FTire

Physical Tire Model

sales@cosin.eu| www.cosin.eu | 2025

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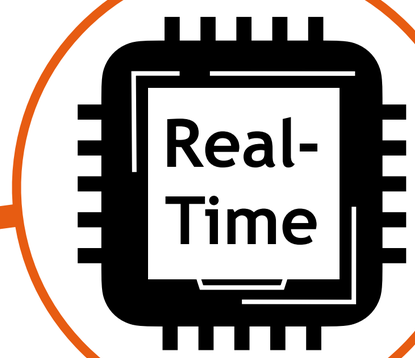
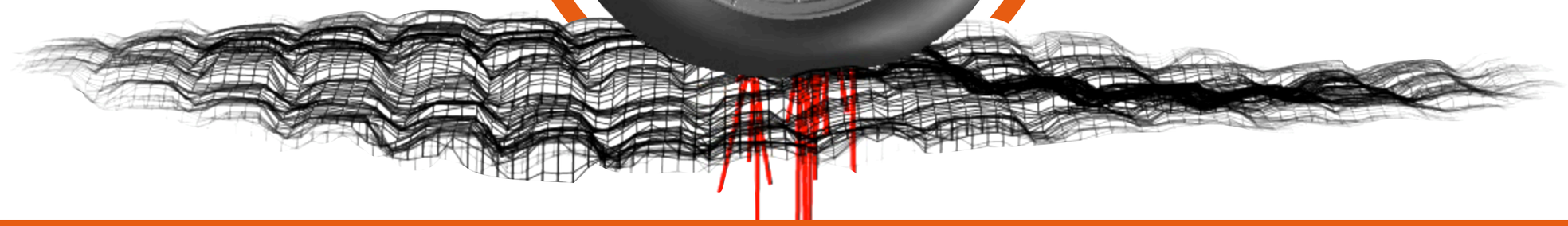
FTire - Digital Twin

FTire in the Office and in Real-Time.

Control
Wear
Steering
Misuse
Ride
Handling
NVH
Durability
Comfort





One Tire for all Domains. A seamless Approach. Consistent. Trusted. Validated.

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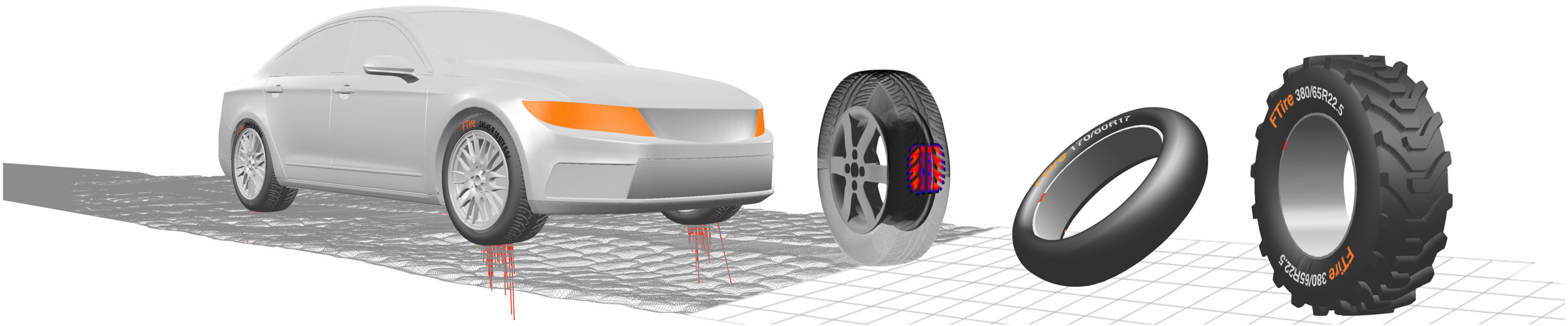
FTire - The 3D Flexible Structure Tire Model

Why FTire?

FTire is the most comprehensive simulation software package for advanced tire and road surface modeling on the market.
The 3D Flexible Structure Tire Model (FTire) is the multi purpose virtual tire model designed for applications where tire dynamics have an important effect on the vehicle dynamics simulation.
FTire is applied and supported by vehicle and tire manufacturers in the areas of passenger car, motorcycle, bus, truck, agricultural, and aerospace development.
Together with several partners worldwide, cosin scientific software offers a full range of support for tire data measurement, parameter identification, and road surface measurement.

Multi-Contact!



FTire is the physical tire model, simulating complex tire phenomena on a strictly mechanical and thermo-dynamical basis. No magic.

