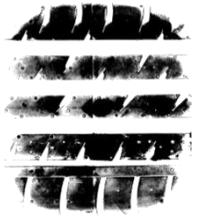

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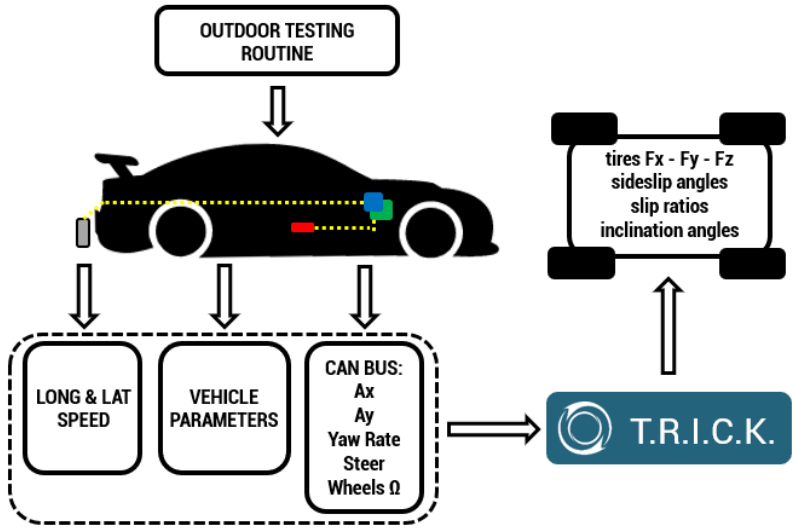
- **PHYSICAL VEHICLE MODEL**
- **FROM ONBOARD STANDARD SENSORS TO TIRE FORCES EVALUATION**
- **SPECIFIC OUTDOOR TESTING PROCEDURE**
- **REAL TIRES / REAL ROAD / REAL CONDITIONS**



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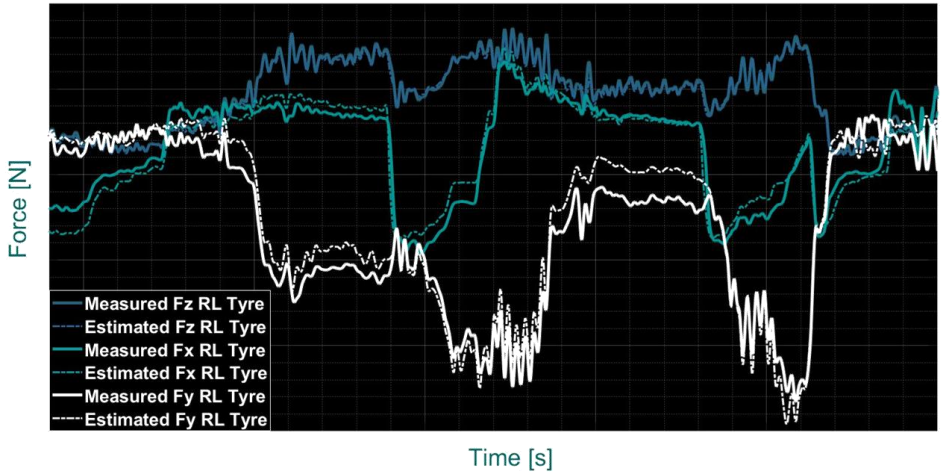

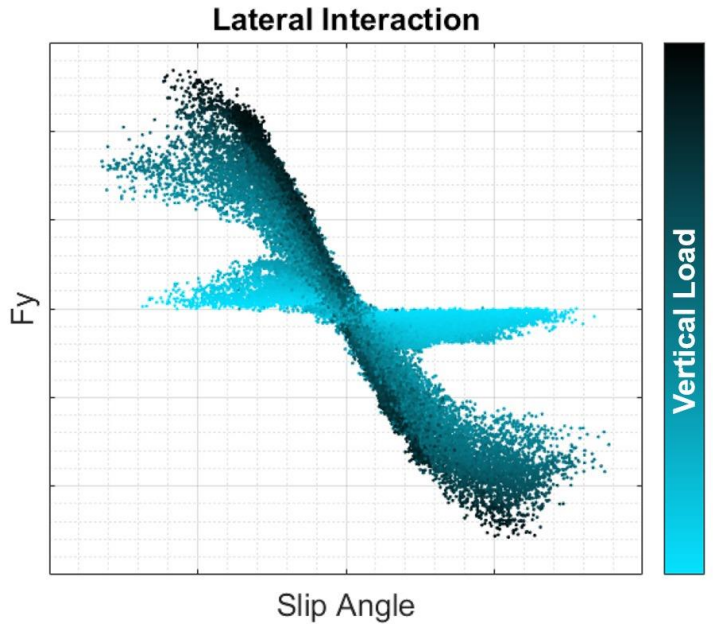

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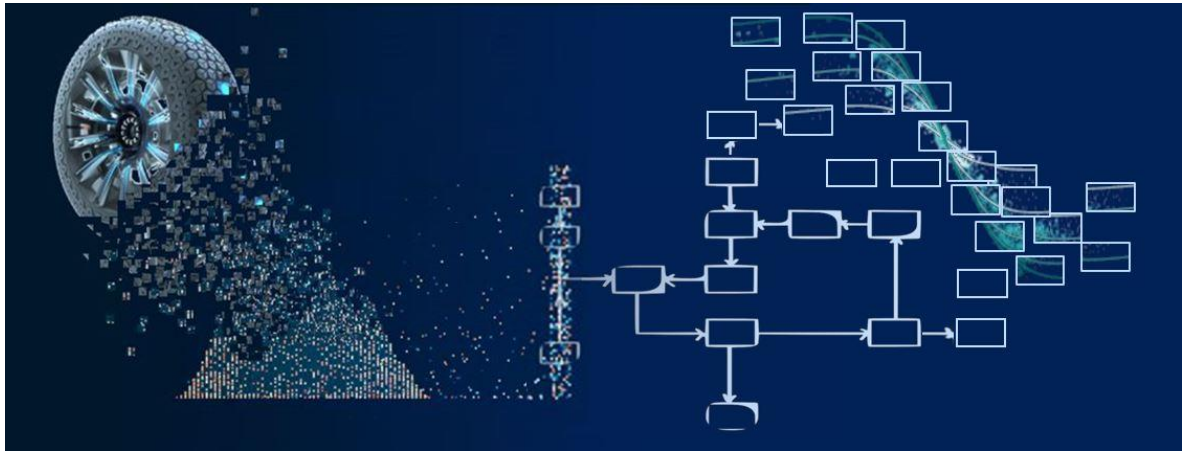

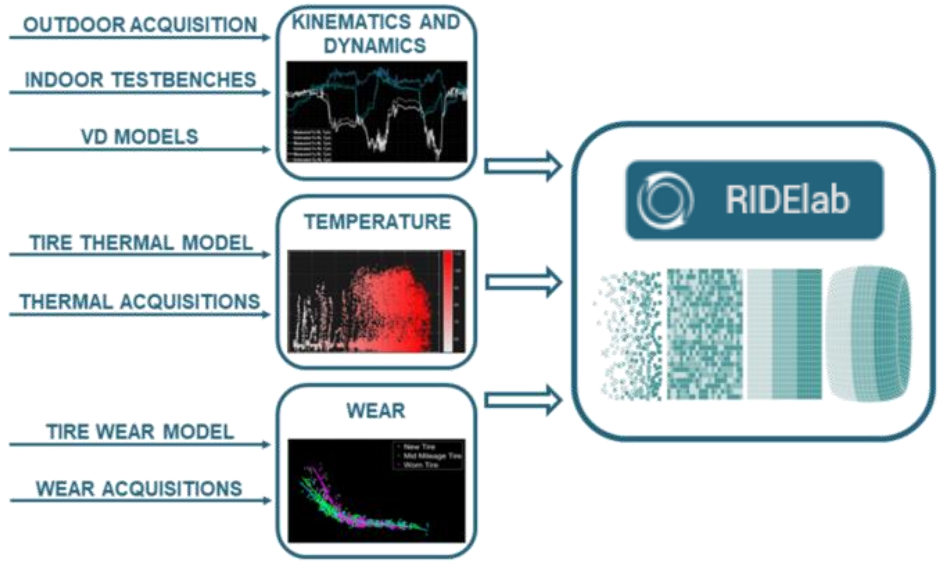

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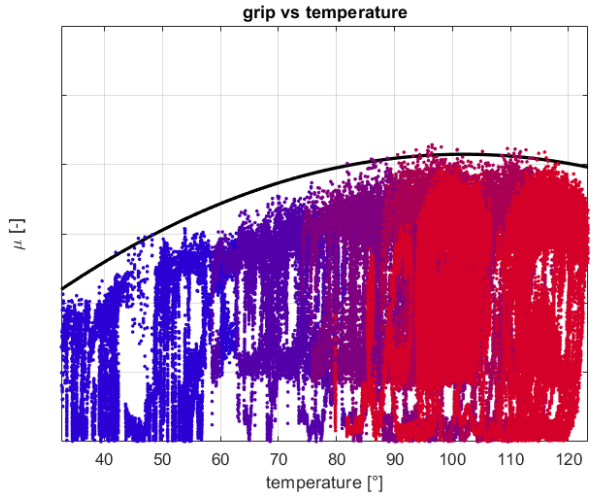

