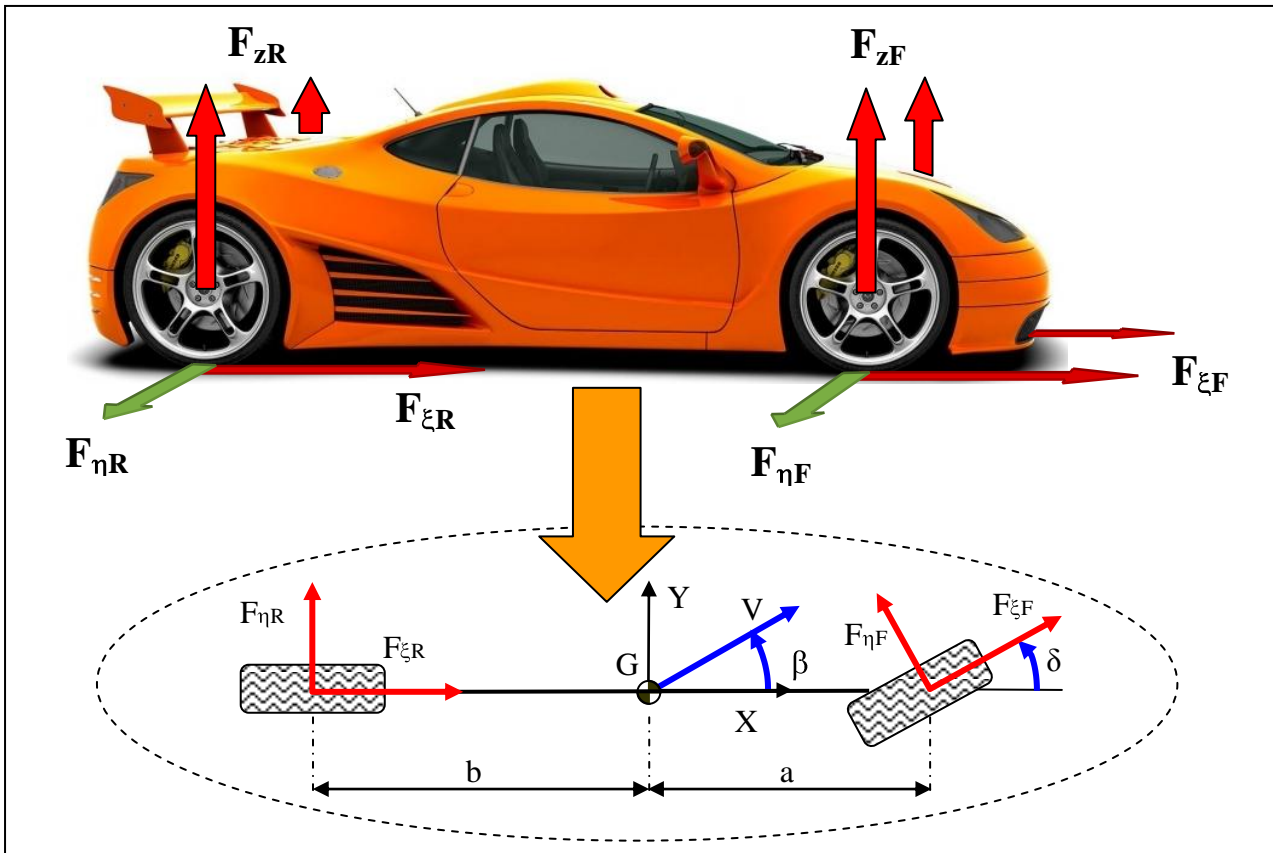


CARPET

A PROGRAM FOR EVALUATING THE
AUTOMOTIVE TYRE BEHAVIOUR BY
REVERSE DYNAMICS



OVERVIEW

CARPET is an application software developed with MATLAB/SIMULINK® for evaluating the automotive tyre dynamic behaviour. In particular **CARPET** simulates vehicle reverse dynamics starting from the experimental time history of cinematic variables acquired from road tests and performing the calculation of the vehicle dynamic behaviour together with other cinematic relevant terms. Furthermore the program is endowed with several toolboxes to analyse, post-process and save the simulation results.

PROGRAM DESCRIPTION

CARPET runs under the MathWorks MATLAB/SIMULINK® environment: a very powerful, qualified mathematical solver and systems simulation tool. The **CARPET** program includes user-friendly graphic interface based on buttons and menu driven commands, which only require knowledge of basic pc use.