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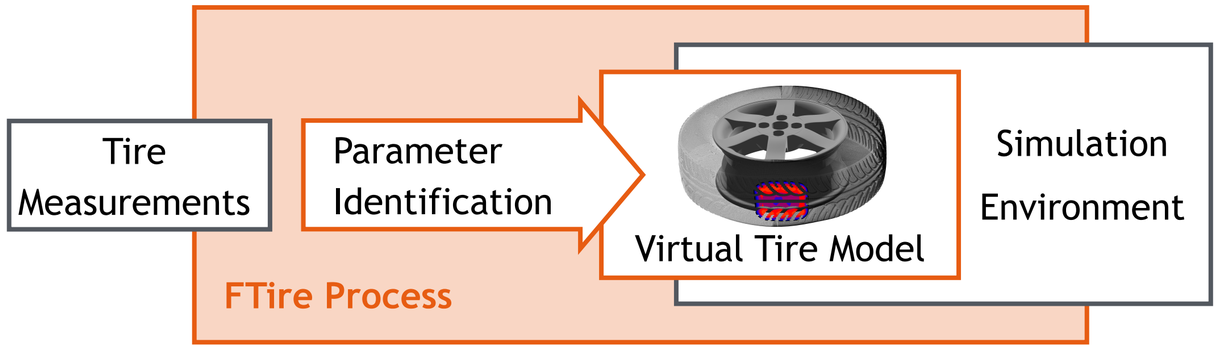
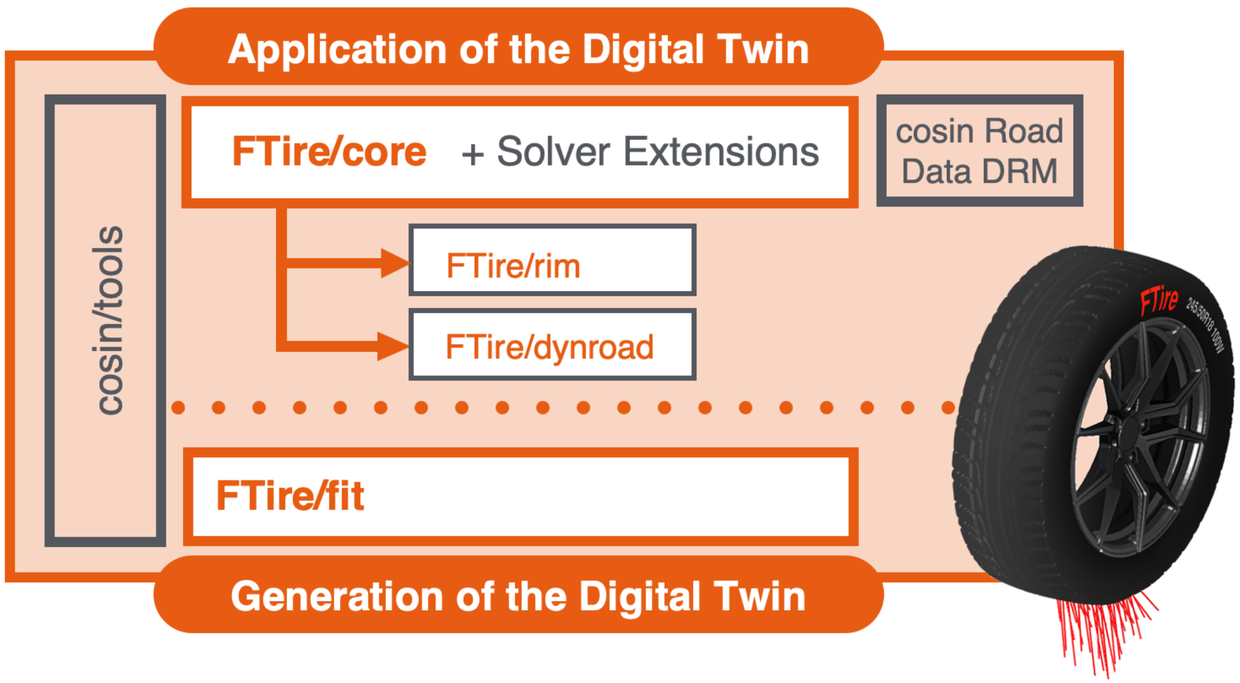
FTire - The Tire Simulation Software

Why FTire?

The FTire software package covers the full process from processing measurement data, over parameter identification, generating the virtual tire simulation model, up to the use in a wide environment of CAE software tools with a huge variety of application cases.



One Tire Simulation Software covering the full Process.



The tire simulation software FTire consists of its main product FTire/core, the 3D flexible structure tire model with dedicated solver extensions and the standalone product FTire/fit for parameter identification out of measurements.

In addition users are provided with the powerful cosin/tools to handle, post process and animate FTire data.