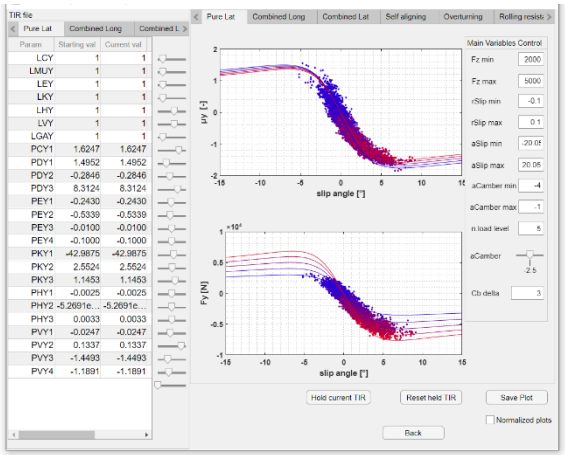

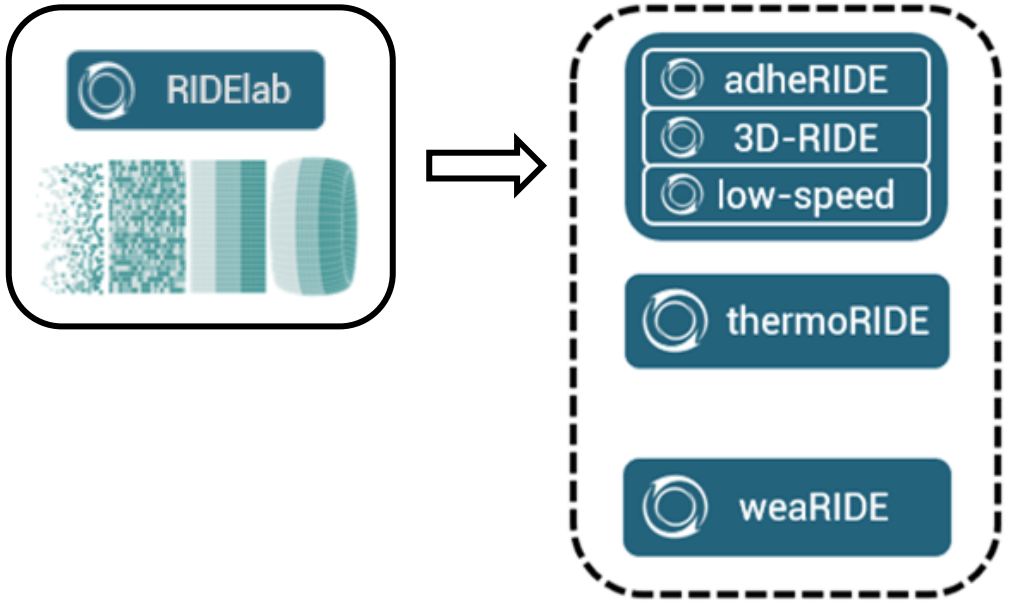

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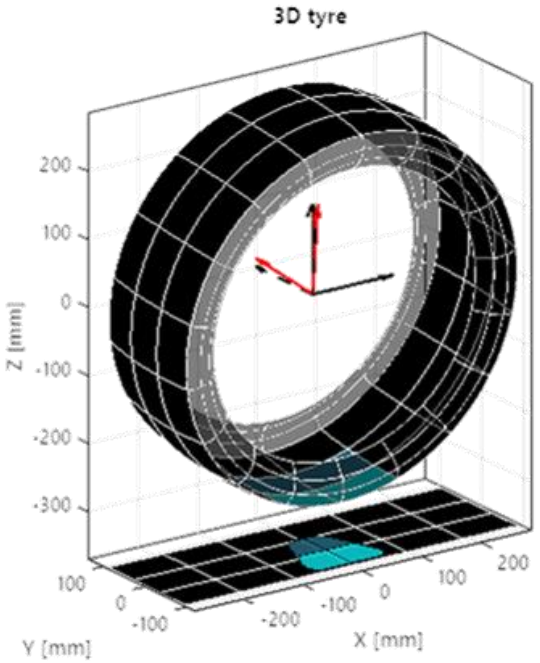
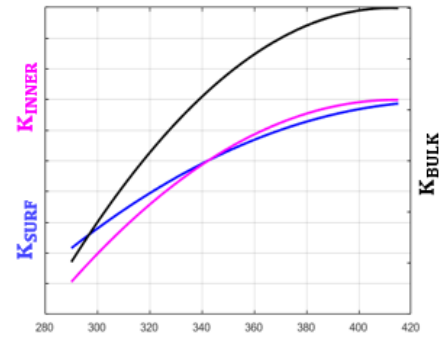
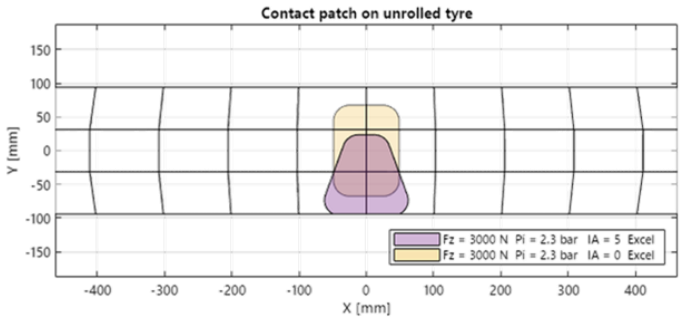
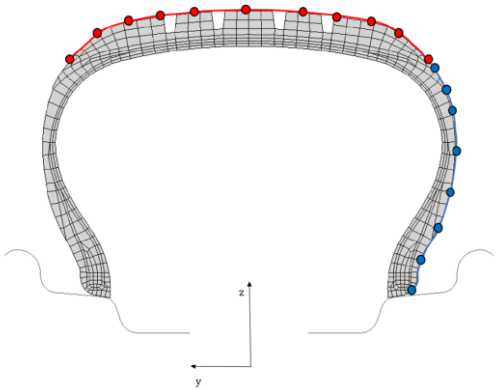
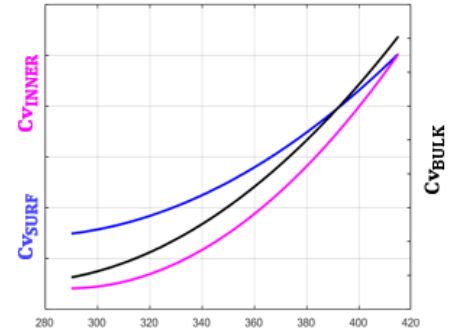


With the aim to make the users of MegaRide technologies progressively autonomous and independent, RIDEtool has been designed as a platform useful to parameterize the geometric, inertial, thermodynamic and viscoelastic tire characteristics inside RIDEsuite physical modules.

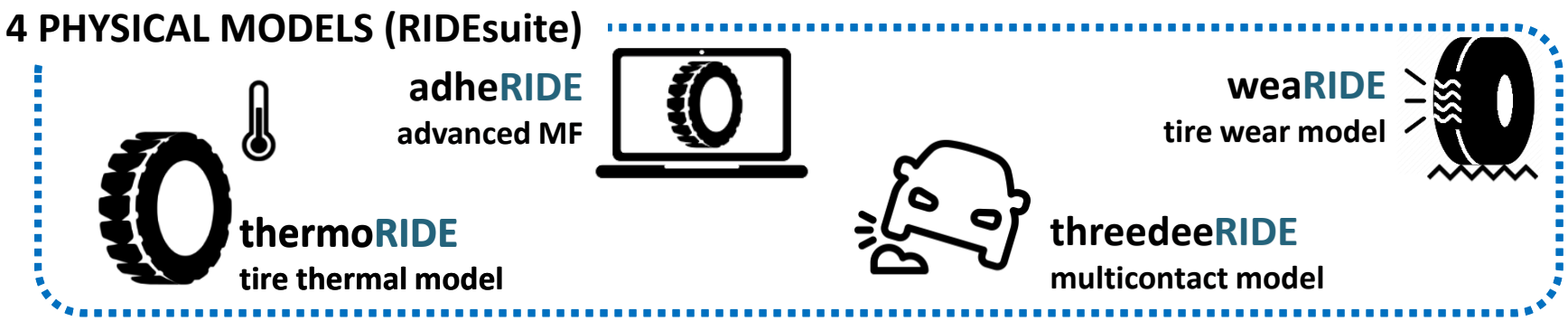




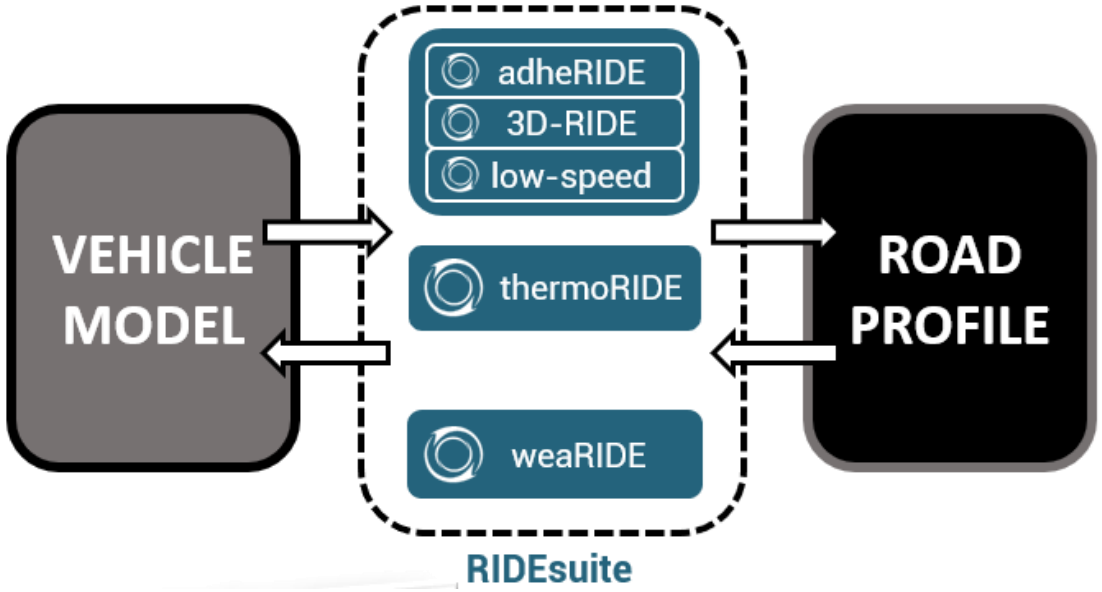




PHYSICAL MODELS: RIDEsuite – thermoRIDE



Physical Models developed by MegaRide constitute the RIDEsuite. It comprises four main elements, able to simulate in detail the physical effects characterizing a vehicle interacting with the external environment:



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tire thermal model

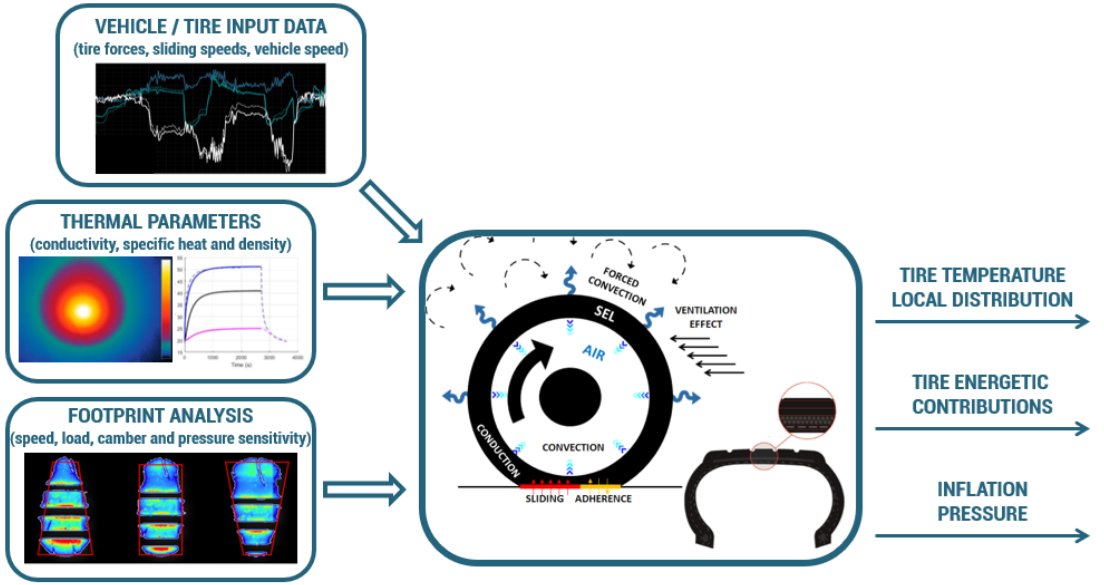
adheRIDE
advanced MF

weaRIDE
tire wear model

threedeeRIDE
multicontact model

thermoRIDE is a physical-analytical tire thermal model, currently employed by vehicle and tire manufacturing companies and in motorsport, developed with the aim to:

- **PREDICT LOCAL TIRE THERMAL DISTRIBUTION AND ITS EFFECT ON VEHICLE PERFORMANCE**
- **SIMULATE TIRE THERMAL BEHAVIOUR IN REAL-TIME ENVIRONMENTS RECEIVING IN INPUT VEHICLE DATA**
- **UNDERSTAND AND OPTIMIZE TIRE BEHAVIOUR WITH CONSEQUENTIAL SETTING OF PROPER VEHICLE SETUP**



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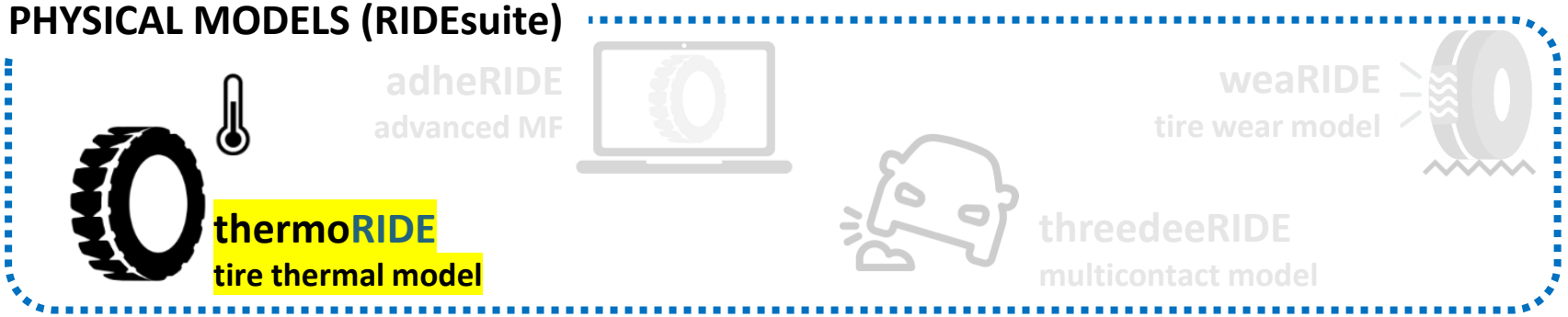

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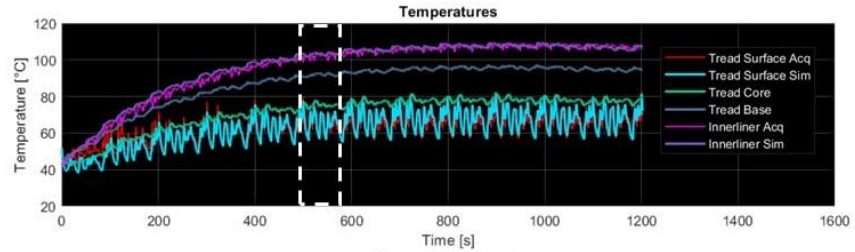

