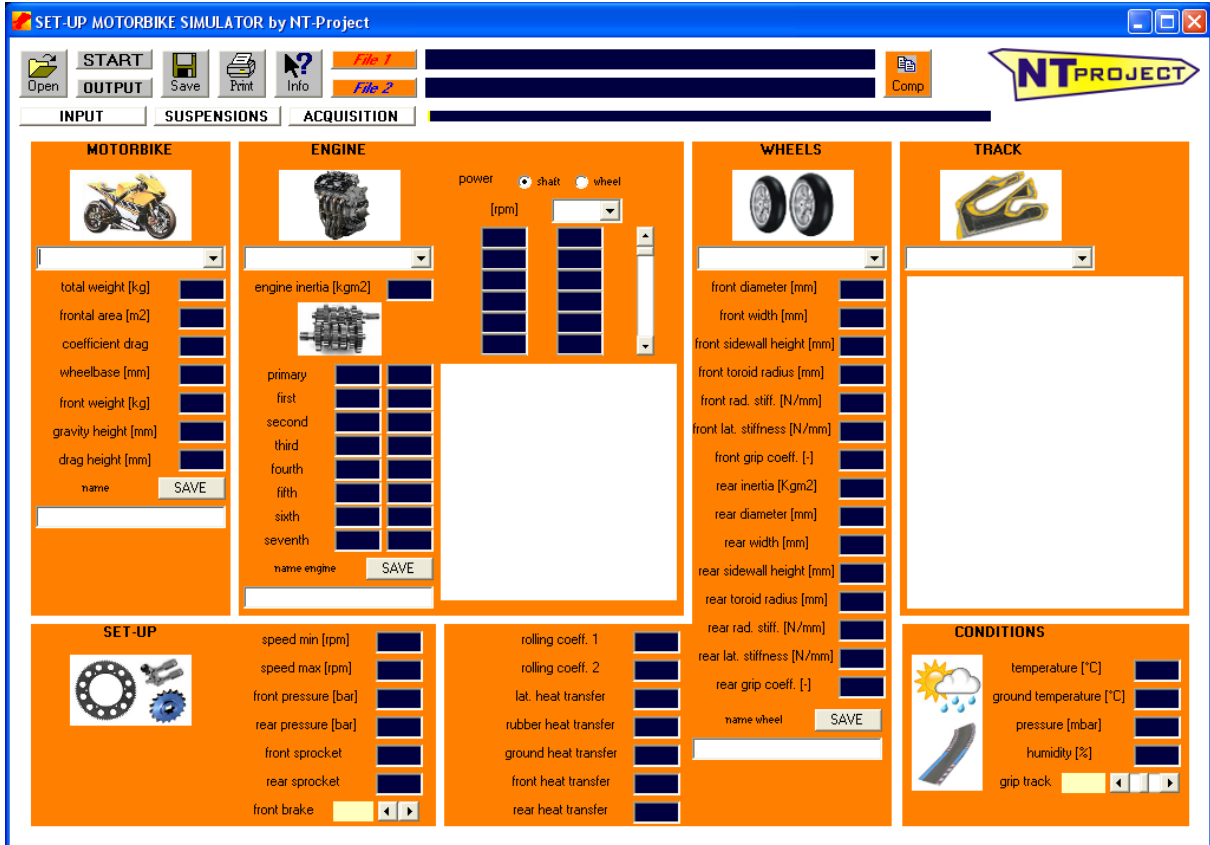


## SOFTWARE SET-UP MOTORBIKE SIMULATOR

When opening the software appears this screenshot:



**SET-UP MOTORBIKE SIMULATOR by NT-Project**

Open START OUTPUT Save Print Info File 1 File 2 Comp

**INPUT** SUSPENSIONS ACQUISITION

**MOTORBIKE**

total weight [kg] [ ]  
frontal area [m2] [ ]  
coefficient drag [ ]  
wheelbase [mm] [ ]  
front weight [kg] [ ]  
gravity height [mm] [ ]  
drag height [mm] [ ]  
name [ ] SAVE

**ENGINE**

power ☐ shaft ☐ wheel  
[rpm] [ ]  
engine inertia [kgm2] [ ]  
primary [ ] [ ]  
first [ ] [ ]  
second [ ] [ ]  
third [ ] [ ]  
fourth [ ] [ ]  
fifth [ ] [ ]  
sixth [ ] [ ]  
seventh [ ] [ ]  
name engine [ ] SAVE

**WHEELS**

front diameter [mm] [ ]  
front width [mm] [ ]  
front sidewall height [mm] [ ]  
front toroid radius [mm] [ ]  
front rad. stiff. [N/mm] [ ]  
front lat. stiffness [N/mm] [ ]  
front grip coeff. [-] [ ]  
rear inertia [kgm2] [ ]  
rear diameter [mm] [ ]  
rear width [mm] [ ]  
rear sidewall height [mm] [ ]  
rear toroid radius [mm] [ ]  
rear rad. stiff. [N/mm] [ ]  
rear lat. stiffness [N/mm] [ ]  
rear grip coeff. [-] [ ]  
name wheel [ ] SAVE

**TRACK**

**SET-UP**

speed min [rpm] [ ]  
speed max [rpm] [ ]  
front pressure [bar] [ ]  
rear pressure [bar] [ ]  
front sprocket [ ] [ ]  
rear sprocket [ ] [ ]  
front brake [ ] [ ]

rolling coeff. 1 [ ]  
rolling coeff. 2 [ ]  
lat. heat transfer [ ]  
rubber heat transfer [ ]  
ground heat transfer [ ]  
front heat transfer [ ]  
rear heat transfer [ ]

**CONDITIONS**

temperature [°C] [ ]  
ground temperature [°C] [ ]  
pressure [mbar] [ ]  
humidity [%] [ ]  
grip track [ ] [ ]

This screen already identified one of the three data entry tabs, in the specific case of that relating to INPUT.