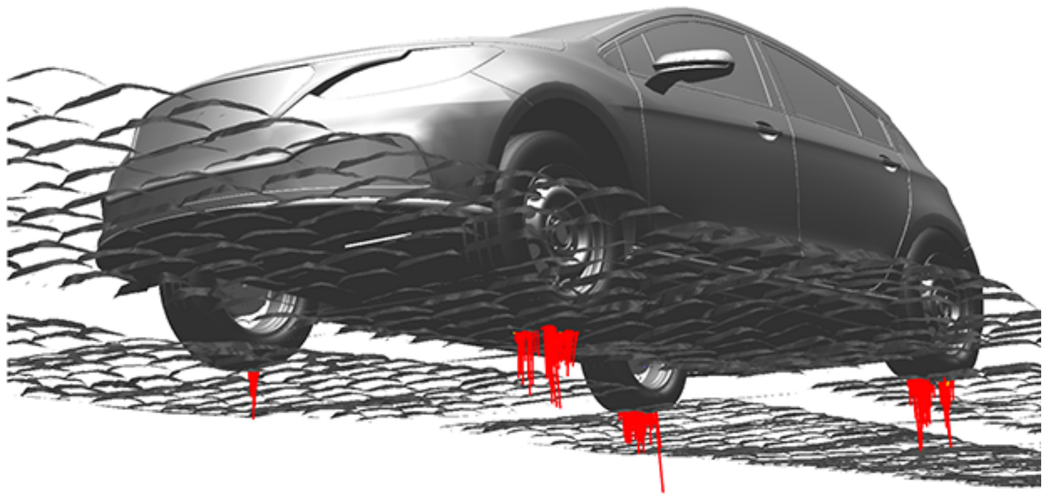
cosin Road Data DRM enables digital rights management and road data encryption.

FTire/core - The 3D Flexible Structure Tire Model

Why FTire?

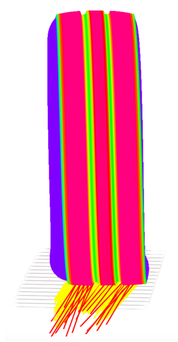
FTire/core Features

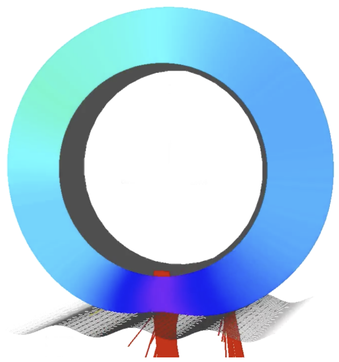
- Physical tire model with fully nonlinear 3D tire structure deformation model covering all frequencies up to 250 Hz and exceeding
- Extensions for detailed tire temperature and thermal effects, internal air flow and air volume vibrations included
- Tire imperfection models embedding tread gauge variation, imbalance effects, conicity and non-uniformity
- Solver extensions for tread wear, flexible rim, and deformable road
- Optional misuse contact elements like rim-to-belt (bottoming), sidewall-to-road, and rim-to-road
- Dynamic tread-road contact model with a resolution below 1 mm and optional use of geometrical tread patterns
- Wide variety of road data formats including RGR, RDF, CAD formats, OpenCRG, and user-written road models supported
- Unlimited number of tires and roads per simulation model

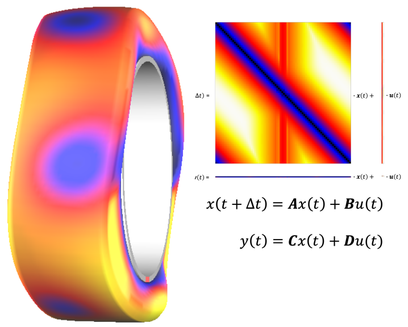


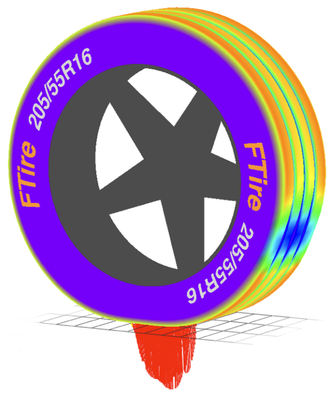
All Extensions in One Model.

FTire/core Extensions









Imperfection & Misuse - 3D Thermo-Dynamic & Heat-Transfer - Air Cavity Vibration - NVH / Linearization - Wear

FTire/core - Extensions FTire/rim and FTire/dynroad

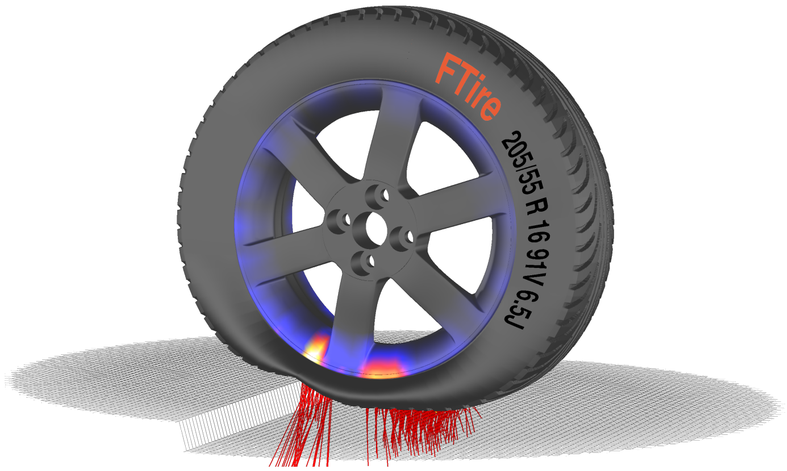
Why FTire?

