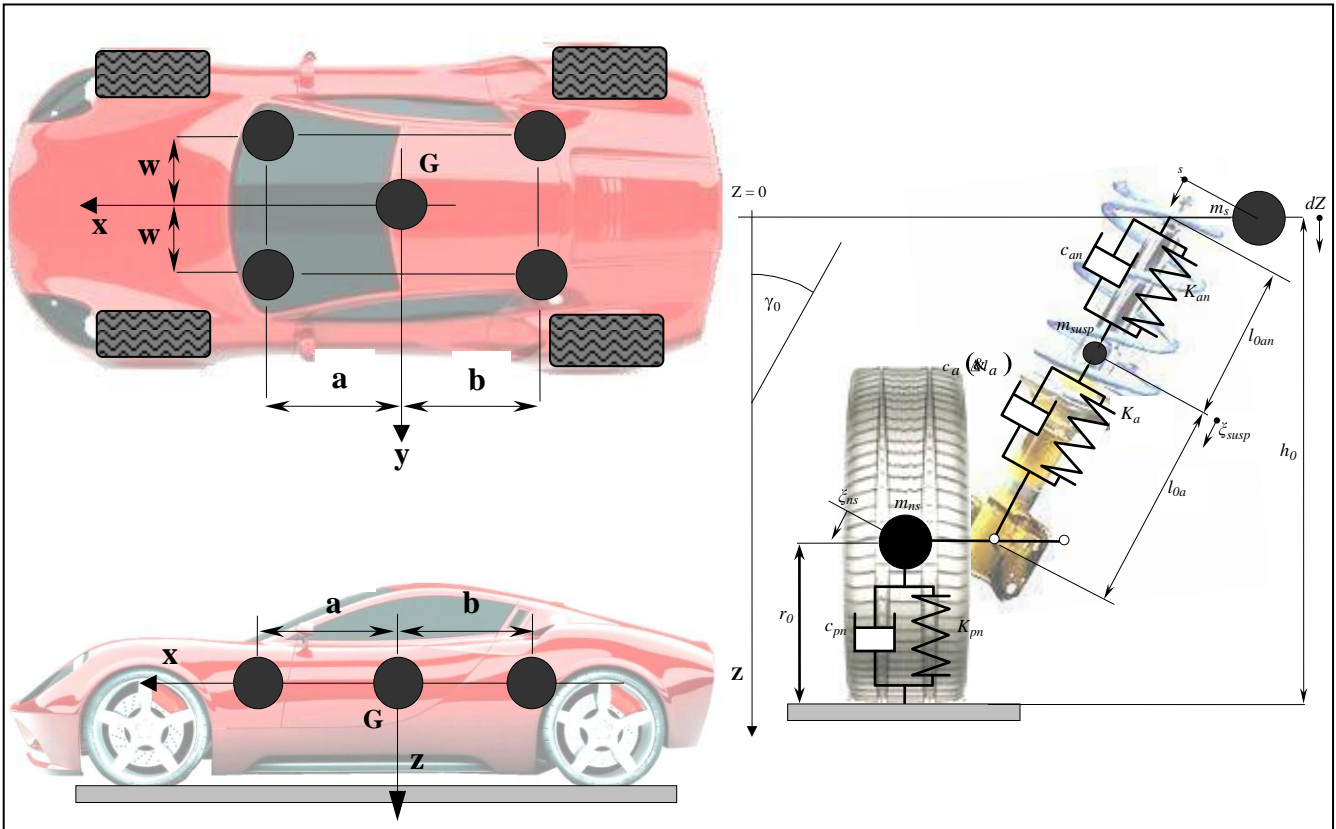


BENCH

A PROGRAM FOR THE SIMULATION OF CAR SUSPENSION TEST BENCHES



OVERVIEW

BENCH, developed using MATLAB® and Simulink®, simulates the vehicle and suspensions dynamics during tests on the shock absorber test bench. Coupled dynamics of sprung and unsprung masses is simulated. Chassis torsional and bending stiffness and damping are taken into account. Shock absorbers can have a non-linear damping behaviour that, for semi-active suspensions, can be changed through the absorbers' input signal. Each absorber can have different characteristics; it is therefore possible to introduce differences due to production tolerances and detect out of tolerance components comparing numerical and experimental results. The imposed motion of the bench plates can be directly imported from the experimental data and the results can be compared with the measured ones.

PROGRAM DESCRIPTION

BENCH runs under TheMathWorks' MATLAB/Simulink® environment: a very powerful, qualified mathematical solver and systems

simulation tool. The **BENCH** program includes user-friendly graphic interface based on buttons and menu driven commands, which only require knowledge of basic PC use.

Dynamic simulation of the vehicle on the test bench is performed by the simulation of the interconnected mass subsystems representing the vehicle chassis (five equal masses, one placed on the vehicle centre of gravity), the wheels (four equal masses) and shock absorbers (four different masses).