The other tabs are accessed from the buttons following.

**SUSPENSIONS**

**ACQUISITION**

Now let's see in detail the data to be placed on each tab, starting from that of INPUT and appearing at the opening.

## INPUT data entry

To work the software needs the informations about:

MOTORBIKE  
ENGINE  
WHEELS  
SET-UP  
CONDITIONS

### MOTORBIKE

The data that is necessary enter are:



- total weight [kg]
- frontal area [mm<sup>2</sup>]
- coefficient drag
- wheelbase [mm]
- drag height [mm]

For frontal area, coefficient drag, and drag height, if you don't know the specific values, we advice adequate values in function of the features of your motorbike.

In addition at these data you must enter the gravity center of the motorbike.

For the horizontal balance, you must simply to weigh the front of the motorbike with the driver on board. You need a scale, where you put only the front wheel:

- front weight [kg]

For the determination of the gravity height, you can use the web-app [http://www.ntproject.com/calculation\\_gravity\\_bike.php](http://www.ntproject.com/calculation_gravity_bike.php) and add at the value calculated "height gravity" the tire radius.

- gravity height [mm]

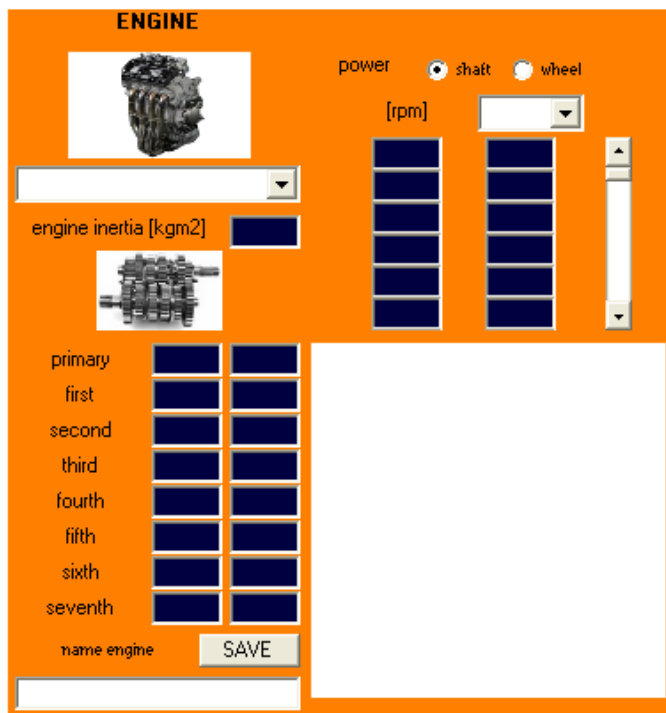
Together with the web-app we can advised others methods of formulas to obtain experimentally the height.

After that you've entered these data, in the software there is the possibility to save the data in the list, so you can recall the different motorbike that you've easily.

You must simply enter a new name in the white box below the data, and click the button SAVE.



## ENGINE



It's necessary to enter the gears of the transmission primary, and of the gearbox, for your engine. If there isn't the gearbox, you can leave empty the fields.

An other data that can increase the precision of the calculation, is the value of

- engine inertia [kgm2] → the value refers to the inertia of the crankshaft and of the accessories mounted on it (for example ignition, clutch, flywheel, etc.);

This value isn't easy to find anyway this data not change the results significantly.

In addition to the gears data, it's necessary to enter the power curve of the engine. You must indicate if the power is measured at the crankshaft, or at the wheel, and select the unit of the power that you enter.

Also in this case is possible to save the new data in the list, entering the name of the new engine and clicking SAVE

## WHEELS

<input type="text"/>		rear inertia [Kgm2]	<input type="text"/>
front diameter [mm]	<input type="text"/>	rear diameter [mm]	<input type="text"/>
front width [mm]	<input type="text"/>	rear width [mm]	<input type="text"/>
front sidewall height [mm]	<input type="text"/>	rear sidewall height [mm]	<input type="text"/>
front toroid radius [mm]	<input type="text"/>	rear toroid radius [mm]	<input type="text"/>
front rad. stiff. [N/mm]	<input type="text"/>	rear rad. stiff. [N/mm]	<input type="text"/>
front lat. stiffness [N/mm]	<input type="text"/>	rear lat. stiffness [N/mm]	<input type="text"/>
front grip coeff. [-]	<input type="text"/>	rear grip coeff. [-]	<input type="text"/>

It's necessary to enter the dimensions of front and rear tyres.

- diameter [mm]
- width [mm]
- sidewall height [mm]
- toroid radius [mm]

In addition, if you know it, enter also:

- rear wheel inertia [kgm2]

Together with the tires dimension you must enter the structural and compound features:

- radial stiffness [N/mm]
- lateral stiffness [N/mm]
- grip coefficient

Also in this case is possible to save the new data in the list, entering the name of the new wheel and clicking SAVE

In addition with these data, there also important data necessary to characterize the tyres:

rolling coeff. 1	<input type="text"/>
rolling coeff. 2	<input type="text"/>
lat. heat transfer	<input type="text"/>
rubber heat transfer	<input type="text"/>
ground heat transfer	<input type="text"/>
front heat transfer	<input type="text"/>
rear heat transfer	<input type="text"/>

- rolling coefficient 1
- rolling coefficient 2

$$F_{\text{rolling}} = \text{load}[\text{N}] * (\text{res\_rot1} + \text{res\_rot2} * \text{speed}^2)$$

- lat. heat transfer [-]
- rubber heat transfer [-]
- ground heat transfer [-]
- front heat transfer [-]
- rear heat transfer [-]

For these coefficients are already entered default values, and anyway we can advice how modify them in function of the specific needs.