FTire/rim and FTire/dynroad extend the modeling capabilities offered through FTire/core. These features add a more detailed description to tire and road simulation analysis, which covers all application fields from ride/comfort and extended handling over durability to NVH.

FTire/rim

Extension to FTire/core for flexible and visco-plastic rim modeling

- Internal elastic and plastic rim deformation model on basis of FE load cases import
- Interface to user-defined rim models
- Rim-to-tire friction and slip models



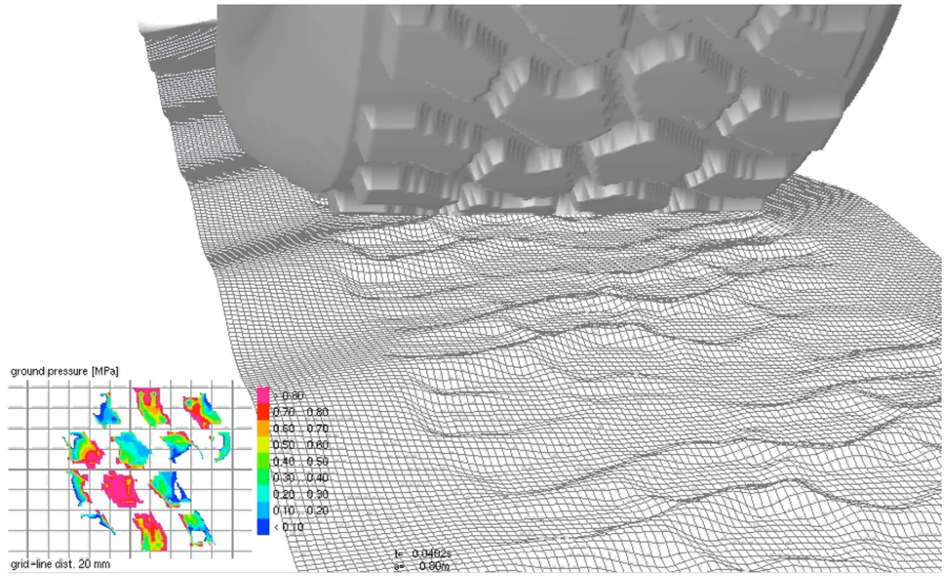
Benefits at a Glance

- Fast approach for elastically deformable rim
- Enhanced misuse events
- Rim-to-belt and rim-to-road contact
- FTire / FEA (finite element analysis) coupling

FTire/dynroad

Extension to FTire/core for visco-elastic road modelling including the following deformable road surface models:

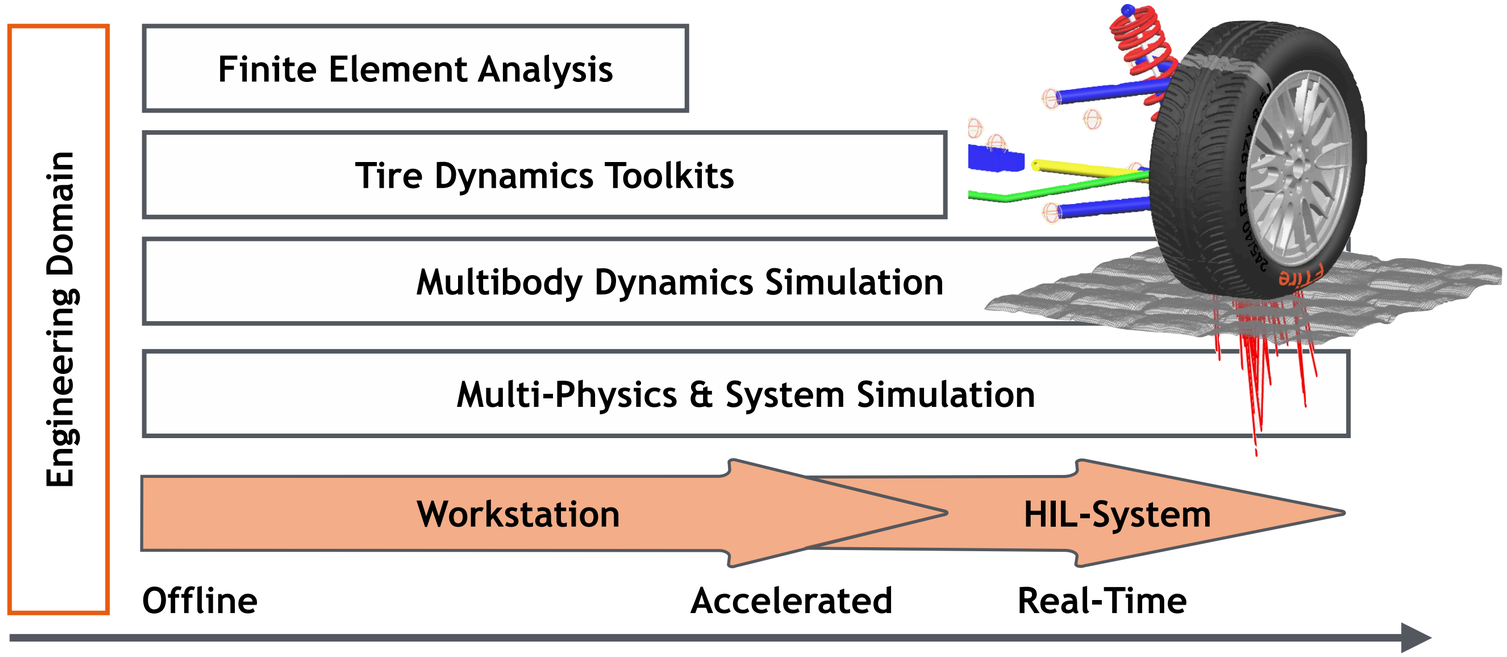
- cosin soil model
- Bekker/Wong soil model
- interface to user-defined FE-based soil models



