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A Predictive Thermo-Mechanical Framework for Tire Temperature and Performance Modeling

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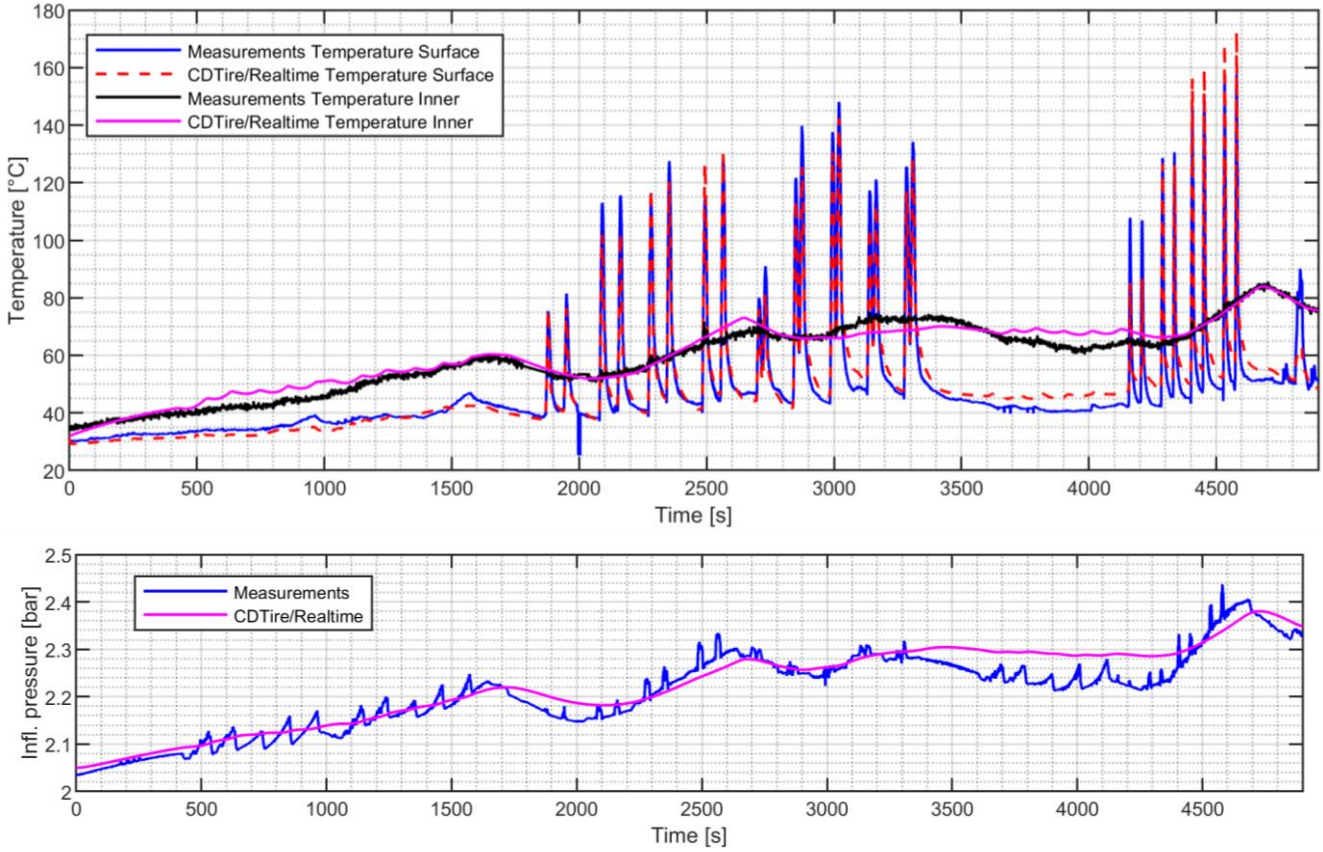
ABSTRACT: The growing demand for sustainable products drives the industry to improve CAE methods for predicting wear and rolling resistance, both strongly temperature-dependent. The authors work enhances temperature modeling and parameterization in the thermo-mechanical CDTire model. Its finite-volume formulation separates geometry from material properties, improving physical accuracy and therefore reducing parameter identification effort due to enhanced prediction capability. A measurement-based methodology is presented and validated on multiple passenger-car tires, showing improved accuracy of standard characteristics with minimal extra effort. Temperature effects on cornering/braking stiffness, friction, and pressure are examined in details. Future work targets improved rolling-resistance and wear prediction.

KEY WORDS:**CDTire, temperature, tire thermodynamic, wear, rolling resistance,** tire simulation



1. SUMMARIZED PAPER

This work has presented an extended thermo-mechanical tire model, CDTire/Thermal, suitable for industrial use. The model employs a three-dimensional finite-volume formulation of the Fourier diffusion equation and accounts for structural dissipation, frictional power at the road interface, convection with internal and external air, road conduction, and rim and brake-disk heat exchange. A clear separation between material and geometric properties, supported by an auto-mesher, enables flexible discretization and automatic resizing of thermo-mechanical allows CDTire/Thermal to be combined with CDTire/3D, CDTire/Realtime, and CDTire/MF++. CDTire/3D serves as a "mother model" for contact-patch and dissipation data, which can be transferred semi-automatically to CDTire/Realtime. Validation against indoor drum tests on seven tires shows good agreement in temperatures, inflation pressure, and lateral forces, including friction saturation and thermal hysteresis. With real-time capability and robust parameterization, the model is ready for standard industrial applications, particularly for electric vehicles.

Figure 1:Indoor measurements vs CDTire/Realtime plus CDTire/Thermal Temperature simulations.