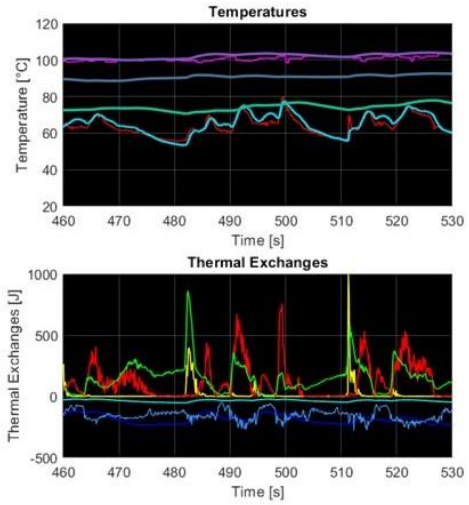

- **NONDESTRUCTIVE THERMAL CHARACTERIZATION**
- **ACCOUNTING FOR WEAR & DEGRADATION EFFECTS**
- **DISCRETIZATION UP TO 8 DIFFERENT LAYERS, 16 DIFFERENT RIBS, IN REAL-TIME FOR BOTH DESKTOP AND DIL APPLICATIONS**
- **COMPLIANT WITH ANY TIRE SIZE AND BRAND**

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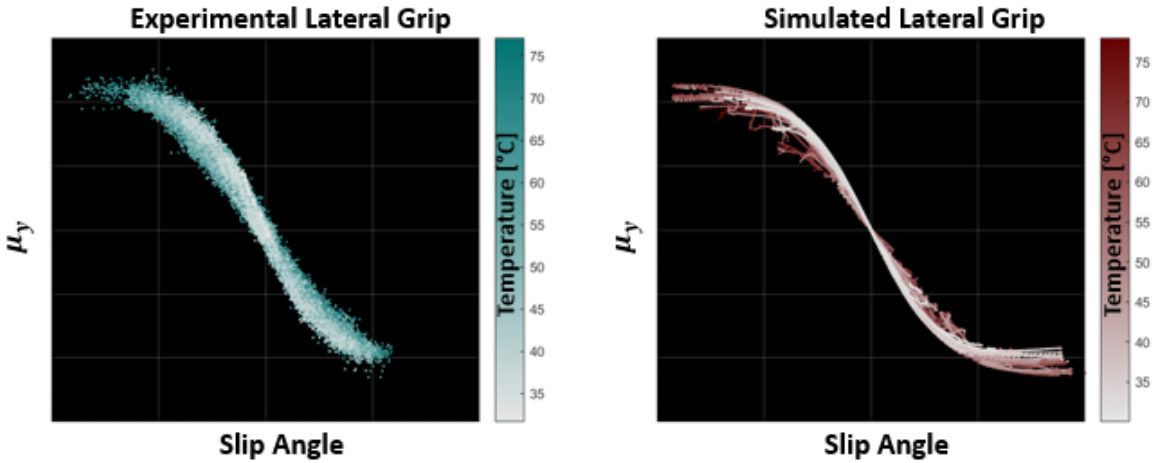
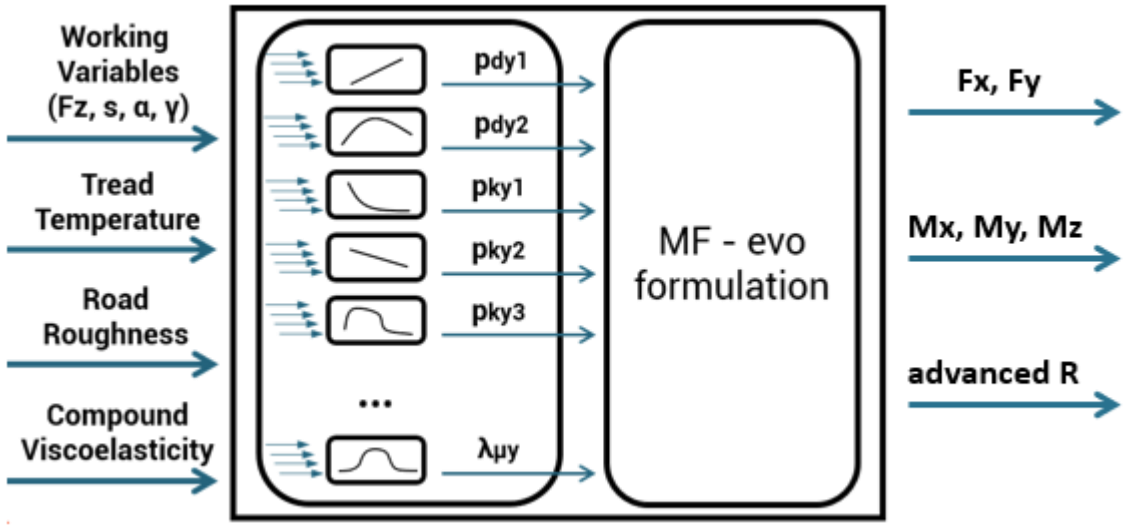
adheRIDE represents an advanced Pacejka-based interaction model, whose parameters are no longer static throughout the entire run, but are variable with physical dependencies (temperature, wear, road roughness and compound viscoelasticity) provided by RIDEsuite modules





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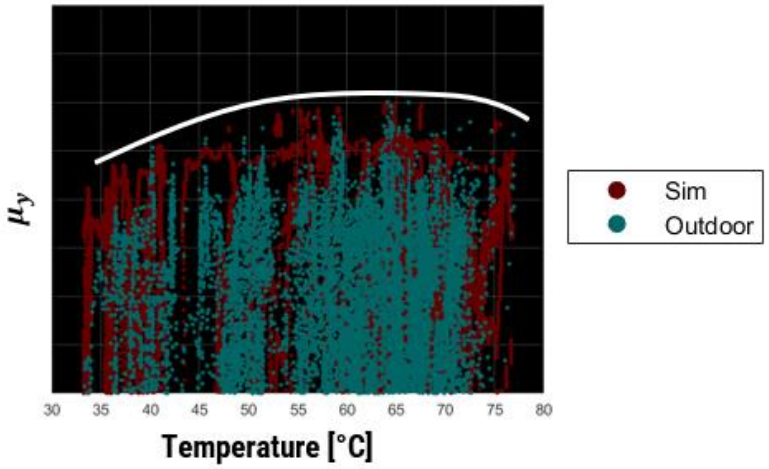

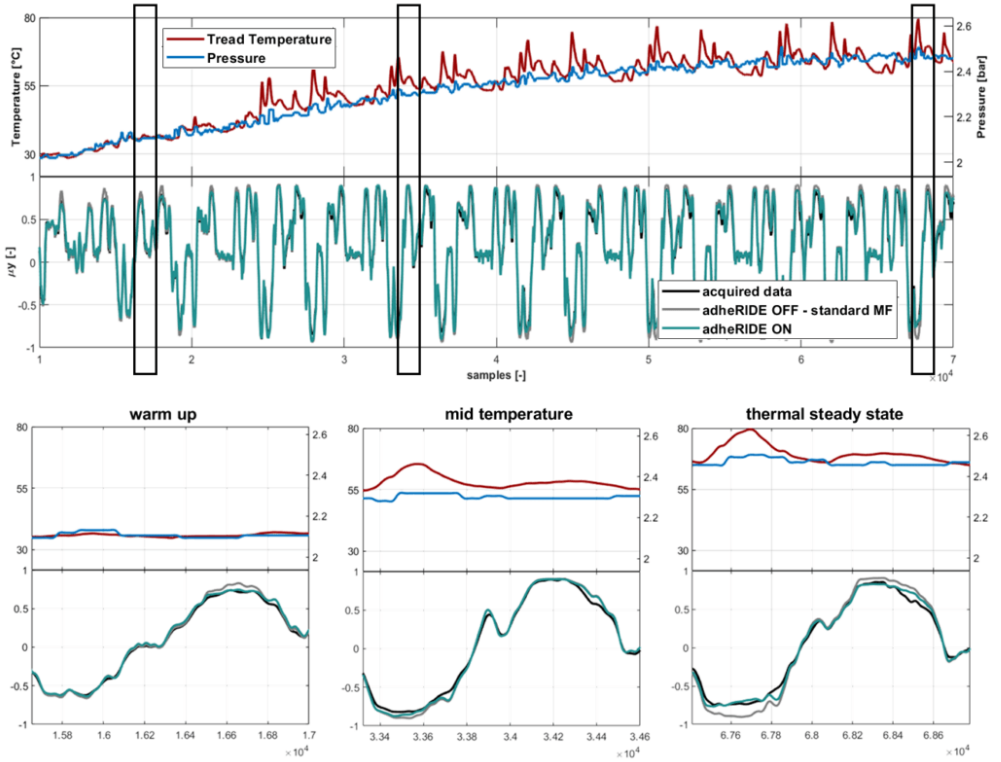

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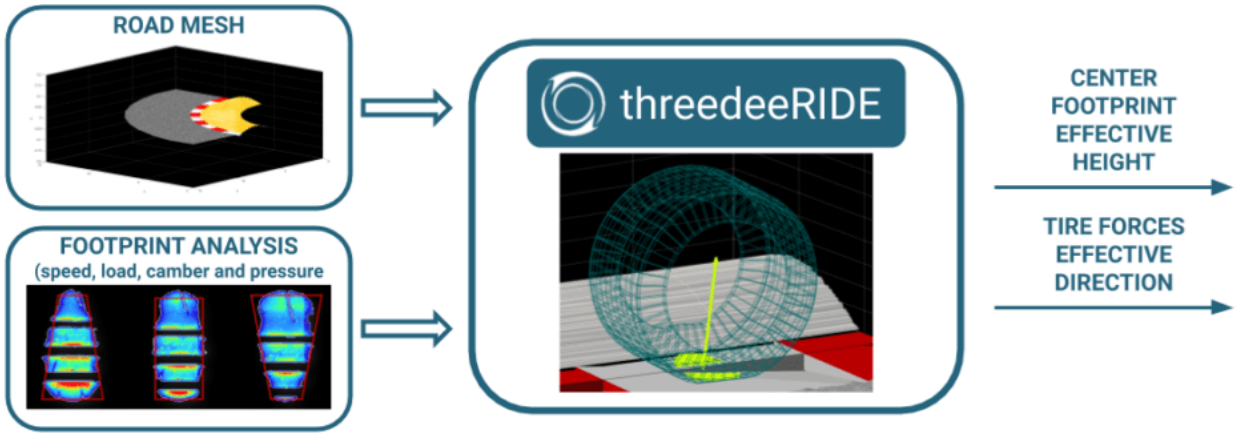
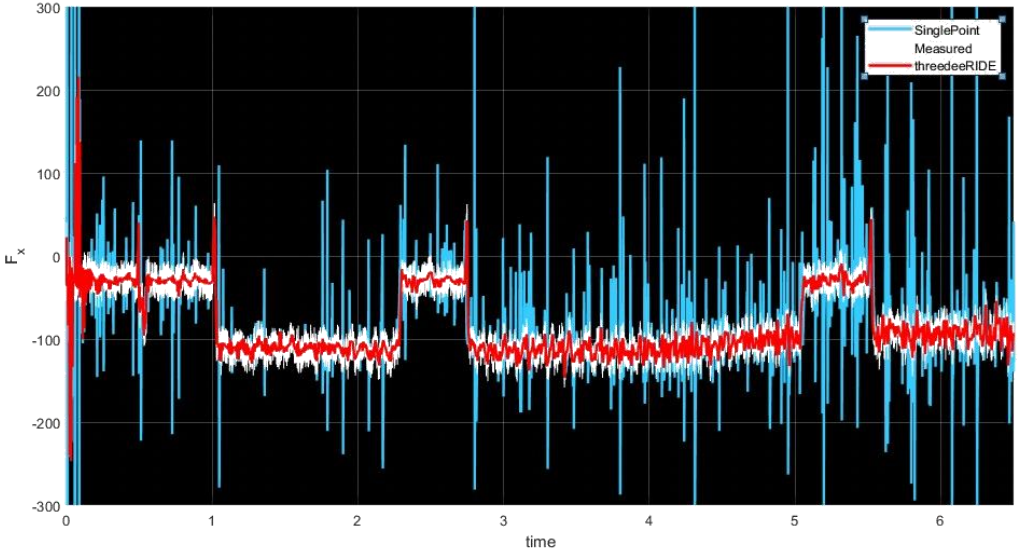
threedeeRIDE is a three-dimensional real-time tire multicontact model, conceived with the aim to overcome the typical issues linked to single contact tire models. It enhances feelings and realism of the driving experience, properly evaluate the kinematics at the tire/road interface.