Benefits at a Glance

- Basic approach for elasto-plastically deformable surfaces
- Agricultural tires on soil

FTire/core - The 3D Flexible Structure Tire Model



One Tire Model for all CAE-Tools* and all Applications.

FTire/core is the multi-purpose virtual Tire Solver

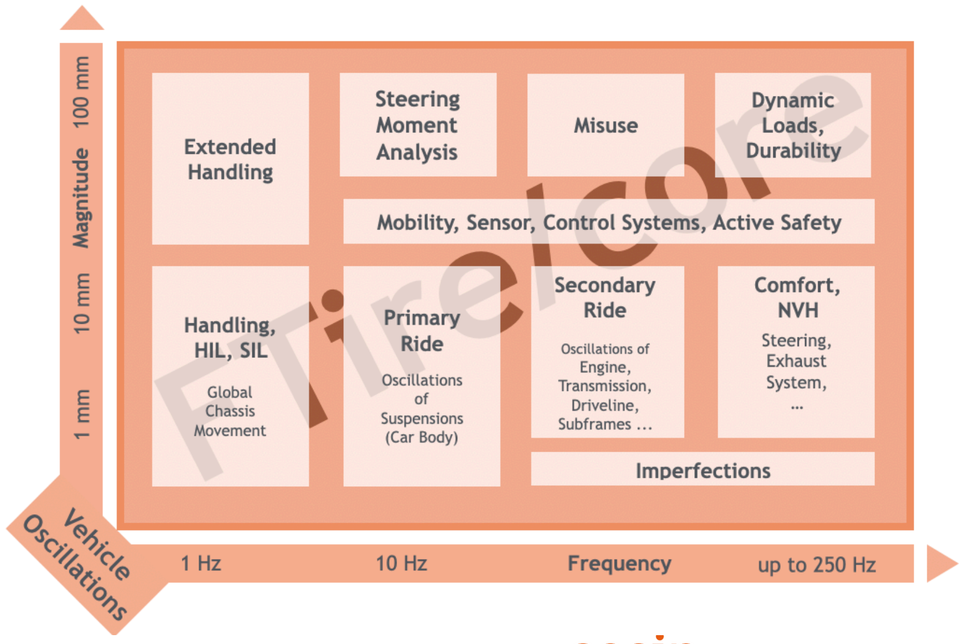
From offline application cases on office workstations up to Hardware-in-the-Loop application cases on specific HiL traget systems, the physical 3D nonlinear tire simulation model solves complex tire phenomena on a strictly mechanical and thermo-dynamical basis. The FTire/core Solver can run in different speed modes, from standard, to acceleration (FTire/acc), up to Real-Time. In order to execute FTire/core for Hardware-in-the-Loop Application Cases (FTire HIL AC) with hard Real-Time requirements, special packages for the particular traget systems are required.

Why FTire?

What is UNIQUE?