## SET-UP & CONDITIONS



Together with the data of motorbike, engine, and wheels, you must enter the informations about the motorbike setup:

- minimum and maximum speed of the engine → you must enter the operation range that you want for the engine in the simulation;
- front pressure [bar]
- rear pressure [bar]
- front sprocket [-] → enter the number of teeth of the front sprocket;
- rear sprocket [-] → enter the number of teeth of the rear

speed min [rpm]	<input type="text"/>
speed max [rpm]	<input type="text"/>
front pressure [bar]	<input type="text"/>
rear pressure [bar]	<input type="text"/>
front sprocket	<input type="text"/>
rear sprocket	<input type="text"/>
front brake	<input type="text"/>

<b>CONDITIONS</b>	
	temperature [°C] <input type="text"/>
	ground temperature [°C] <input type="text"/>
	pressure [mbar] <input type="text"/>
	humidity [%] <input type="text"/>
	grip track <input type="text"/>

- sprocket;
- front brake → move the bar to identify the percentage of front braking respect the total (this value depends from the driving style of your rider, and how it use the rear brake), 100% identify that the rider use only the front brake.

To see the increase of the tyres temperature in the actual conditions, in the software is possible to enter the air temperature (default 20°C), and the ground temperature (default 25°C). Moreover is possible to enter the air and humidity pressure, so the software can correct the power at the real condition. It's possible also modify the grip level to take account of the track conditions respect to the default value of the grip coefficient entered in the tires features.

## SUSPENSIONS data entry

Clicking on the button SUSPENSIONS you go on the tab to entry the chassis and suspensions data.

The screenshot shows the 'SET-UP MOTORBIKE SIMULATOR by NT-Project' window. The 'SUSPENSIONS' tab is active, displaying three main sections: GRAVITY, CHASSIS GEOMETRY, and FRONT/REAR SUSPENSION.

**GRAVITY**

- Motorcycle Weight [Kg]
- Rider Weight [Kg]
- Wheelbase [mm]

**CHASSIS GEOMETRY**

Diagram of a motorcycle chassis with points 9, 10, L, and M marked. Below the diagram are input fields for:

- x [mm]  y [mm]
- 9  10
- 8
- L  M
- Pitch Chain [mm]
- Pitch Inertia [Kg·m²]

**FRONT SUSPENSION**

- Fork Length [mm]  Front Wheel Mass [Kg]
- Min Fork Length [mm]  Damping Comp [Ns/m]
- Fork Preload [mm]  Damping Ext [Ns/m]
- Fork Stiffness [N/mm]

**REAR SUSPENSION**

Type  x [mm]  y [mm]

[mm] 4  6

A   
B   
C   
D   
E   
F   
G   
H   
I

Shock Length [mm]  Rear Wheel Mass [Kg]   
Min Shock Length [mm]  Damping Comp [Ns/m]   
Shock Preload [mm]  Damping Ext [Ns/m]   
Shock Stiffness [N/mm]

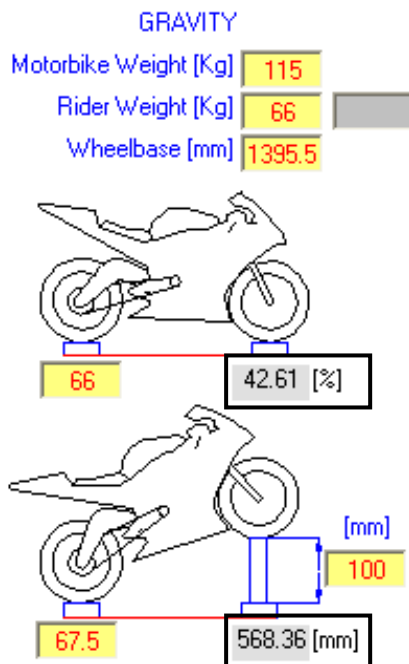
The first area of the software is to calculate the position of the center of gravity of the motorbike, without and with the rider, from a simple experimental test.

For first you must enter:

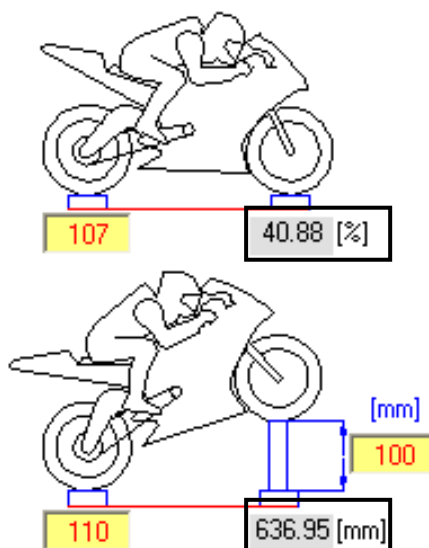
- Motorbike Weight [Kg]
- Rider Weight [Kg]
- Wheelbase [mm]

At this point you must weight the rear of the motorbike, before with the motorbike horizontal on the ground, and after lifting the front of the motorbike of at least 100 mm.

Entering this data the software automatically calculates the percentage of load that you've on the front, and gravity height of the motorbike.

