Preface

Special issue on the 4th International Tyre Colloquium

Ever since the first meeting in 1991, organised by Professor Pacejka at the Delft University of Technology, Tyre Colloquia have provided a platform for researchers and scientists from industry and academia to discuss and consolidate progress in the understanding and simulation of tyre-road-vehicle interactions. In particular, the 1st Tyre Colloquium focused on the steady-state shear forces and torque generating properties of the tyre. The 2nd Colloquium, organised by Professors Böhm and Willumeit at the Technical University of Berlin in 1997, primarily discussed transient tyre characteristics. With the development of increasingly sophisticated mechatronic automobiles, the topics at the 3rd Tyre Colloquium (held at the Vienna University of Technology in 2004) ranged from tyre modelling to control aspects of vehicle dynamics. The event was organised by Professors Lugner and Plöchl, who also presented the first results of the international Tyre Model Performance Test. In 2015, the 4th Tyre Colloquium was held at the University of Surrey, Guildford, United Kingdom. In line with the tradition, the topics focused on current challenges related to modelling of tyres for vehicle dynamics analysis.

Since the first Colloquium, the capabilities of simulating tyre-road-vehicle interactions have significantly advanced so that nowadays tyre forces and moments can be accurately modelled within experimentally tested conditions. Yet, many simulation challenges remain unsolved as tyre mechanics/dynamics is a complicated subject and a full understanding of the fundamental tyre-road interaction mechanisms is still missing. Today, driven by the use of high fidelity simulation tools in the vehicle development process, one of the main issues is the accurate tyre behaviour prediction outside tested conditions to allow simulation of all possible facets of running characteristics. Also, considering the increasing connectivity of vehicles, the use of tyres as a real time sensor offering chassis control systems direct access to tyre forces and road friction conditions is highly desirable and, at same time, very challenging.

The 4th Tyre Colloquium focused on today's challenges by discussing a wide range of topics, including tyre measurements and measurement techniques, application of tyre models to vehicle dynamics, determination of tyre model parameters, measurement and modelling of rubber friction, tyre-road contact simulation, and evaluation and verification of tyre models. This special issue includes a small selection of papers presented in April 2015. The contributions are organised as follows.

The first paper by Michael Gipser [1] provides a clear and structured account of the potential of predictive capabilities of a tyre model by exploring five different operating scenarios such as running on very rough roads. The author demonstrates that physically consistent modelling allows instructive insights into complex tyre behaviour without the need of modelling every effect, while pointing out the limitations in terms of absolute accuracy due to the lack of detailed understanding of rubber/road friction. The second contribution by Yintao Wei et al. [2] further investigates the benefits of physically consistent modelling by studying and analysing the speed-dependency of steering torque characteristics. Using a validated detailed nonlinear finite-element model, the authors identify turn-slip-related kinematics as the main mechanism for the speed-dependent tyre steering torque. The important comfort-related aspects of driving noise and vibrations are discussed by Manfred Bäcker al. [3] by incorporating a structural tyre model into a frequency based simulation framework. The authors show that the approach correctly captures tyre behaviour for frequencies of up to 250 Hz resulting from geometric road excitations. The fourth paper by Antoine Schmeitz and Mohsen Alirezaei [4] also studies tyre vibrations, but with the view of extracting information on the tyre-road friction condition. In particular, the resonance peak in the wheel speed signal excited by road roughness is used to estimate changes in road friction. Results show that the proposed estimation technique is reasonably accurate. Friction is the main topic of the fifth contribution by Robin S. Sharp et al.
This study discusses the mechanics of rubber friction by revisiting the classical experiments of Grosch and comparing the measurements with friction coefficient predictions from Persson’s deformation theory. It is shown that there is value in the current rubber theory but considerable scope for further research on the mechanics of rubber friction exists. The sixth paper, written by Michal Maniowski [6], closes the special issue by highlighting the importance of tyres in relation to vehicle handling. The author explores the influence of temperature-sensitive tyre characteristics on vehicle behaviour and driving strategy by solving the multi-parametric optimisation problem of the minimum lap time at a race circuit.

All together, we hope that the reader will find this special issue as interesting as we do and the new insights and inputs will be useful for researchers and engineers working with tyres.

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References