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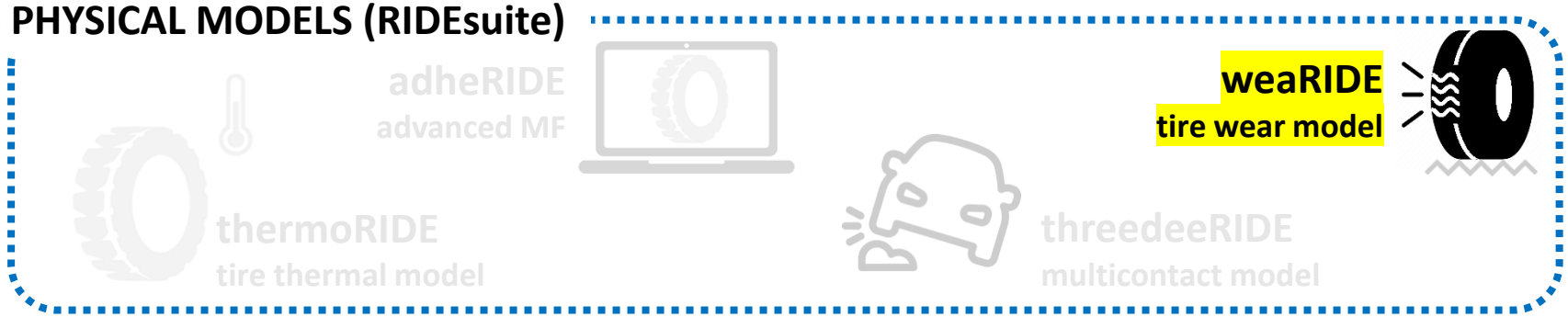
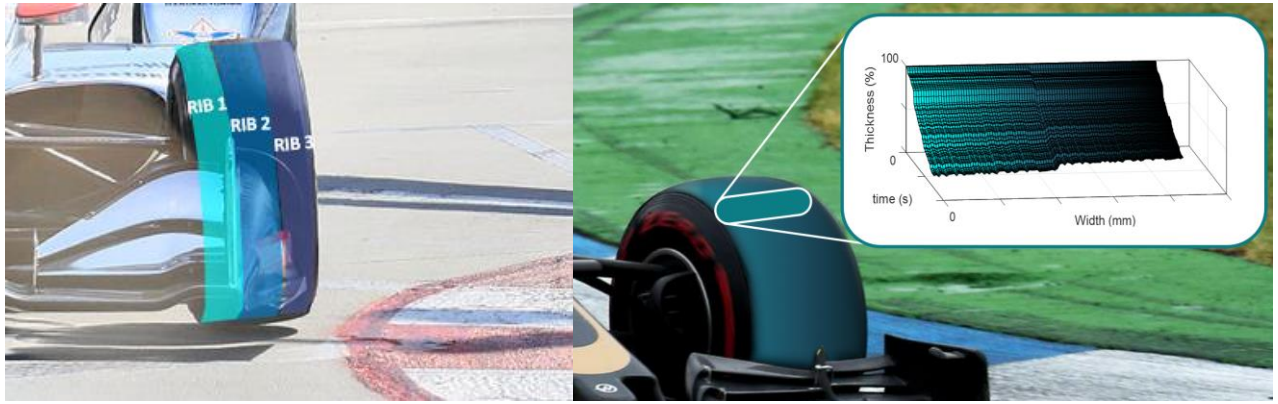
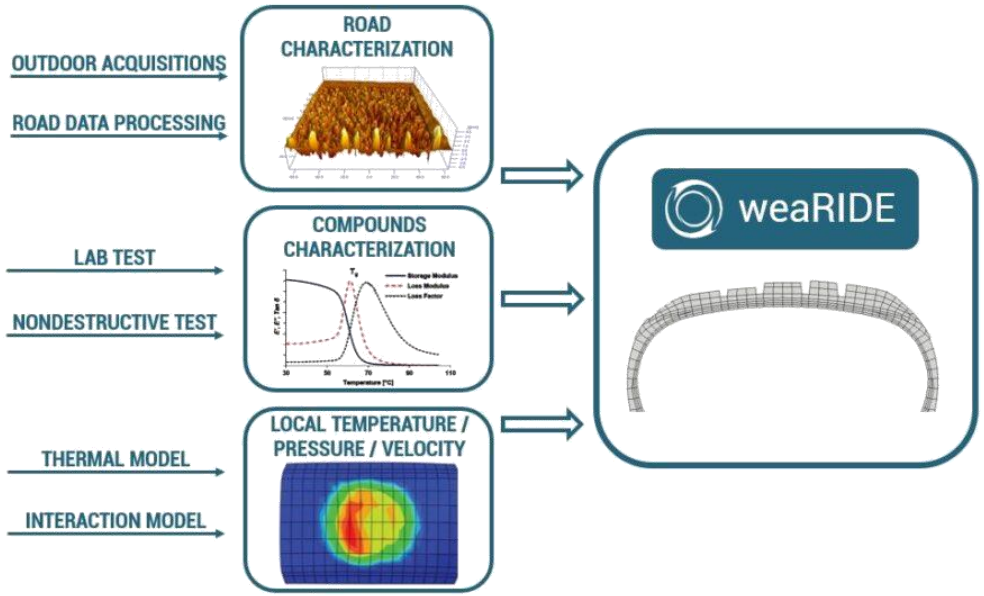


The multiphysical approach proposed by MegaRide is completed by the wear model weaRIDE, developed to consider tread wear and tire degradation phenomena involved in tire lifecycle and in races, taking into account aspects concerning road and tire compound characterizations, and local thermal phenomena occurring within the contact patch.





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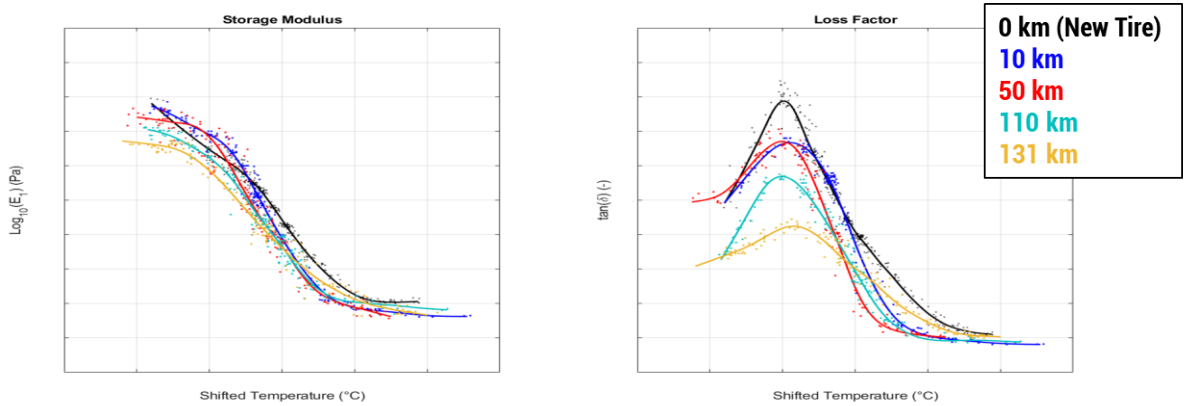

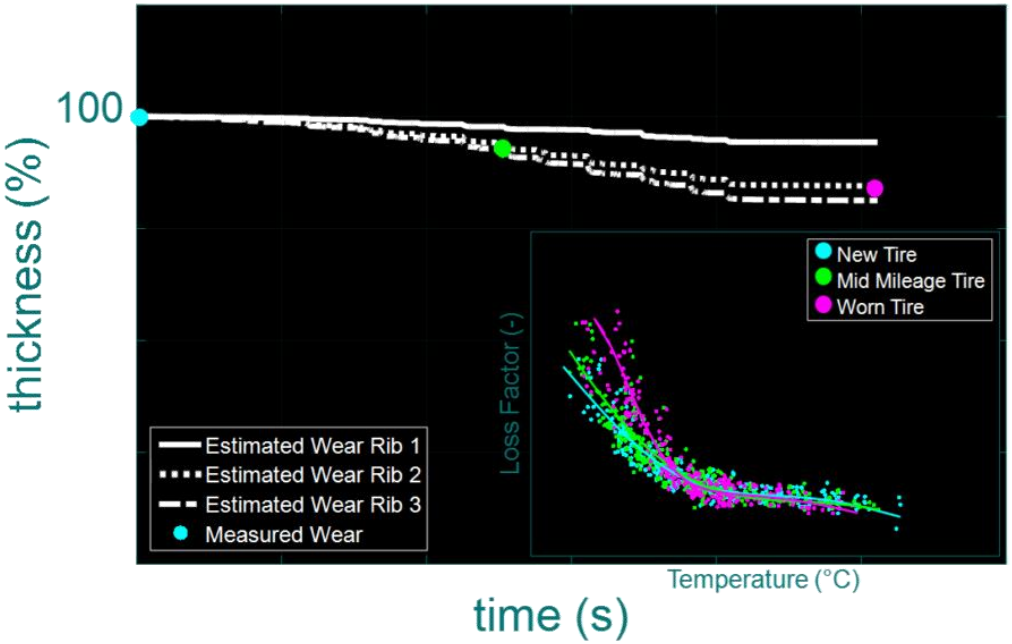

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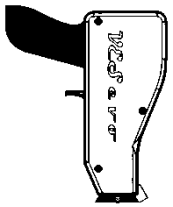

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nondestructive tread compound analyzer

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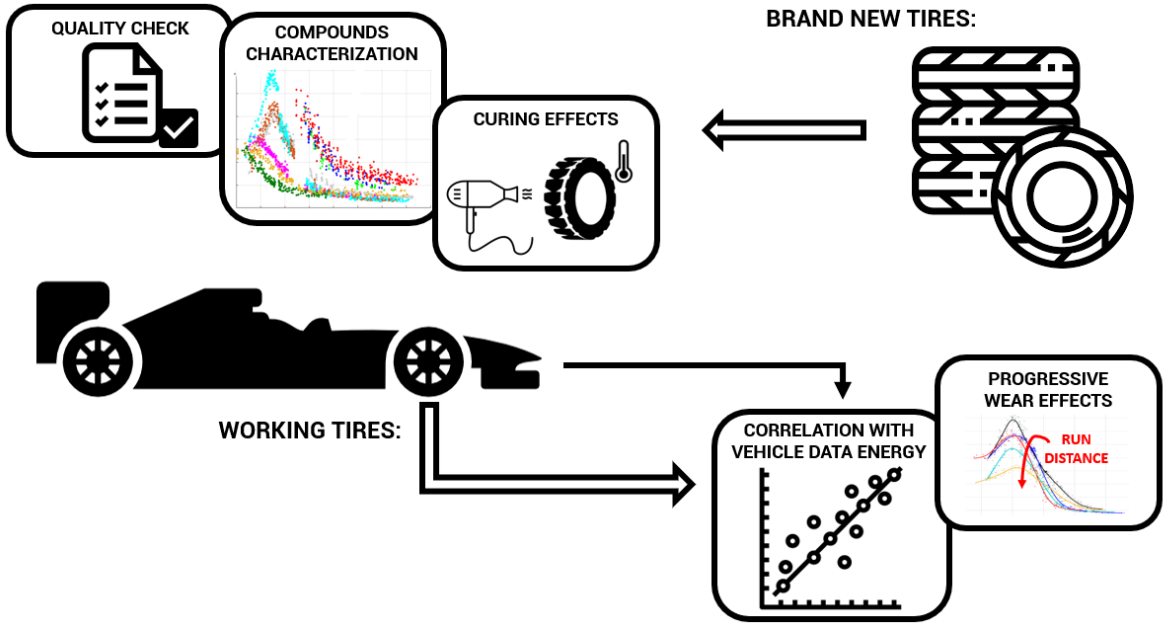
shape & contact pressure

In the last year a new hardware has been developed and launched:
VESevo tire compounds characterization device. Its features:

- NONDESTRUCTIVE TIRE VISCOELASTIC TESTING
- PORTABLE, FAST AND EASY TO USE
- LIVE TRACK DATA FOR DEVELOPING RACING STRATEGIES
- OBJECTIVE DATA FOR PHYSICAL GRIP AND WEAR MODELS



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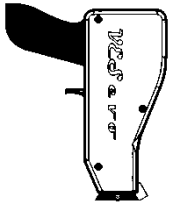

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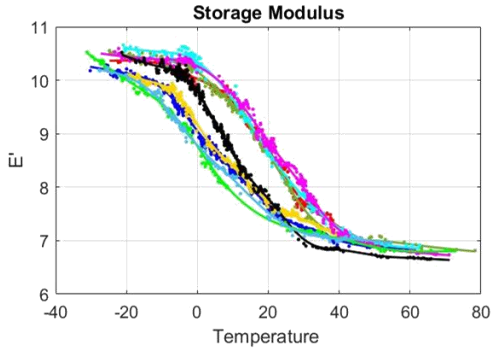