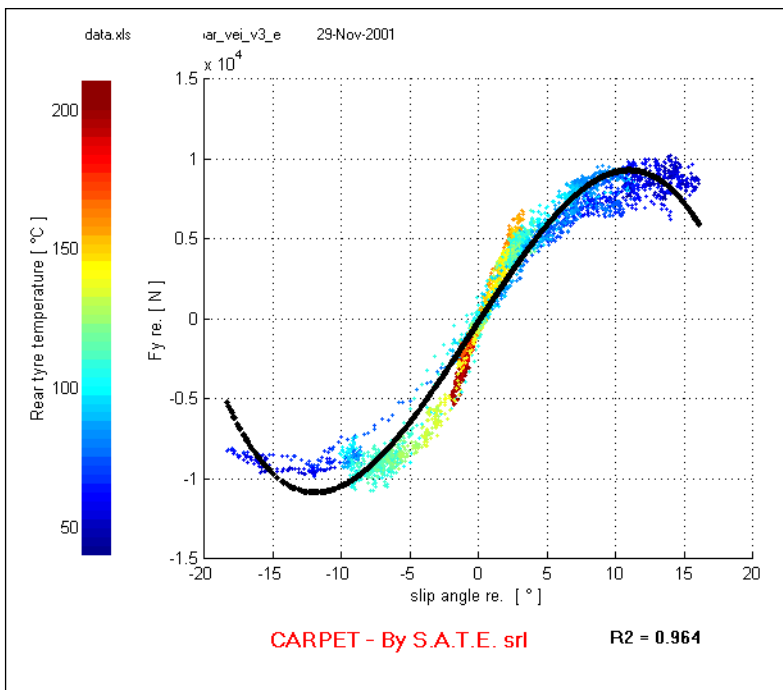
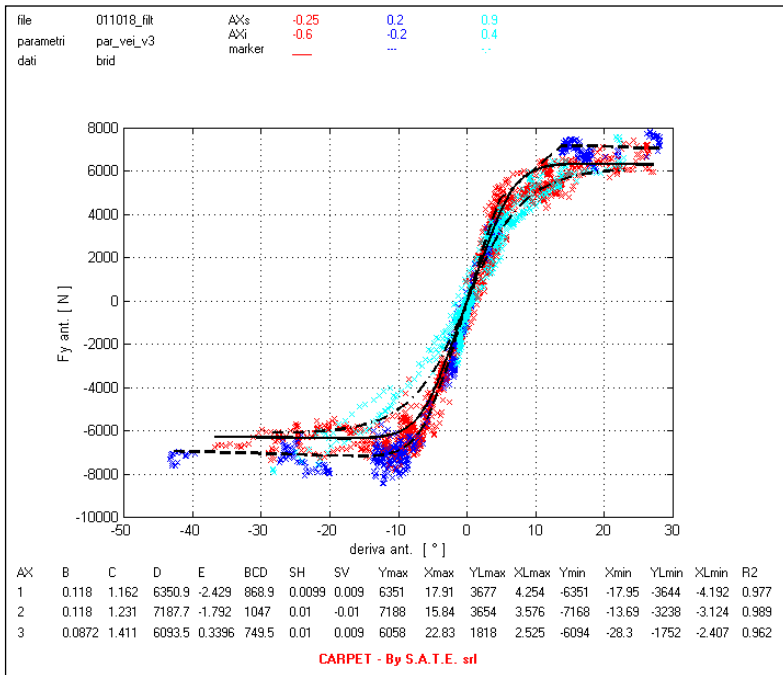
In order to perform the simulation, the program requires an input data file containing the experimental time history of the following variables: time, body slip angle, steer angle, velocity, longitudinal acceleration and lateral acceleration. Other variables as yaw velocity, tyres temperature and front

and rear axle velocity, should they be available, can be added to the input data file to improve the simulation accuracy and visualize additional results. If required, input data file can be filtered with a low-pass filter before running the simulation.

The vehicle reverse dynamics is simulated solving the system of linear equations of the so called bicycle model, a simple but effective 2 degrees of freedom model that allows calculating the forces acting on vehicle as a function of the motion variables. Simulation results can be visualized in terms of several diagrams listed below:

- lateral force – slip angle (carpet diagram)
- lateral acceleration – slip angle
- slip angle – lateral acceleration
- longitudinal force – slip ratio
- longitudinal acceleration – slip ratio
- steer angle – lateral acceleration
- body slip angle – lateral acceleration
- $\frac{dV_y}{dt} + V_x \cdot \omega$ - lateral acceleration

Each diagram can be either represented simply in terms of points set, and either in terms of fitting curve.



Two kinds of fitting curve are available: polynomial curves and Pacejka's Magic Formulae; these latter are identified by solving a non linear least-squares problem that requires the use of the Matlab Optimization Toolbox®.

PROCEDURES OUTLINE

The user defines the vehicle parameters in easily editable and preformatted MS Excel® files; also the acquired time history to be loaded is an Excel® file; all of them can be stored to create a library of parameters and data sets that may be recalled for further simulations.

After having performed the simulation, several data post-processing tools can be used: manual or statistical filtering, resampling according to longitudinal acceleration ranges, normalization and Magic Formula identification through parameters optimisation. Numerical results can be stored in Matlab files and can be also written in already formatted MS Excel® files for further easy handling.

SIMULATION SERVICES

CARPET is also used as a tool for engineering services that S.A.T.E. provides customers not wishing to enter the functions and details of the program. In this case the results of the simulations are produced as reports, together with comments and guidelines for system modifications.

SOFTWARE LICENCE

CARPET can be licensed on a non-exclusive basis together with the library of configurations. Special confidentiality agreements can be set up for clients' proprietary configurations, leaving however S.A.T.E. the sole proprietary of the software tools.

S.A.T.E. Systems and Advanced Technologies Engineering S.r.l.

Santa Croce 664/a, 30135 VENICE (ITALY)

Tel.: +39 041-2757634

fax: +39 041 – 2757633

Email: info@sate-italy.com

www.sate-italy.com