The main features of the program are:

- Calculation of position of sprung and unsprung masses;
- Calculation of velocity of sprung and unsprung masses;
- Calculation of acceleration of sprung and unsprung masses;
- Calculation of forces acting on sprung and unsprung masses;
- Calculation of bending and torsional velocity deformation of the frame;
- Calculation of frame roll, pitch and yaw velocities;
- Comparison with experimental data.

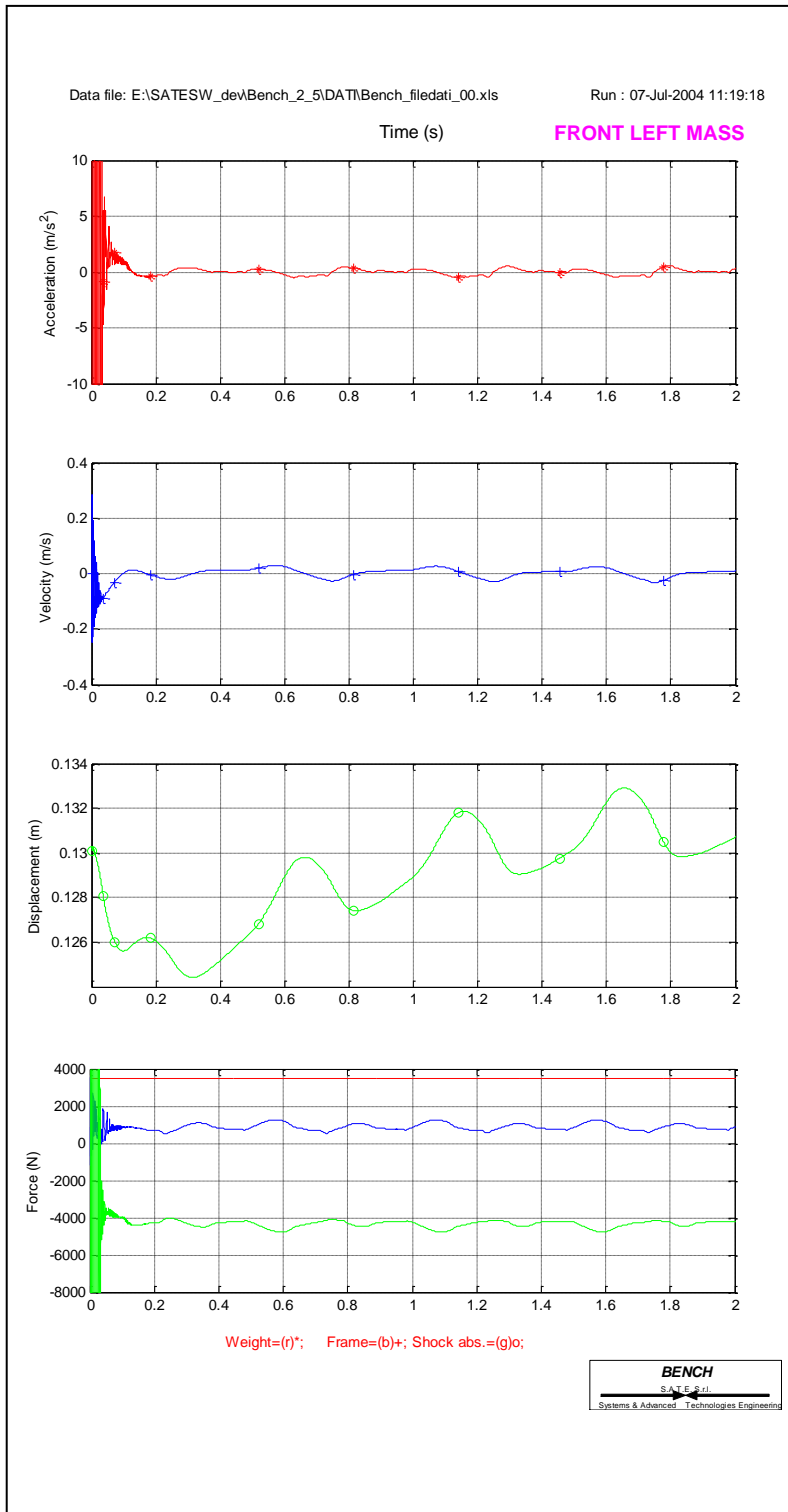
PROCEDURES OUTLINE

The user defines the parameters of the simulation in easily editable and pre-formatted MS Excel® files, which can be stored to create a library of data sets that may be recalled for further simulations. Data include relevant dimensions, test bench actuators input, kinematic and dynamic features of the vehicle, suspension and tyres and initial conditions. The imposed motion of the test bench plates can be defined as sinusoidal functions or can be imported from files with real recorded data.

Results of the simulation, illustrated as time histories of the calculated variables, are displayed in a variety of output plots that can be printed or exported to other environments. Numerical results can also be written in files compatible and already formatted for easy handling by spreadsheets such as MS Excel®. Should experimental data be available, it is also possible to compare them with the results of the simulation by displaying the two sets in the same plot.

SIMULATION SERVICES

BENCH 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 **BENCH**. Although the Client is not required to know details of MATLAB/Simulink® programming. In this case the results of the simulations are produced as reports, together with comments and guidelines for system modifications.



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