cosin
scientific software

Gipser + Hofmann, Ingenieure, Partnerschaft

Agnes-Pockels-Bogen 1
80992 München
GERMANY

info@cosin.eu
www.cosin.eu

FTire Parameterization

Proposed Measurement and Data Processing Procedures

Preface

Parameterization of *FTire*, as for all comparable physically based tire models, is not easy and clearly needs some experience.

On the other hand, *FTire* is able to pre-process different kinds of data in a very flexible way. By this, the parameterization process can be adapted to the kind of measurements that are available or that can be generated at affordable costs.

Three main tools are available to assist in parameterization:

- *FTire/calc* calculates most of the tire structural data used by *FTire*, on basis of tire design data as they are typical for an FE model;
- *FTire/fit* identifies most of *FTire* data on basis of static and steady-state measurements, as well as dynamic cleat tests. Measurements proposed in the next chapter are meant to be processed by *FTire/fit*;
- *FTire/estim* estimates *FTire* data by comparing its dimension with a similar, well known reference tire, and applying customizable arithmetic estimation formulae. *FTire/estim* is contained both in *FTire/fit* and *FTire/tools*.

For more information on how to get and apply these tools, please contact info@cosin.eu, and visit cosin.eu.

Standardized Measurement Procedure

This proposal is primarily meant for passenger car tires. For other types of tires, the measuring conditions have to be adapted accordingly.

The standardized TYDEX file format is proposed for measurement ids 11 to 23. Data resulting from this procedure should be processed with the aid of *FTire/fit*. Measurement ids 10 to 23 are to be repeated for two different inflation pressure values, if variation of inflation pressure is intended during the model application.

All proposed measurements are designed to be potentially replaced by simulation results with an advanced FE model.

General Data Id / Type	Description	Measurement Procedure	Result Data	Remarks
1 DIMENSION	tire and rim dimension (ECE-R 30), including load index, speed symbol, and rim width			example: 195 65 15 91 H 6.5
2 MANUFACTURER	manufacturer, type			
3 PRESSURE	inflation pressure(s) applied during measurements			

Measurement Id / Type	Description	Measurement Procedure	Result Data	Remarks
4 MASS	tire mass without rim			
5 OUTER_CONTOUR	tire's cross section outer contour in inflated but unloaded condition, for first inflation pressure		x/y data pairs (distance less than 10 mm) or drawing to be digitized	need not resolve grooves or ribs
6 TREAD_THICKNESS	tread (including cap base) thickness vs. lateral belt co-ordinate		x/y data pairs (distance less than 10 mm) or drawing to be digitized	need not resolve grooves or ribs. Alternatively, a detailed crosssection drawing in inflated but unloaded condition can be used, which include belt and carcass layers
7 RMAX	inflated maximum radius	measure circumference of inflated tire		

Measurement Id / Type	Description	Measurement Procedure	Result Data	Remarks
8 RDYN	dynamic rolling circumference	tire rolling in drum at half LI load v = 3 Km/h .. 100 Km/h (slowly accelerated) zero slip, zero camber	.tdx-file. Channels: drum speed drum revolution angle tire revolution angle	
9 SHORE_A	Shore A stiffness (or Young's modulus)	standard Shore test		[Shore A] or [MPa]; only required if measurement id 20 (traction) is not available
10 FOOTPRINT	footprint	gray-scale footprint at: half LI load, zero camber LI load, zero camber half LI load, 6 deg camber LI load, 6 deg camber	4 bitmap files. If not in original size, bitmaps must contain a horizontal or vertical line of known length (preferably 100 mm)	
11 CVERT	vertical stiffness on flat surface	release brake. Slowly move tire downward against a flat surface. Find first contact = zero deflection.	.tdx-file. Channels: tire deflection Fz	
12 CVERT_CLEAT	vertical stiffness ona transversal cleat cleat height and width comparable in size to tire deflection at half LI load	release brake. Slowly move tire downward against the cleat. Find first contact = zero deflection.	.tdx-file. Channels: vertical tire deflection Fz	
13 CVERT_LONG_CLEAT	vertical stiffness on a longitudinal cleat cleat height and width comparable in size to tire deflection at half LI load	release brake. Slowly move tire downward against the cleat. Find first contact = zero deflection.	.tdx-file. Channels: vertical tire deflection Fz	
14 CVERT_CAMBER	vertical stiffness on flat surface 6 deg camber angle	release brake. Slowly move cambered tire downward against a flat surface. Find first contact = zero deflection.	.tdx-file. Channels: vertical tire deflection Fz	

Measurement Id / Type	Description	Measurement Procedure	Result Data	Remarks
15 CVERT_CLEAT_CAMBER	vertical stiffness on a transversal cleat height and width comparable in size to tire deflection at half LI load 6 deg camber angle	release brake. Slowly move cambered tire downward against the cleat. Find first contact = zero deflection.	.tdx-file. Channels: vertical tire deflection Fz	
16 CLAT	lateral stiffness on flat surface	release brake. Slowly move tire downward against a flat high friction surface until it reaches half LI load. Slowly move tire in lateral direction (at least twice the vertical displacement)	.tdx-file Channels: vertical deflection lateral tire displacement Fy Fz Mx Mz	
17 CLONG	longitudinal stiffness on flat surface	release brake. Slowly move tire downward against a flat high friction surface until it reaches half LI load deflection. Lock brake. Slowly move tire forward (at least twice the vertical displacement)	.tdx-file. Channels: vertical deflection longitudinal displacement Fx Fz My	
18 CTORS	torsional stiffness on flat surface	release brake. Slowly move tire downward against a flat high friction surface until it reaches half LI load. Slowly turn tire at least 6 deg about vertical axis in contact patch center.	.tdx-file. Channels: vertical deflection toe angle Fy Fz Mx Mz	

Measurement Id / Type	Description	Measurement Procedure	Result Data	Remarks
19 CVERT_DYN	vertical stiffness on/in drum, at 0, 50, 100 Km/h drum speed	for standing (brakes released) or free rolling tire on/in drum, apply sinusoidal tire deflection (1Hz, 0..30 mm, 5 cycles)	3 .tdx-files. Channels: vertical deflection Fx Fz My	
20 TRACTION	longitudinal force characteristic	for free rolling tire on/in drum (v = 50 Km/h), slowly increase brake torque until wheel is completely locked. Camber angle 0 deg, half LI load	.tdx-file. Channels: long. slip wheel deflection camber angle Fx Fz My	combinations of wheel load, drum speed, camber angle etc. might be different as stated, but should cover the operating conditions of interest
21 HANDLING	side force characteristics	for free rolling tire on/in drum (v = 50 Km/h), slowly sweep slip angle between +/-15 deg. Camber angle 0 and 6 deg, half LI load	2 .tdx-files. Channels: slip angle wheel deflection camber angle Fx Fy Fz Mx My Mz	see measurement 20
22 CLEAT	rolling on/in drum over a transversal cleat, at 30, 60, 90 (if possible) Km/h drum speed, cleat height and width comparable in size to tire deflection at half LI load	for free rolling tire on/in drum, run over cleat, at half and full LI wheel load	6 .tdx-files. Channels: vertical deflection Fx Fz My	see measurement 20
23 CLEAT_OBLIQUE	rolling on/in drum over a 45 deg obliquely oriented cleat, at 30, 60, 90 (if possible) Km/h drum speed, cleat height and width comparable in size to tire deflection at half LI load	for free rolling tire on/in drum, run over cleat, at half and full LI wheel load	6 .tdx-files. Channels: vertical deflection Fx Fy Fz Mx My Mz	see measurement 20