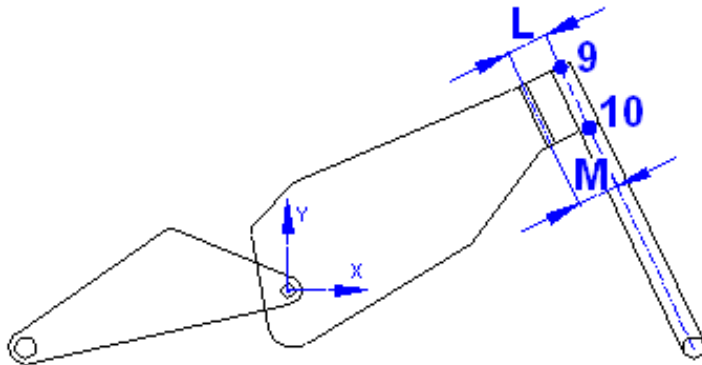


The same if you repeat the measure with the rider on board



The second area of the software is to calculate the geometry of the motorbike.

#### CHASSIS GEOMETRY



The first data that you must enter are the positions of point 9 and 10 (are the points on the fork axle of the upper plate, and of the lower plate).

You must enter the cartesian coordinates (horizontal X, and vertical Y) respect the pivot of the rear arm (take account also of the direction of axes of reference system, point above the pivot has a positive value for Y coordinate, and point at the right of the pivot has a positive value for X coordinate, viceversa put the sign before the number).

Moreover you must enter the distance from the point 9 of the steering axle on the upper plate, and from the point 10 of the steering axle on the lower plate.

In addition you must enter:

- Pitch Chain [mm]
- Pitch Inertia [Kgm<sup>2</sup>] → is the value of the pitch motorbike inertia, if you don't know precisely this value, is possible to leave the field empty because the software calculate automatically an estimate value from the weight and the dimensions of the motorbike;

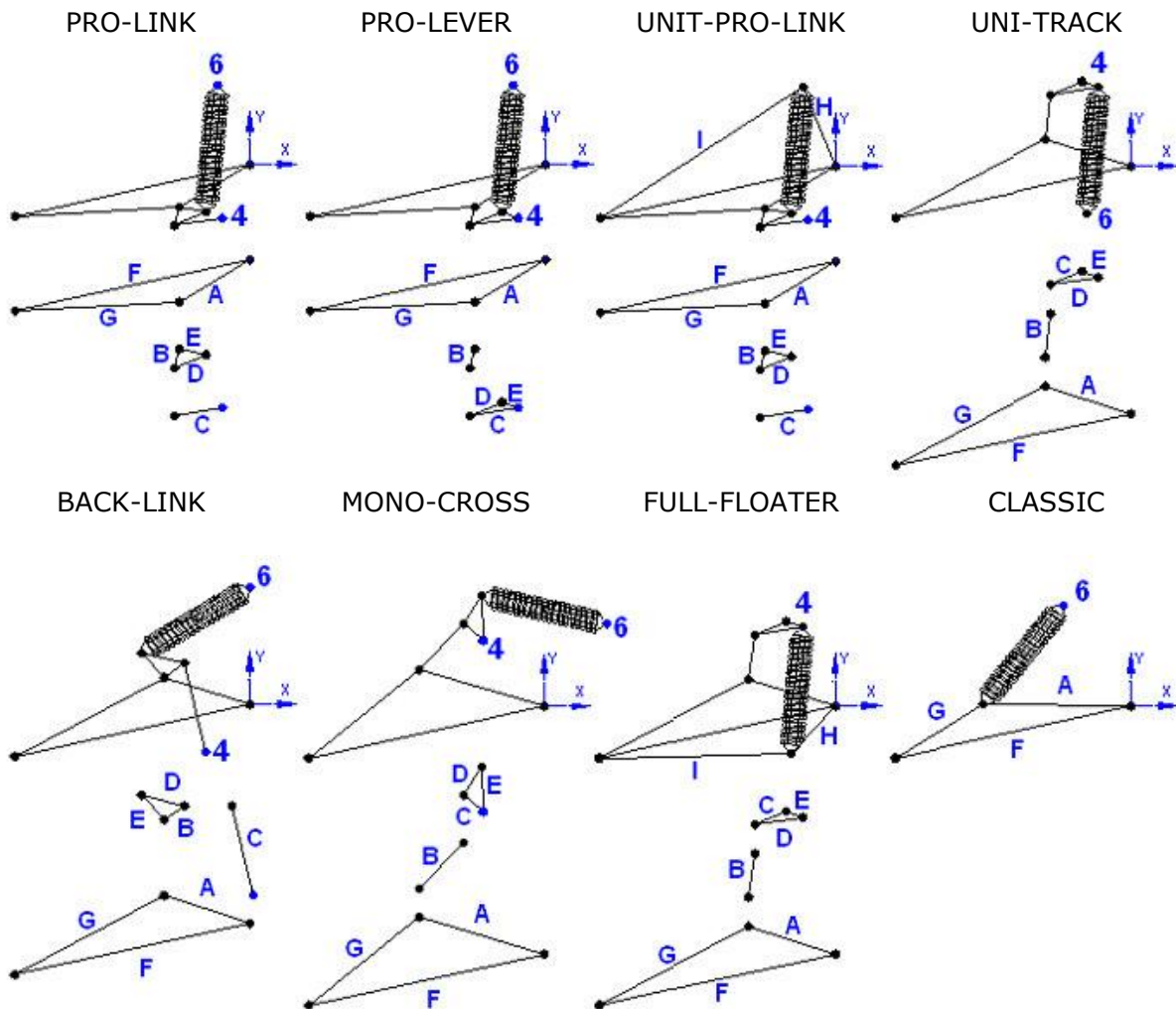
At this point you must enter the features of the suspensions:

#### FRONT SUSPENSION

- Fork Length [mm]
- Fork preload [mm]
- Fork stiffness [N/mm]

## REAR SUSPENSION

For first you must select the type of rear suspension that you've on your motorbike:



Therefore you must enter the position, of the point where shock absorber is linked at the chassis (point 6), and of the point where the other element of the suspension is linked at the chassis (point 4).