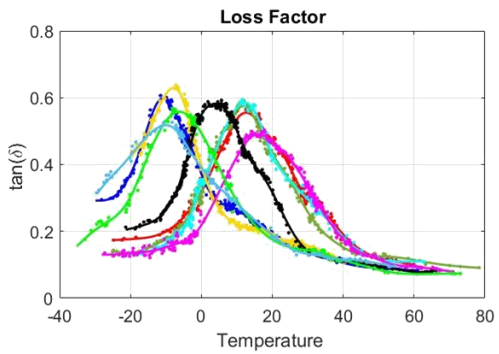

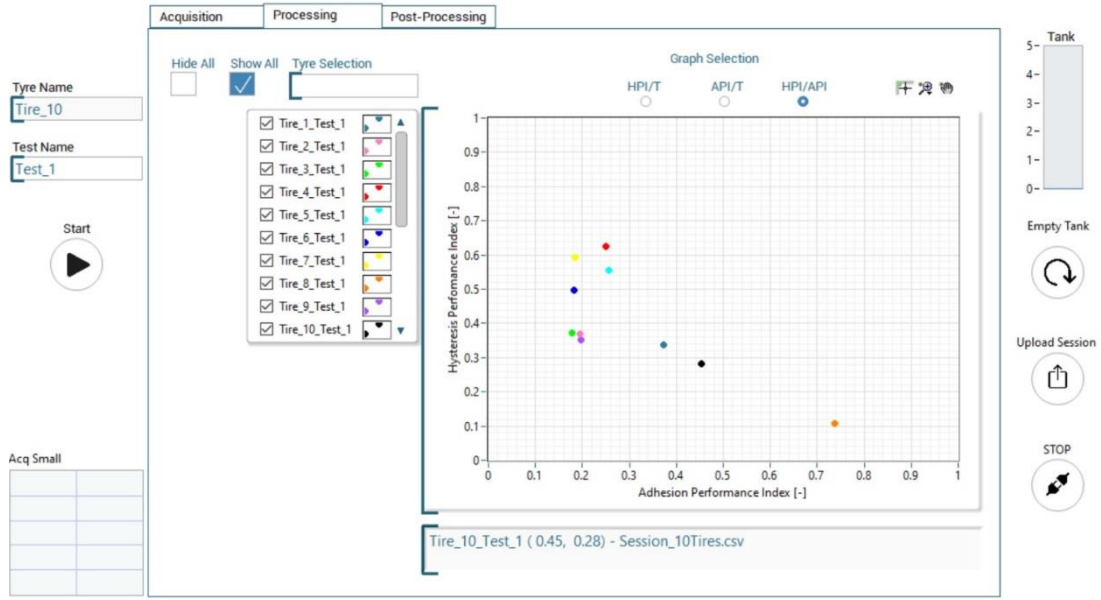

Tire Analysis – Thermal Bench

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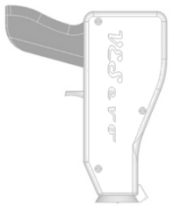

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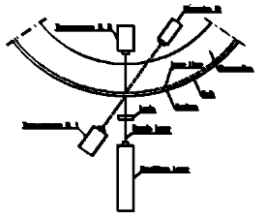

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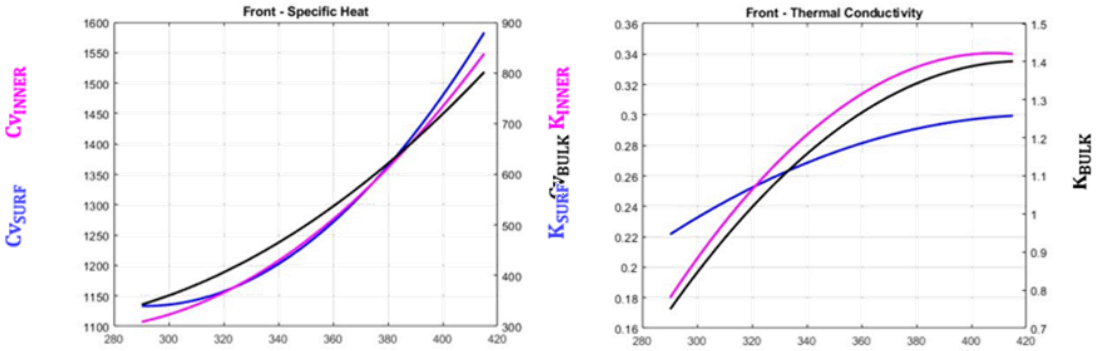
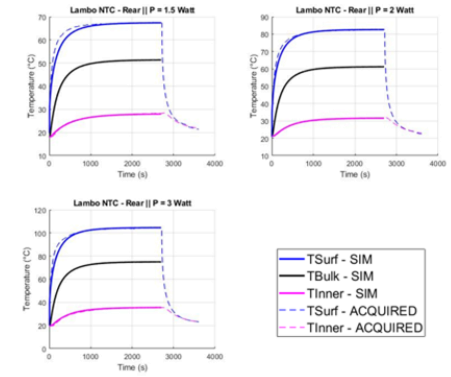
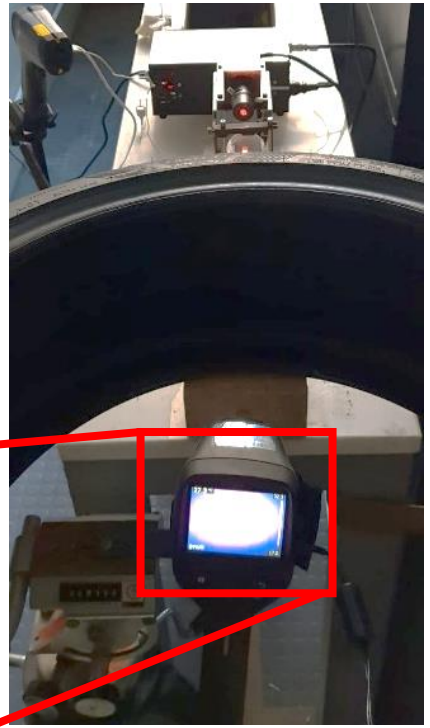
Innovative laser-based nondestructive methodology for the identification of thermal conductivity, specific heat and density characteristics vs temperature, of the materials constituting inner tire layers. An identification model-based technique allows to get thermoRIDE physical parameters

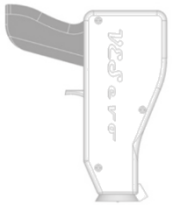






Tire Analysis – Footprints ID

1 INNOVATIVE DEVICE + TESTBENCHES



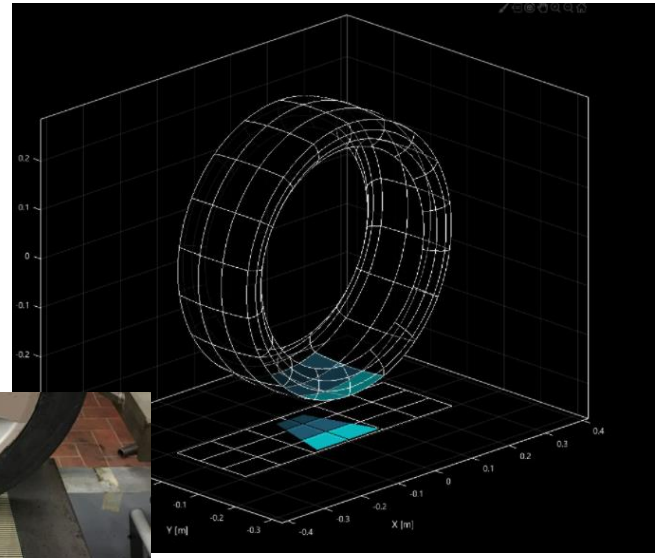
VESevo
nondestructive tread compound analyzer

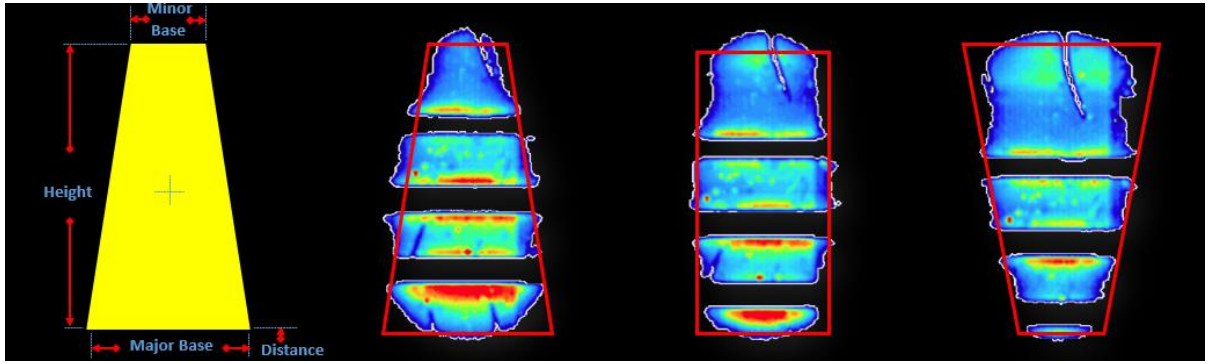
thermobench
tire thermal analysis

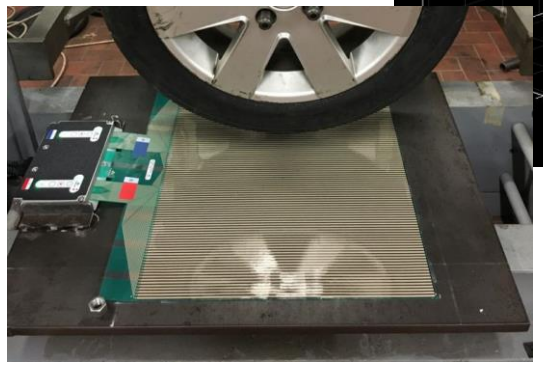
footprints-ID
shape & contact pressure

Lab hydraulic press allows to vary vertical load, inclination angle and inflation pressure, acquiring shape and pressure distribution

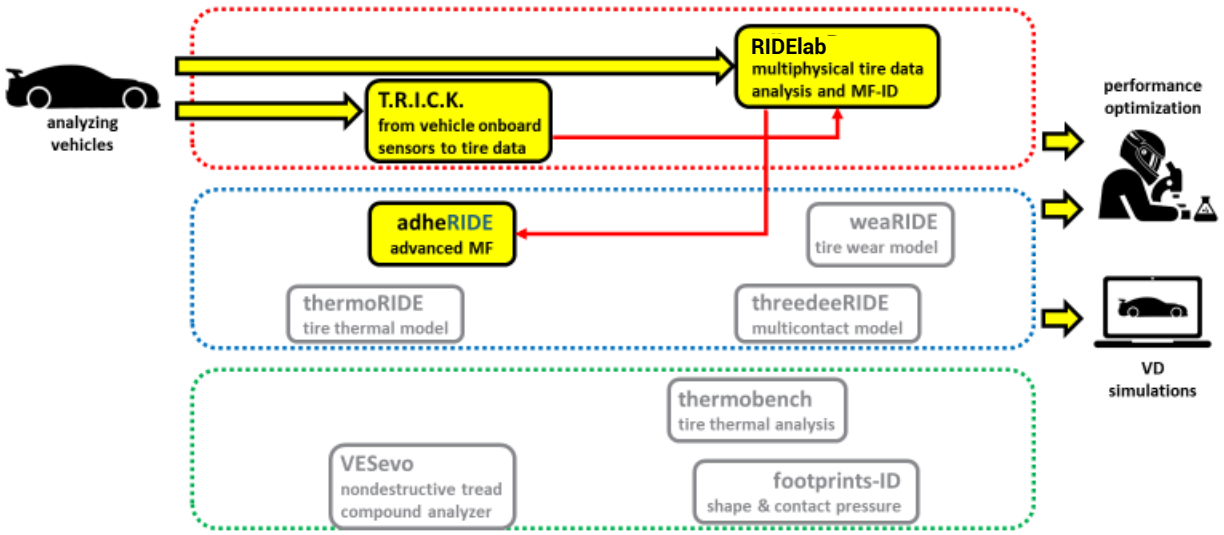
- **TEST ON CAR, MOTORBIKE AND LIGHT TRUCK TIRES**
- **PROPRIETARY TOOL FOR FOOTPRINTS "VIRTUALIZATION"**
- **DATA USED FOR THERMAL, WEAR AND MULTICONTACT MODELS**