Seamless modelling approach:

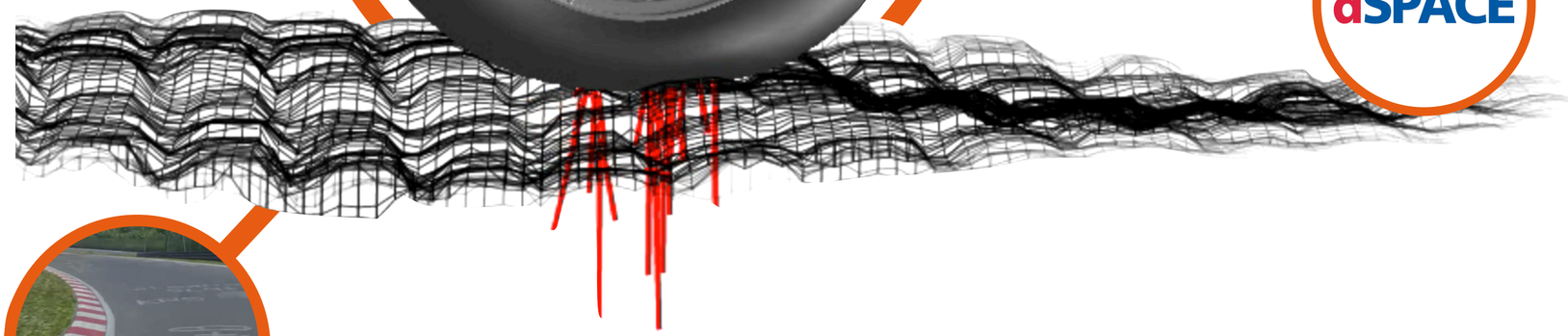
- The identical high-quality virtual tire can be used throughout the entire tool chain and applications across all development departments
- One solver from the office, to HiL SiL and MiL, up to testbed systems and driving simulators
- No reduction of belt fidelity for higher solver speed modes
- Full level of detail and dynamic range even under hard Real-Time operation conditions
- One product which covers most tire dynamics phenomena
- Interfaces to a large number of CAE software tools



FTire/core - Digital Twin

Hardware-in-the-Loop Environments.

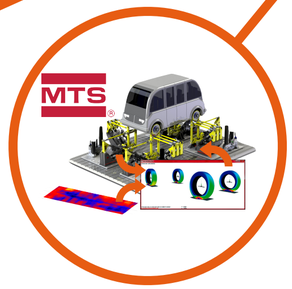
Durability
Handling
Wear
Steering
Control
Ride
Misuse
NVH
Comfort



UHD Road Surfaces

Real-Time

Testbed Systems
HiL Systems
Driving Simulators



dSPACE

HiL Systems
Steering-HiL
Breaking-HiL

concurrent REAL-TIME

Full Tire Belt Dynamics up to 200 Hz in Real-Time.

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FTire - The Digital Twin

Comprehensive. Easy. Single Source.

One virtual Tire for all Application Cases

Used in a wide Simulation Environment

Tire Data shared across all Departments

The identical high-quality virtual tire can be used throughout the entire tool chain and applications across all development departments, from the office, up to Real-Time environments.

No Smoothing. No Reduction. No conversion.

Multi-Contact! No Magic. No Formula.

High Frequency and Realistic Feedback of the Road Surface

Required for Reliable Vehicle Dynamics Simulation

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FTire/core - Full Tire Dynamics in Real-Time

Feel the Difference.

FTire HiL AC

Enables Hardware-in-the-Loop (HiL) Application Cases (AC) executing FTire/core on HiL Systems, such as testbed systems and driving simulators.

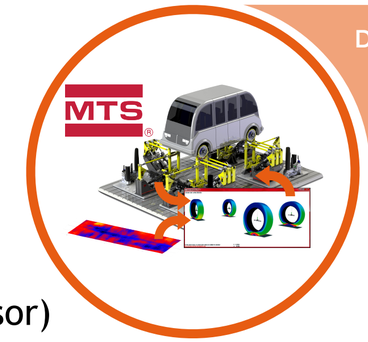
- Guaranteed compatibility to specific target systems
- Hard Real-Time conditions (guaranteed response times)
- High accurate in frequency range up to 200 Hz
- Parallel solver execution for multiple tire instances
- Taking full advantage of multi-core systems
- Suitable for all applications from steering, ride/comfort, extended handling, vibrations, to durability

What is UNIQUE?

- Full featured FTire/core model runs under hard Real-Time conditions (full level of detail and dynamic range)
- No changes in tire and road data-sets
- Standard road resolution 5 mm x 5 mm also for FTire HiL AC
- Re-use of the same high-quality Digital Twin across all simulations guarantees a seamless workflow

to be announced

3D Tire Dynamics in Real-Time on the Driving Simulator.