You must enter the cartesian coordinates (horizontal X, and vertical Y) respect the pivot of the rear arm (take account also of the direction of axes of reference system, point above the pivot has a positive value for Y coordinate, and point at the right of the pivot has a positive value for X coordinate, viceversa put the sign before the number).

Ending you must enter the dimensions of the length of each elements of the rear suspension as indicated on the figure (letters from A to H in function of the type of suspension).

In addition you must enter the features of the shock absorber:

- Shock Length [mm]
- Shock preload [mm]
- Shock stiffness [N/mm]



For classic type of rear suspension enter the values for a single shock absorber, the software take already account that for this scheme are two.

## ACQUISITION data entry

Clicking on the button ACQUISITION you go on the tab to entry the file acquired from your acquisition system that you want analyze.

The screenshot displays the 'SET-UP MOTORBIKE SIMULATOR by NT-Project' window. The 'ACQUISITION' tab is selected, showing options for importing data files and configuring simulation settings.

**Top Bar:** Includes icons for Open, START, OUTPUT, Save, Print, Info, File 1, File 2, and Comp. The NT-PROJECT logo is on the right.

**Navigation Tabs:** INPUT, SUSPENSIONS, ACQUISITION (selected).

**Left Panel:**

- RUN CONDITIONS:** Includes icons for weather and a track. Fields for pressure [mbar], temperature [°C], humidity [%], and track grip.
- RESULTS OPTIONS:** Includes a graph icon. Fields for minimum rpm, maximum rpm, and filtering.

**Center Panel:**

- DATA ACQUISITION:** Features an icon of a laptop and a data logger. A section titled 'IMPORT ACQUISITION DATA FILE' includes a 'data filter' dropdown and a list of parameters (space, time, speed, engine speed, acc\_lat, acc\_lon, slope, lean\_angle, track\_angle, temp\_exhaust, lambda) with checkboxes for selection. A 'keep selected labels' checkbox is at the bottom.
- lap time [s]:** A table with 10 rows and 2 columns of checkboxes.

**Right Panel:**

- CALCULATION SETTING:** Includes radio buttons for 'PERFORMANCE SIMULATION' (selected) and 'USE ACQUIRED DATA'. Checkboxes for 'dynamic calculation' and 'suspensions calculation' are present for both.
- CALCULATIONS FOR SIMULATION:** Includes checkboxes for 'power calculation', 'save power with name', 'track calculation', 'save track with name', 'tires calculation', 'save tires with name', and 'save acquired data'. A 'RUN' button is located to the right of these options.

## IMPORT DATA ACQUISITION FILE

For first by your acquisition data software, you must open the run that you want to analyze, and export it to a file in \* .csv format, at this point on this screen of the software by clicking the "IMPORT FILE DATA ACQUISITION" button you can load the file \* .csv that you've exported.


The software recognizes automatically your acquisition system, and if you've the default name for the channels necessary to make the analysis, you'll see the corresponding squares of color green, if instead you've different names for some channels, you'll have the square red, in this case from the list beside, you must simply select the right name of your channel for the specific quantity.

If you want keep the channel name selected you must simply check the box (keep selected labels)

In this area you can also select the laps that you want use to calculate the power curve (we advice to check five, six laps with the best laps), and the lap to calculate the trajectory (we advice to select the best lap).

For the calculation of the power curve is necessary that you've entered the data of your MOTORBIKE, ENGINE (gears of the transmission primary, and of the gearbox, and engine inertia if you know), and WHEELS, in the INPUT tab.

**RUN CONDITIONS**



pressure [mbar]

temperature [°C]


humidity [%]

track grip

◀   ▶

---

**RESULTS OPTIONS**



minimum rpm

maximum rpm

filtering

◀   ▶

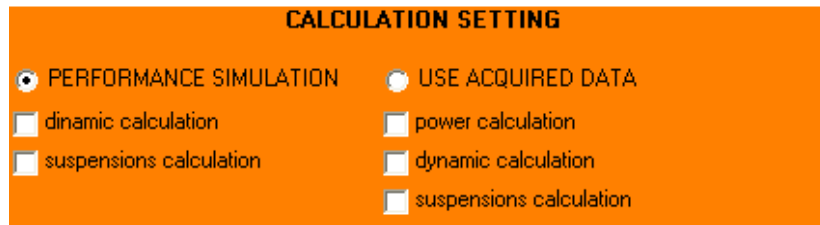
Moreover to have the maximum precision in the calculation of the power curve in the ACQUISITION tab you can enter the weather and the level of the grip, of the file session that you are using.

If you see that the power curve calculated take account also rpm out of the range of normal utilization of the engine, you can restrict the calculation entering the minimum and the maximum rpm that you want for the power curve.

If you see that the power calculated is far away from the engine performance that you expect, you can try to move the option filtering. Probably your acquisition not work perfectly, and you need to increase the filtering.

In the help of the software there are the instructions to export the file CSV from the specific acquisition software (for example Race Studio Analysis 2 for AIM, Analyzer for 2D, I2 for Motec, etc.)

## CALCULATION SETTING and CALCULATION FOR SIMULATION



**CALCULATION SETTING**

☒ PERFORMANCE SIMULATION    ☐ USE ACQUIRED DATA

☒ dynamic calculation    ☐ power calculation

☒ suspensions calculation    ☐ dynamic calculation

☐ suspensions calculation

At this point is possible to select which calculations to perform when you click the button START to have the results.

The software allows to work in two modality, the first is the SIMULATION, and the second the ANALYSIS of the acquired data.