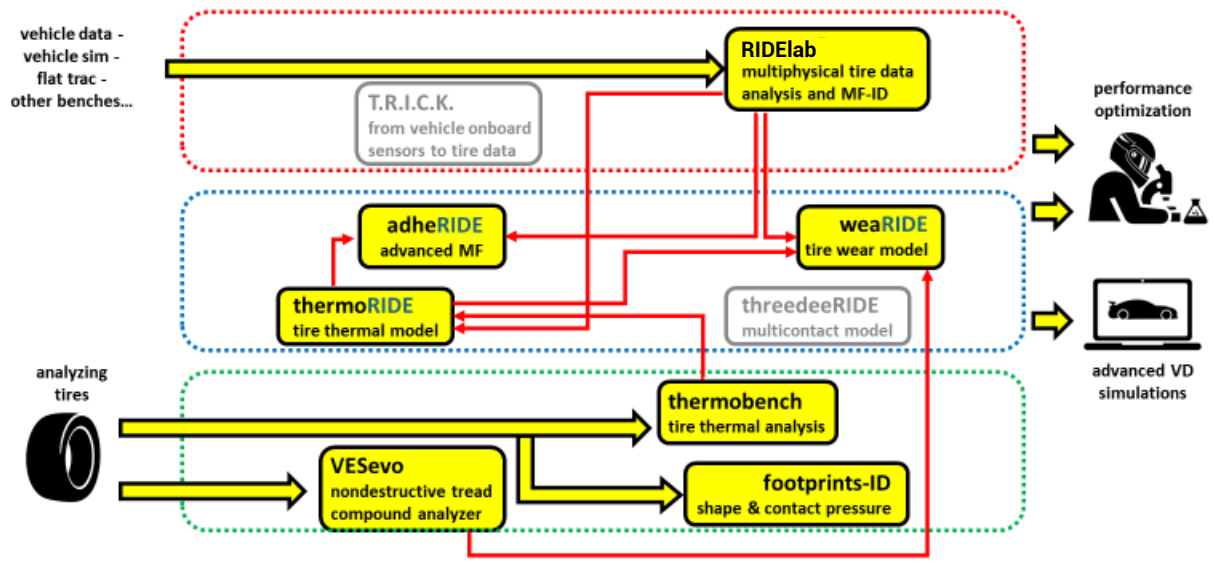




CASE STUDIES – 1. BASIC VEHICLE/TIRE DEV

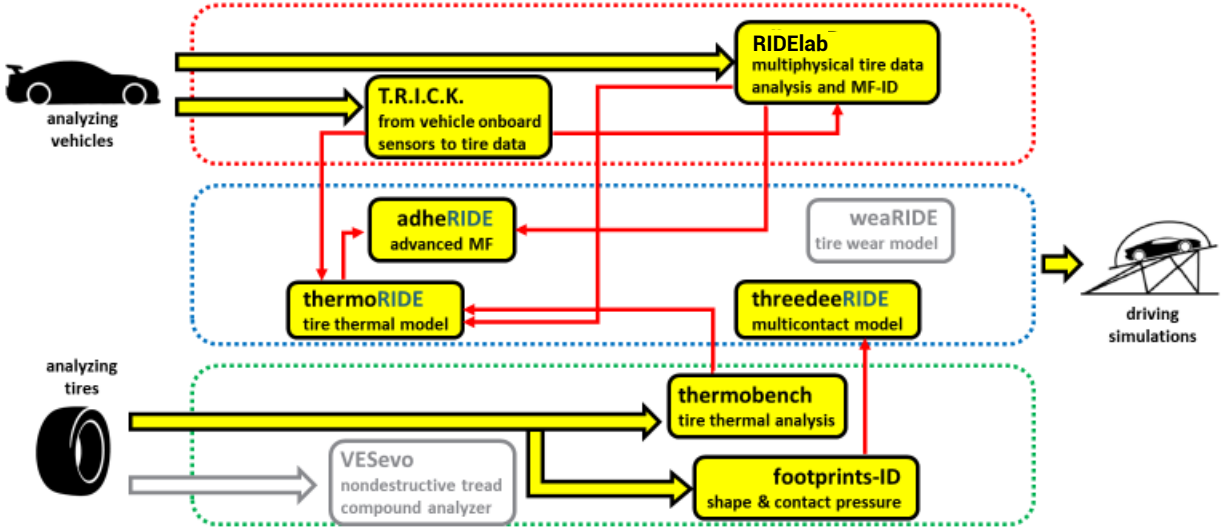


CASE STUDIES – 2. PERFORMANCES FOR RACING



THE REPORTED TOOLS CAN BE MIXED AND ASSEMBLED TO CREATE A COMPLETELY CUSTOMIZED TIRE TESTING, ANALYSIS AND SIMULATION PLATFORM, DIFFERENT PER EACH KIND OF USER AND TARGET

CASE STUDIES – 3. FROM REAL TO DIGITAL TWIN



TIRE DIGITAL TWIN - SCENARIOS OF USE

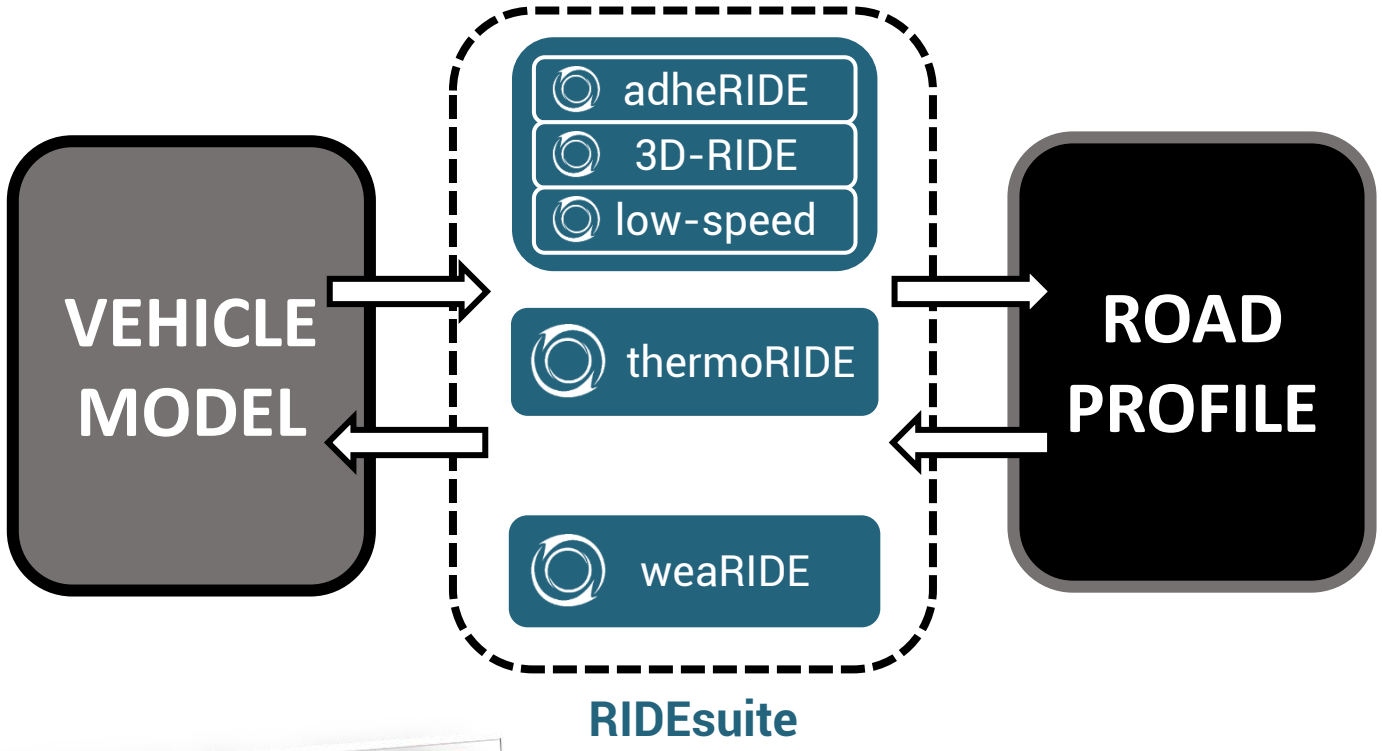
1. GETTING TIRE DATA

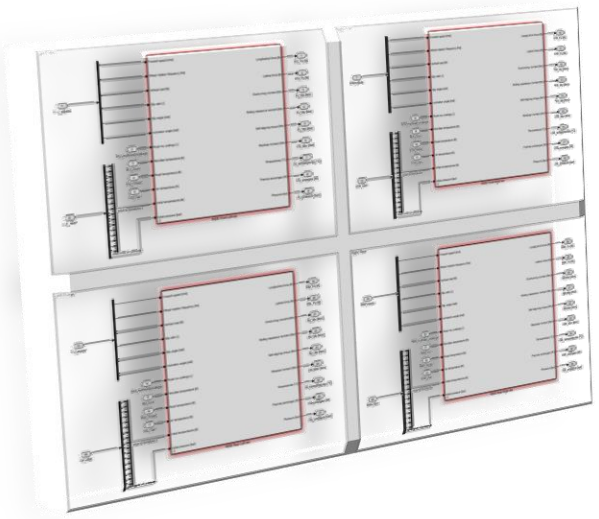
2. CHARACTERIZING MULTIPHYSICS

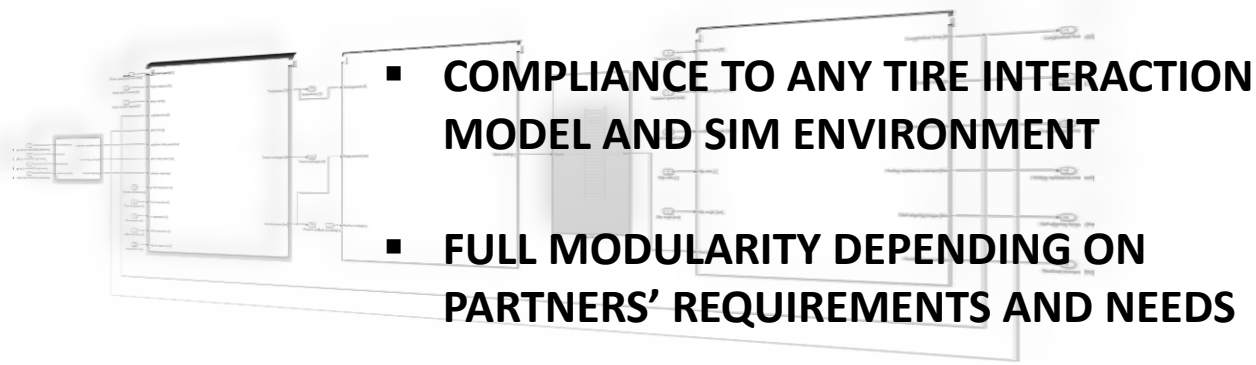
3. MODELLING MULTIPHYSICS

4. CALIBRATION AND VALIDATION

5. TIRE DIGITAL TWIN







- COMPLIANCE TO ANY TIRE INTERACTION MODEL AND SIM ENVIRONMENT
- FULL MODULARITY DEPENDING ON PARTNERS' REQUIREMENTS AND NEEDS