Durability Test Load Generation on a Standard MTS 329 Road Simulator

Currently Supported Hardware (HiL Systems)

- FTire HiL AC for HSRC
  - MTS testbed systems (HSRC application case)
- FTire HiL AC for CCRT (concurrent REAL-TIME)
  - on driving simulator solutions
- FTire HiL AC for dSpace (dSpace SCALEXIO Hypervisor)
  - various HiL setups

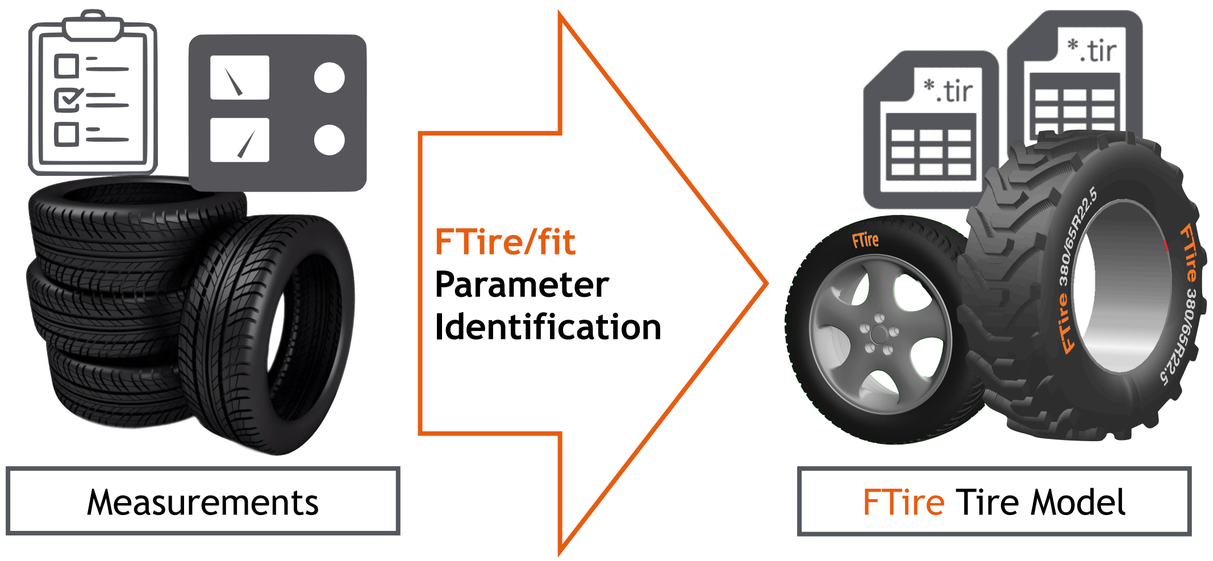
These packages include hardware glue-code and interfacing components to enable FTire/core on the target system.

Benefits at a Glance

- Makes FTire/core available to HiL, testbed system and simulator applications under hard Real-Time conditions
- Simulation setup remains unchanged
- Change tire operating conditions at simulation runtime

FTire/fit - Parameter Identification Tool

Generation of the Digital Twin.



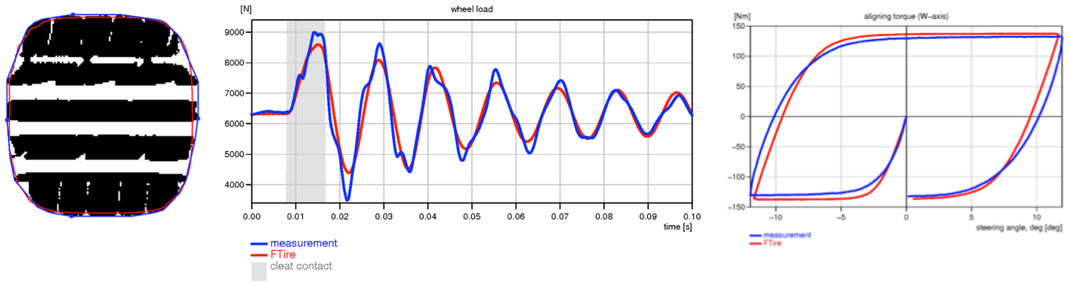
FTire/fit is the software toolbox designed for parameter identification and optimization of FTire data on basis of static and steady-state measurements, footprint geometry, cleat tests and virtual measurements such as finite-element-analysis (FEA) results. The standalone product is developed for tire measurement providers, testing labs, tire manufacturers and automotive OEMs with a high level of in-house testing capabilities.

cosin scientific software provides an extensive consultancy and training for FTire/fit users. Parameter identification from physical measurement data is available as a service.

FTire/fit Features

- Convenient tool for processing, identification, and validation of geometrical, static, steady-state, handling, dynamic, and modal data
- Automatic measurement data format recognition and conversion
- Wide support for input data formats like TYDEX data files, ASCII tables, bitmaps, graphs, MF tire model data, etc.
- Automated footprint comparison and cross-section geometry import
- Automated stiffness determination (radial, longitudinal, lateral, torsion, cornering stiffness, pneumatic trail, and slip stiffness)
- Automated static and steady-state validation by time domain simulation
- Dynamic identification using least squares fits of cleat tests in time and/or frequency domain
- Automated generation of fitting reports
- Fully automatic HTML/PDF-based report creator, including generation and illustration of steady-state and handling simulation results

Identify One Tire for all Applications.