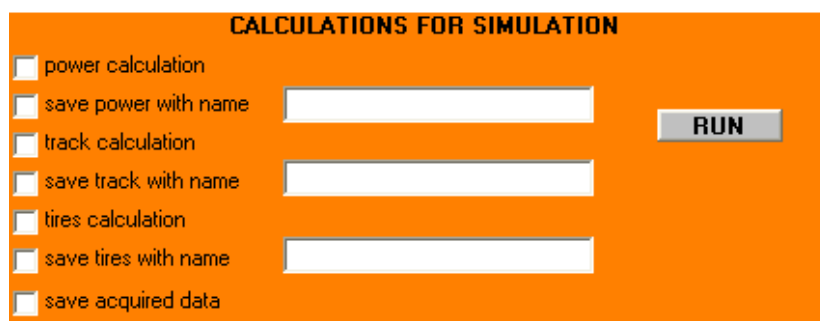
☒ PERFORMANCE SIMULATION    ☐ USE ACQUIRED DATA

In the simulation the software calculates the performance that the features of the motorbike, the engine, and the tires, allow to obtain on the track (track line) selected.

In addition to the simulation of the performance is possible to perform the dynamic calculation, and to calculate the behavior of the suspensions.

Instead using the acquired data, the software processes the data to obtain the power curve of the engine, to analyze the dynamic behavior of the motorbike, and to analyze the behavior of the suspensions.

- power calculation → checking this field the software will calculate torque and power curves of your motorbike engine, from your acquired file in the selected laps;
- dynamic calculation → checking this field the software will calculate the dynamic behavior of the motorbike, and therefore all the informations about the tyres, the motorbike slip angle, and the loads acting on the wheels;
- suspensions calculation → checking this field the software will calculate the behavior of the suspensions, in function of the loads calculated from the lap selected, and of the suspension setup that you've entered;



**CALCULATIONS FOR SIMULATION**

☐ power calculation   

☐ save power with name   

☐ track calculation   

☐ save track with name   

☐ tires calculation   

☐ save tires with name   

☐ save acquired data

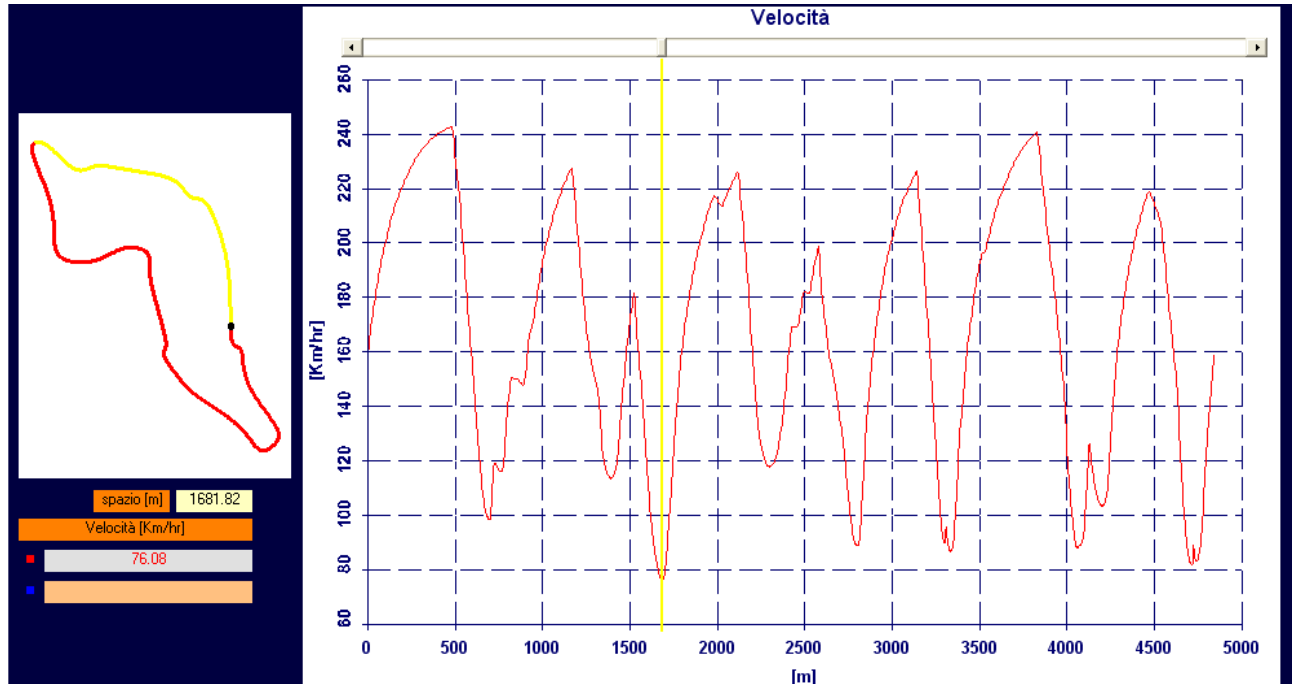
**RUN**

The software allows furthermore to use the acquired data to obtain data useful to perform the simulation, as for example, the engine power curve, the track line, and the grip coefficients of the tires. These data can also to be saved in the INPUT lists of ENGINE, WHEELS, and TRACK.

## results

### SIMULATION

The software calculates the performance that the features of the motorbike, the engine, and the tires, allow to obtain on the track (track line) selected.