TIRE DIGITAL TWIN - STAND ALONE

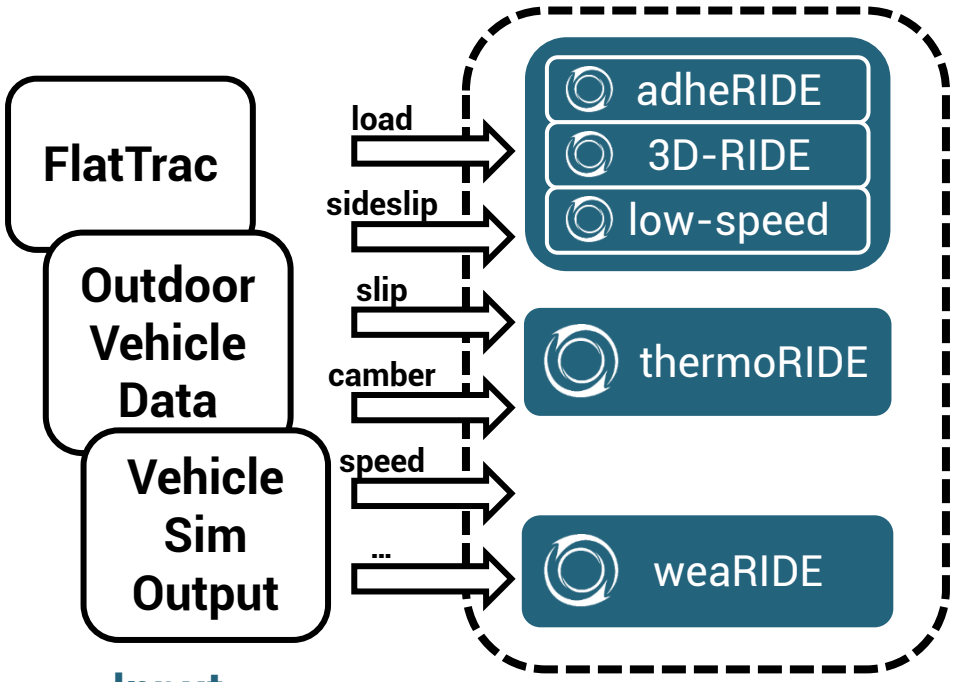
1. GETTING TIRE DATA

2. CHARACTERIZING MULTIPHYSICS

3. MODELLING MULTIPHYSICS

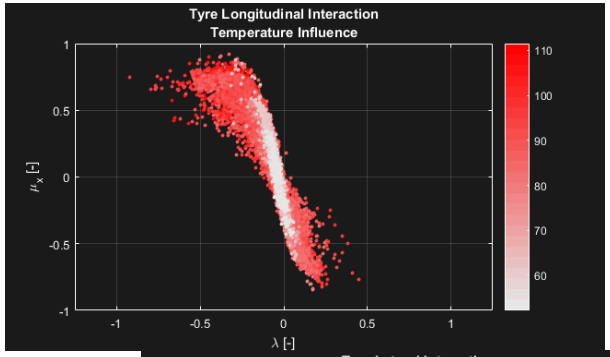
4. CALIBRATION AND VALIDATION

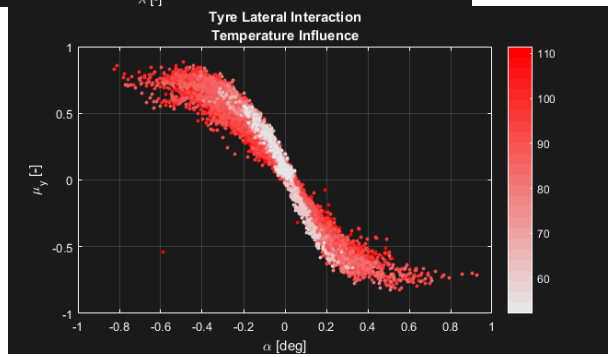
5. TIRE DIGITAL TWIN



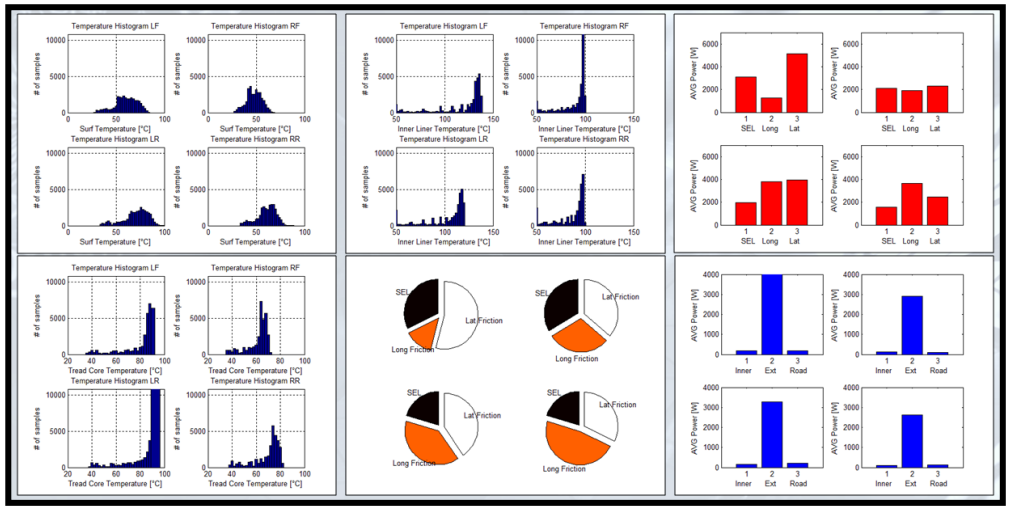
Input Acquisition

RIDEsuite





WARM-UP / HEAT EXCHANGE / THERMODYNAMIC OPTIMIZATION ANALYSIS



ANALYSIS ON TIRE DEPENDENCIES FROM INNER TEMPERATURE / WEAR / ROAD ROUGHNESS / TREAD VISCOELASTICITY

TIRE DIGITAL TWIN - "OFFLINE" SIMULATIONS

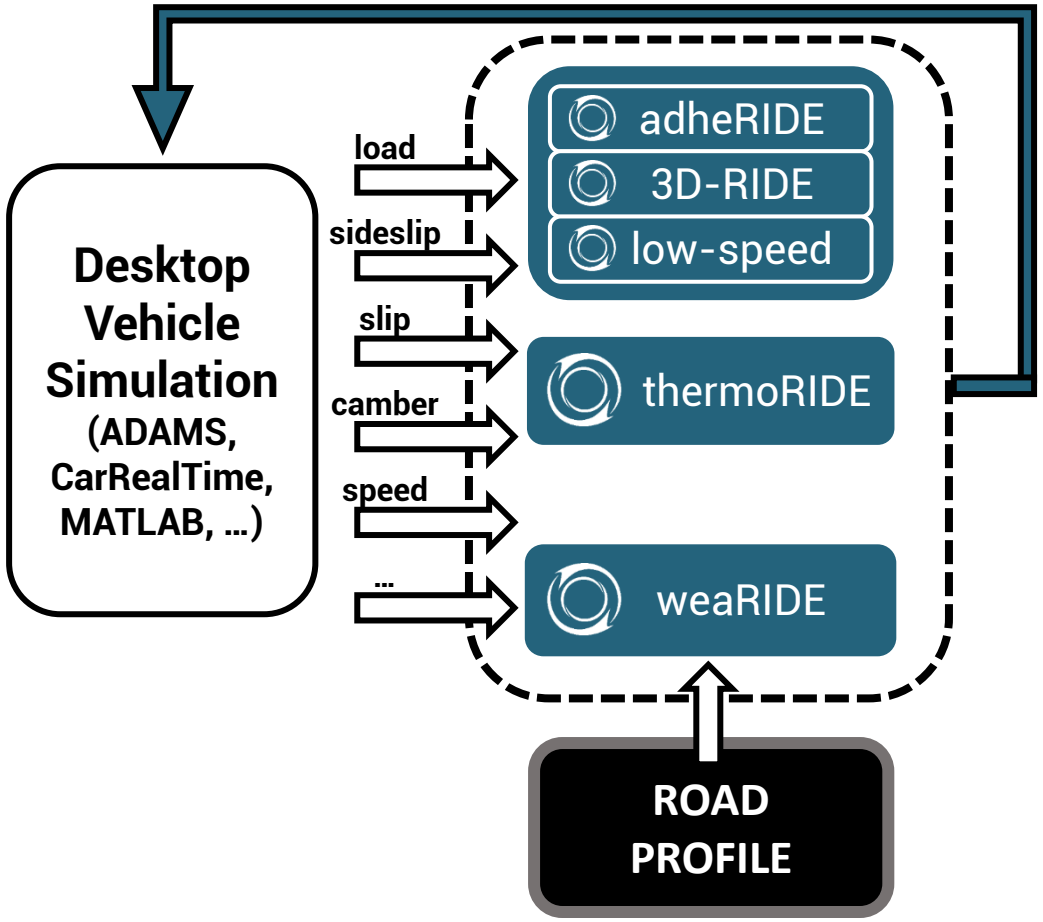
1. GETTING TIRE DATA

2. CHARACTERIZING MULTIPHYSICS

3. MODELLING MULTIPHYSICS

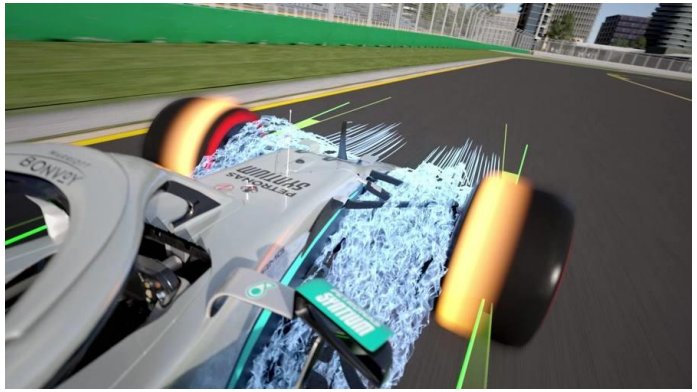
4. CALIBRATION AND VALIDATION

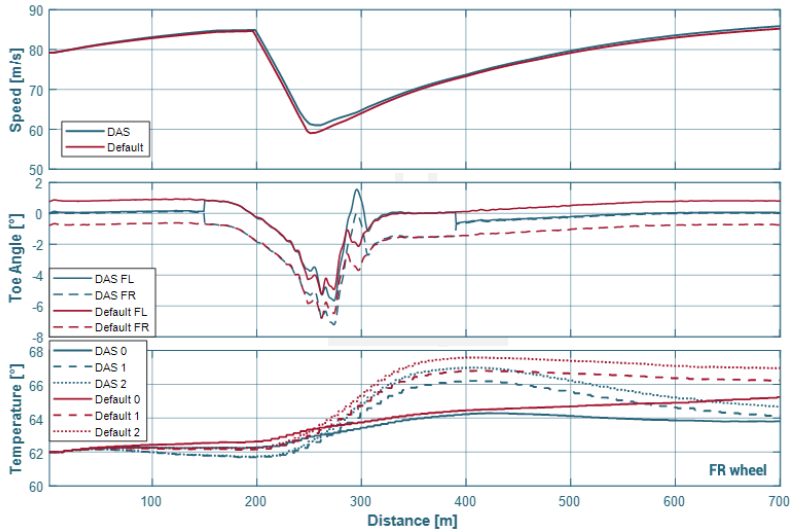
5. TIRE DIGITAL TWIN



Forces
Moments
Temperatures
Tread Wear
…

CASE STUDY: MERCEDES' DAS 2020





- **DYNAMIC SIMULATIONS FOR CAR / BIKE / TRUCK**
- **TIRES IN THE SIMULATION LOOP ACCOUNTING FOR THERMAL / WEAR / ROAD MESH / SPEED PHENOMENA**