Benefits at a Glance

- FTire/fit is the powerful parameter identification and validation toolbox for FTire
- Much more than just a mathematical parameter fitting procedure

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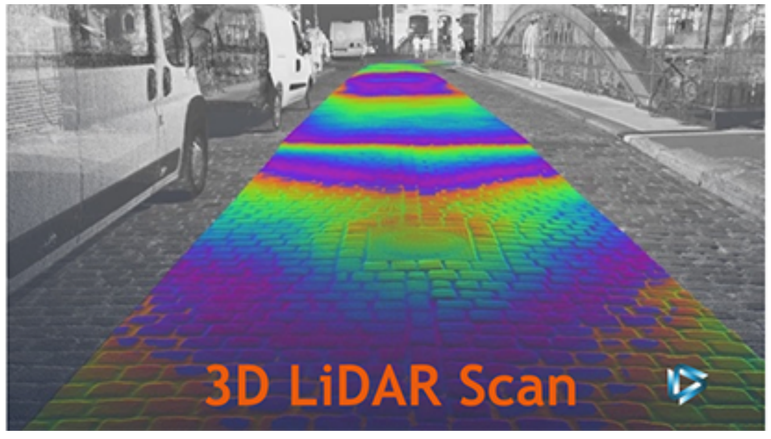
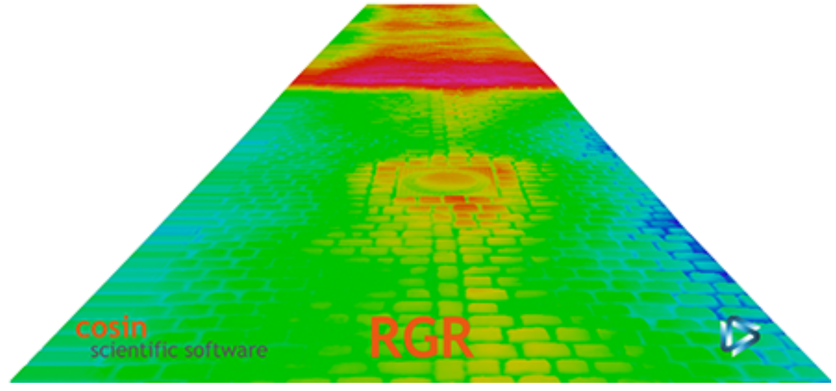
cosin - Road Data Marketplace and DRM

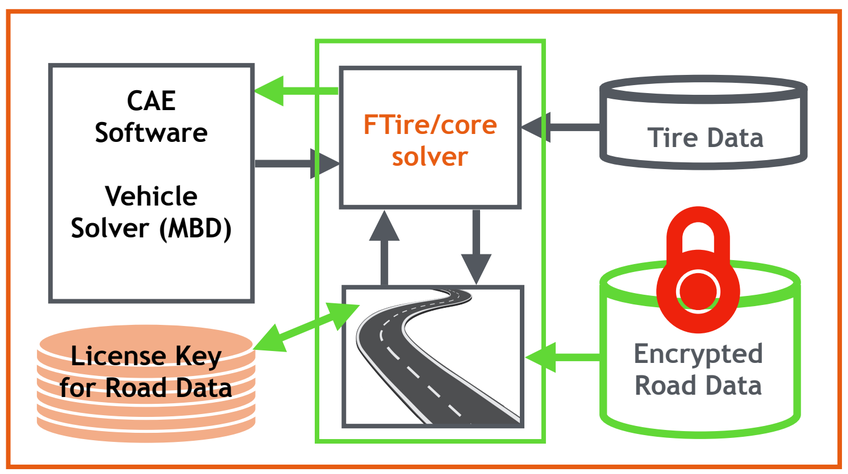
Encrypted Road Data.





High quality tire and road models are key to all kinds of virtual prototyping applications. Advanced virtual CAE methods for vehicle performance analysis, durability prediction, ride comfort evaluation, extended handling maneuvers, ADAS and autonomous control system design require realistic input from the digital twin of the wheels. Road networks, test and race tracks as well as proving grounds are available as ultra high-resolution surface scans.
Please find more details about cosin's Road Data Marketplace on our website*.

Lease Road Data (VPG) for a short Period of Time.



cosin Road Data DRM (digital rights management)

Until now, customers were required to order scanning services as an individual service to purchase digital road data as a proprietary asset. Applying a digital rights management system (DRM) to road data allows users to access encrypted high quality input data in a secure and convenient way. New offerings like restricting data access to particular user groups, short term leasing and publication of proprietary geo data like race tracks or vehicle OEMs proving ground is now possible under the trusted environment provided by the cosin licensing scheme.

FTire - Physical Tire Model.

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