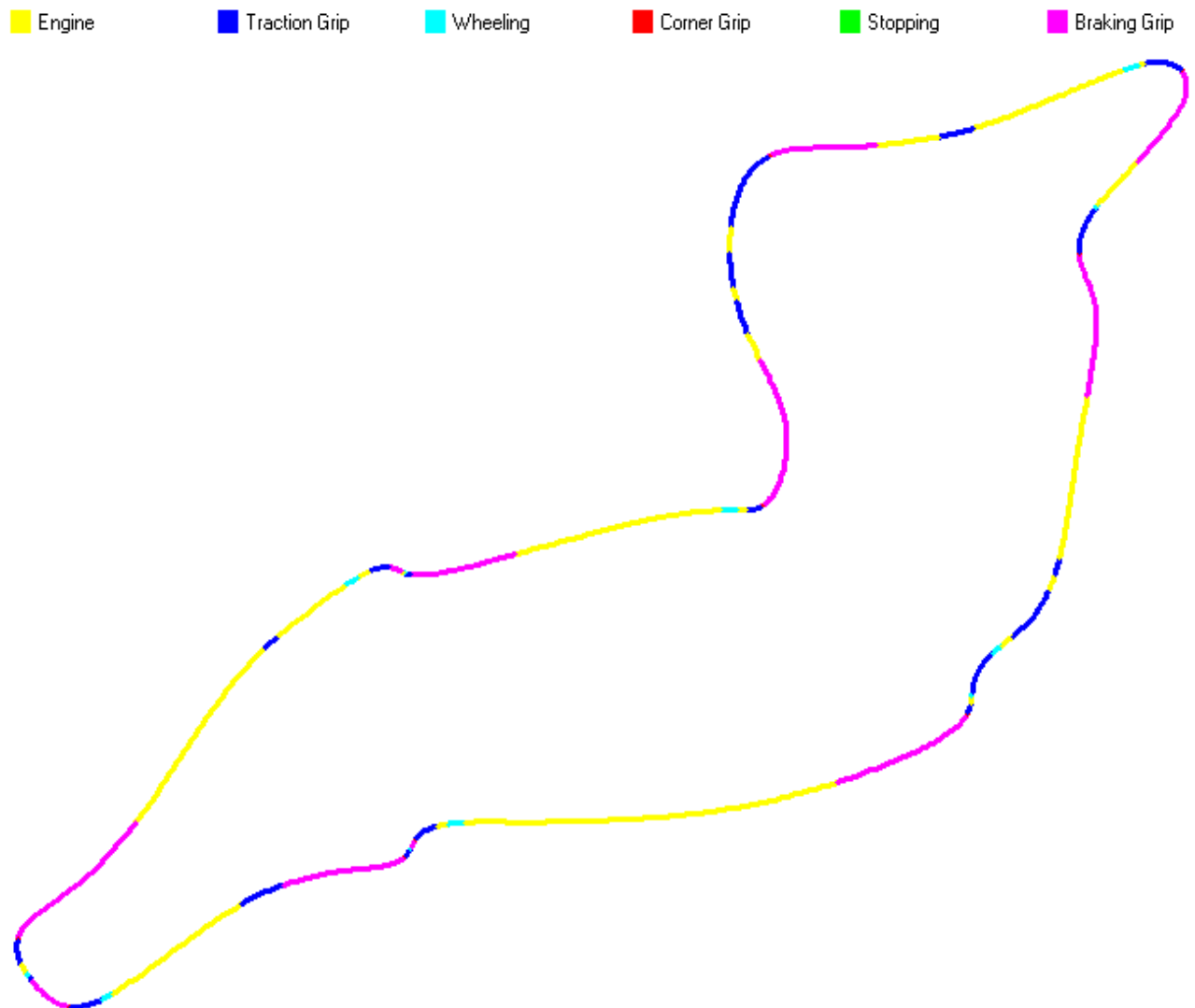


You can see the following graphs:

- time;
- speed;
- engine speed;
- lateral acceleration;
- longitudinal acceleration;
- performance limit reason → this graph is really important because shows in each point of the track which is the reason that has limited the performance of the virtual rider;
- grip maximum speed → this graph shows in function of the track line, the motorbike balance, and the tires grip level, the speed that would be possible to reach in neutral conditions (not acceleration and braking) in each point of the track;
- gear shift;
- throttle engine use percentage → this graph shows how the rider is forced to cut the engine power to respect the grip limit in acceleration;

Together with the graphs the software shows in each point of the track which is the reason that has limited the performance of the rider:

- engine;
- corner and traction grip;
- wheeling on acceleration;
- corner grip;
- stopping on braking;
- braking and corner grip;



## DYNAMIC CALCULATION

At the end of the calculation the software shows the results obtained, in first in a summary screen, which we will see in this page, with the minimum, maximum and average values of each quantities, to have already a first idea of every aspect, after every result calculated is analyzed in all the points of the track to the order to have in-depth information to clearly understand the problems and the most significant areas of intervention.

### SLIP ANGLE ANALYSIS

It is certainly one of the most important results that the software provides, thanks to these calculations you can understand clearly the problems of understeer or oversteer had in the different driving phases.

### TIRES ANALYSIS

Understanding how the tires worked is another aspect fundamental to evaluate the effectiveness of the set-up used, for this the software calculates all the most significant quantities for analyze this aspect.

#### TYRES ANALYSIS

	MIN	MAX
Front Slip Angle [deg]	-0.52	2.07
Front Slip Ratio [-]	-0.10	0.00
Rear Slip Angle [deg]	-0.56	1.98
Rear Slip Ratio [-]	-0.03	0.10

### TIRES

#### CALCULATION

The temperature of the tires is definitely one of the factors that most affect their performance, so the software thanks to a its sophisticated algorithm calculates in function of the data acquired as change the temperature of the tires at each point of the track, dividing the analysis into three areas of the tire, center, side right and left side.