TIRE DIGITAL TWIN – LAPTIME OPTIMIZATION

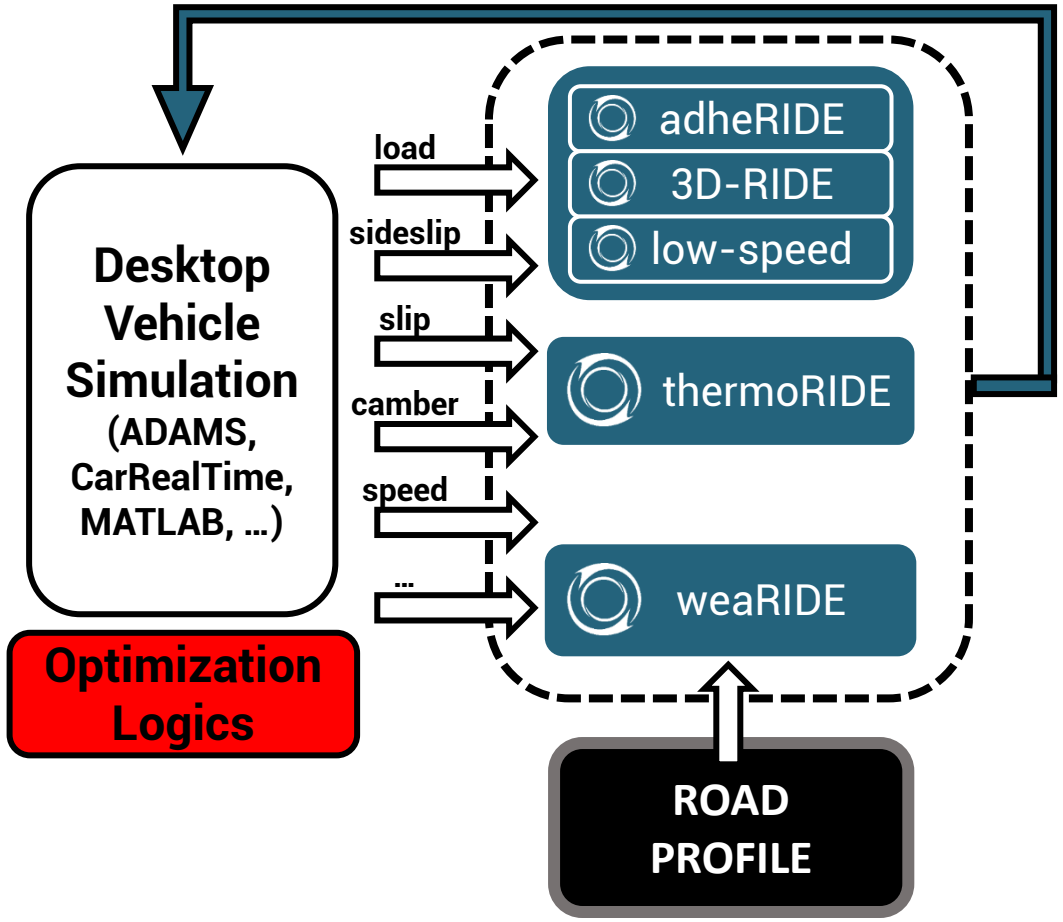
1. GETTING TIRE DATA

2. CHARACTERIZING MULTIPHYSICS

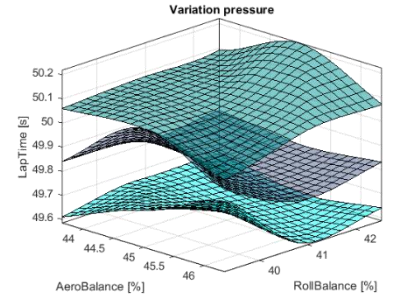
3. MODELLING MULTIPHYSICS

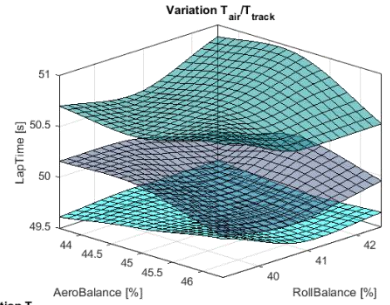
4. CALIBRATION AND VALIDATION

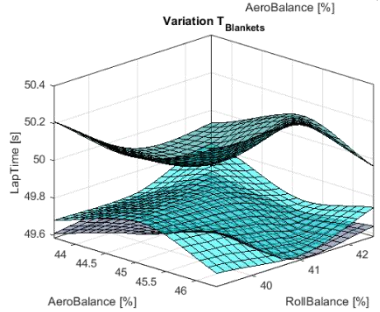
5. TIRE DIGITAL TWIN



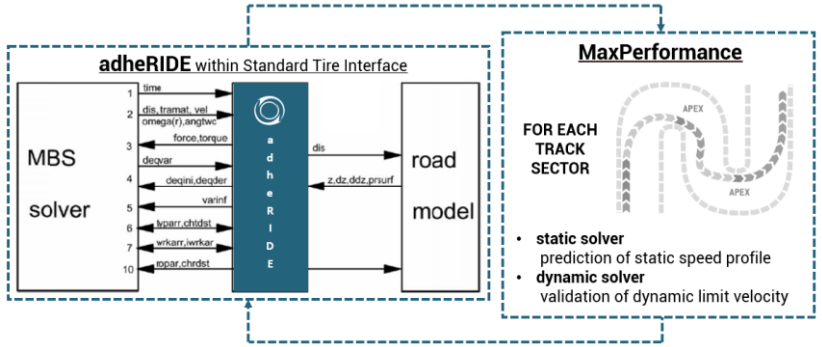
Forces
Moments
Temperatures
Tread Wear
…







- **ADVANCED SETUP OPTIMIZATION (INFLATION PRESSURE / BLANKETS TEMPERATURE / …)**
- **GRIP&STIFFNESS VARIATIONS WITH TEMPERATURE IN THE ITERATIVE OPTIMIZATION ALGORITHMS**



TIRE DIGITAL TWIN – REALTIME PLATFORMS

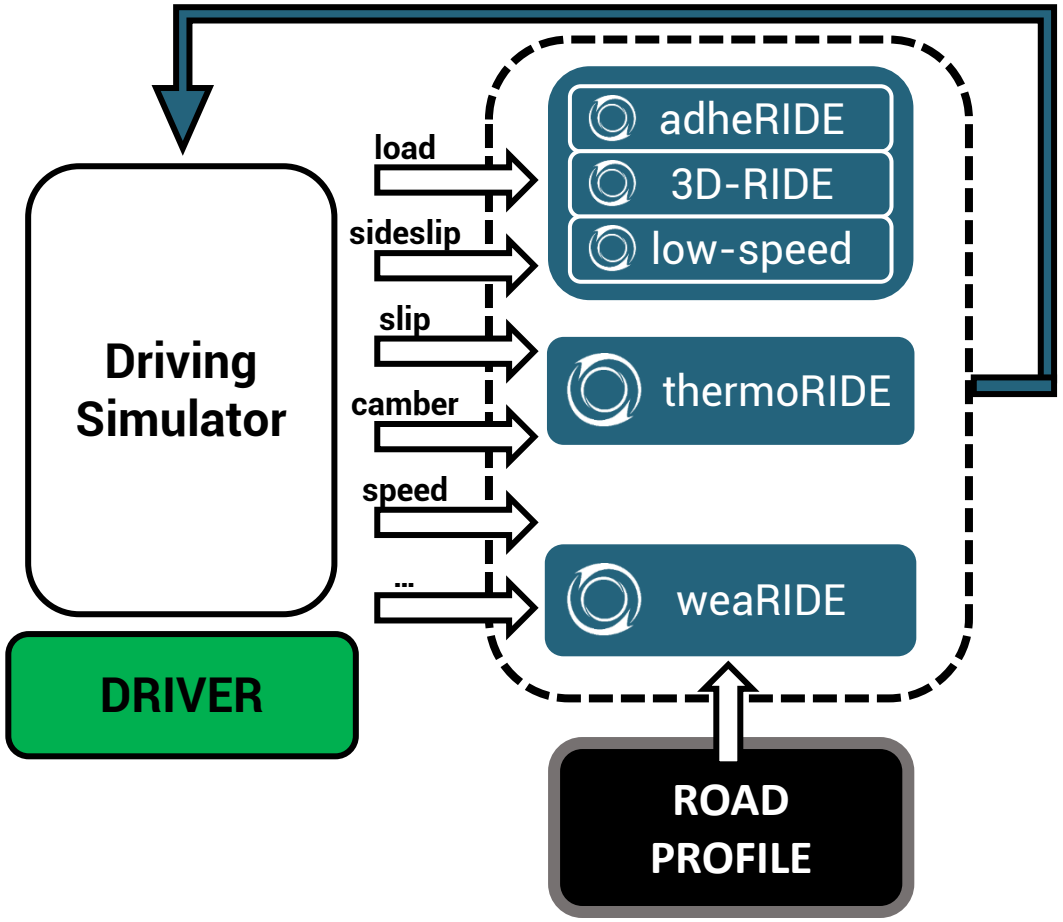
1. GETTING TIRE DATA

2. CHARACTERIZING MULTIPHYSICS

3. MODELLING MULTIPHYSICS

4. CALIBRATION AND VALIDATION

5. TIRE DIGITAL TWIN

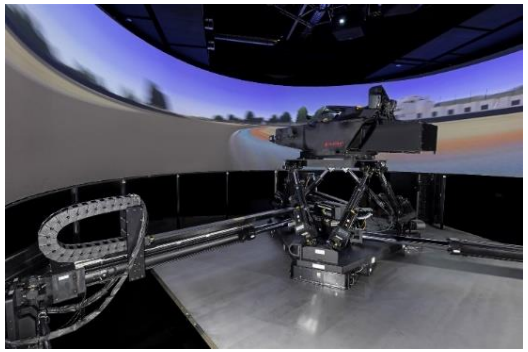


Forces
Moments
Temperatures
Tread Wear
...

- PHYSICAL MODELS OPTIMIZED FOR REALTIME
- ENHANCED FEELINGS FOR SUBJECTIVE ANALYSIS
- MULTICONTACT AND "LOW SPEED" RIDE MODELS

some of the RT users adopting RIDEsuite...

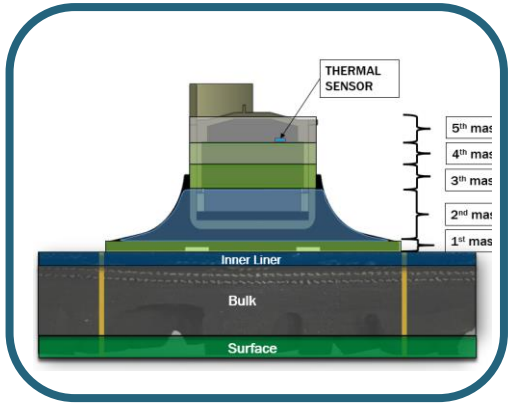
LUXURY AND RACING CAR MANUFACTURERS

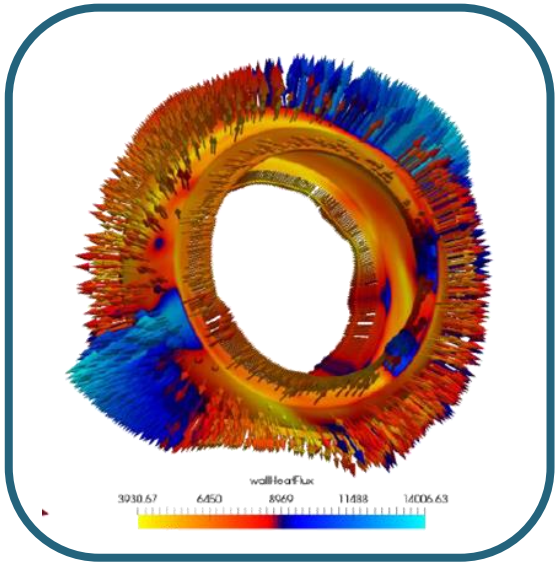


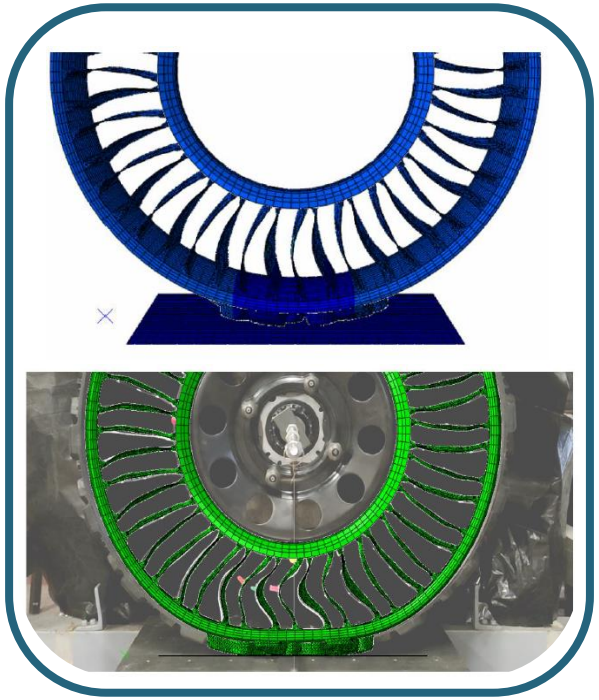
MOTORSPORT TEAMS

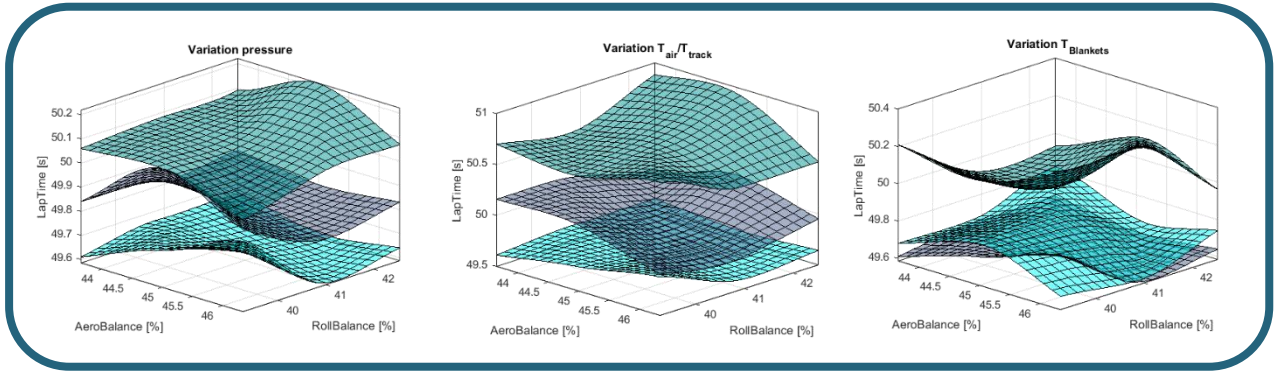
PASSENGER AND GT VEHICLE MANUFACTURERS

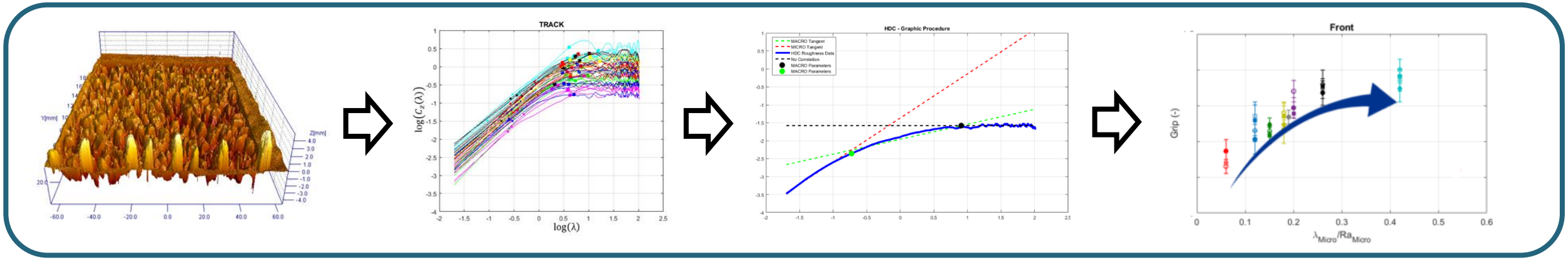
...what's more? Bespoke Tire Research











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