### DRIVING ANALYSIS

understeer (-) oversteer(+)

Motorbike Slip Angle [deg]	
MIN	MAX
-0.46	0.37
Traction	-0.03
Braking	-0.05

front grip coeff.	2.59
max use front grip [%]	100.0
max use front lat. grip [%]	89.1
max use front lon. grip [%]	83.3
rear grip coeff.	2.92
max use rear grip [%]	100.0
max use rearlat. grip [%]	74.3
max use rear lon. grip [%]	86.9

	MIN	MAX	AVG
Front Pressure [bar]	2.08	2.08	
Left Front Temp. [°C]	35	74	52
Center Front Temp. [°C]	48	69	58
Right Front Temp. [°C]	34	65	44
Rear Pressure [bar]	2.26	2.28	
Left Rear Temp. [°C]	57	96	69
Center Rear Temp. [°C]	74	106	88
Right Rear Temp. [°C]	42	68	53

### GEARBOX ANALYSIS

Shows how the use of the gear shift, is distributed during the lap, in this way you can immediately make evaluations for optimize the choice of the gear ratio or final ratio.

### DYNAMIC ANALYSIS

Shows the vertical loads acting on the wheels and the forces that are developed during braking and acceleration.

### TRACK ANALYSIS

Shows the curvature in order to evaluate the line in the different laps.

### LAP ANALYSIS

Shows the results of the most significant quantities during the lap. It also shows how the use of the throttle and of the brake are divided according to the characteristics of the track and the driving style of the rider.

GEARBOX ANALYSIS							
	I	II	III	IV	V	VI	VII
%	0.3	29.2	23.8	24.7	11.6	10.4	0.0

DYNAMIC ANALYSIS		
	MIN	MAX
Front Vert. Load [N]	280	2011
Rear Vert. Load [N]	528	2259
Front Long. Force [N]	-2104	0
Rear Long. Force [N]	-234	2911

TRACK ANALYSIS		
	MIN	MAX
Slope [deg]	-4.84	3.05
Curvature Radius [m]	-28.67	33.81

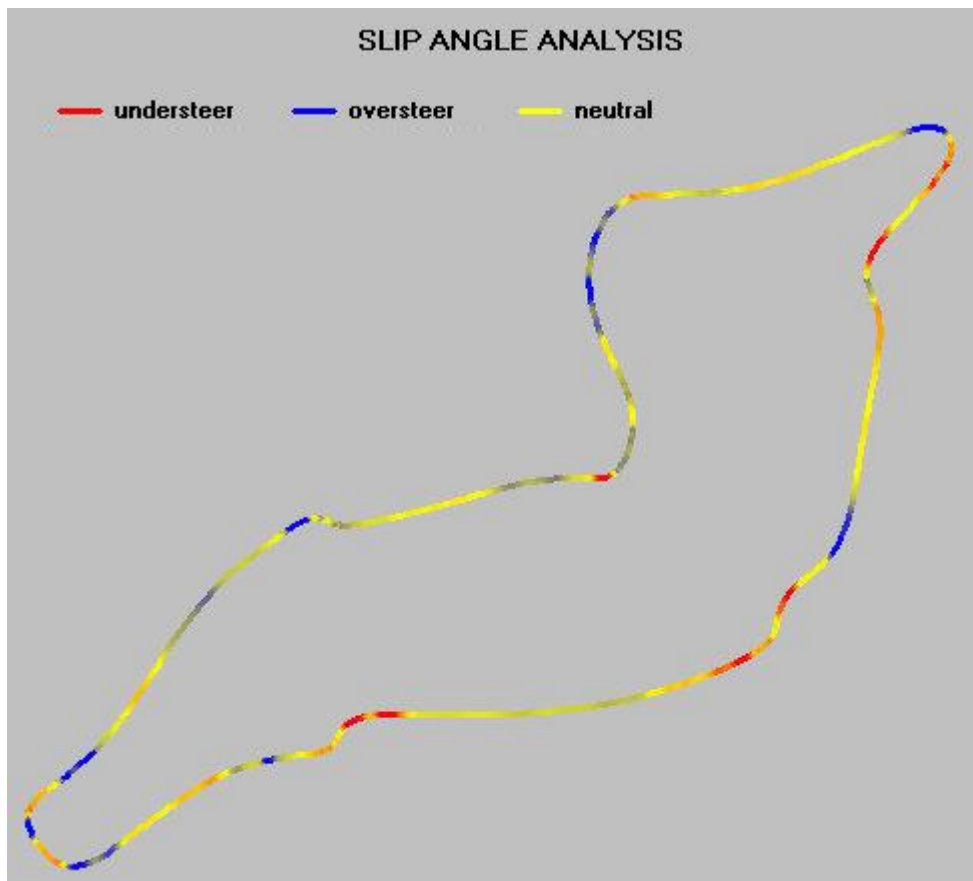
LAP ANALYSIS		
	MIN	MAX
Time [s]		118.10
Speed [Km/hr]	66.74	235.44
Engine Speed [rpm]	6960	16095
Acc. Lat. [m/s <sup>2</sup> ]	-13.57	13.53
Acc. Long. [m/s <sup>2</sup> ]	-10.99	9.50
Roll Angle [deg]	-54.15	53.70
Gear Shift [-]	1	6
	%	
Throttle	64.9	
Brake	35.1	

Below we will see the detailed analysis that the software allows carry out for each calculated quantity.

The software **SET-UP Motorbike Simulator** after to have shown a summary picture of all the quantities calculated, allows you to analyze every aspect influential on the performance in a detailed manner.



## SLIP ANGLE ANALYSIS



The software shows directly on the track the criticalities emerged then immediately you can have a [picture of the situation](#), useful also to compare it with the feeling reported by the rider.

To deepen this aspect, the software also shows the graphs of:

FRONT SLIP ANGLE

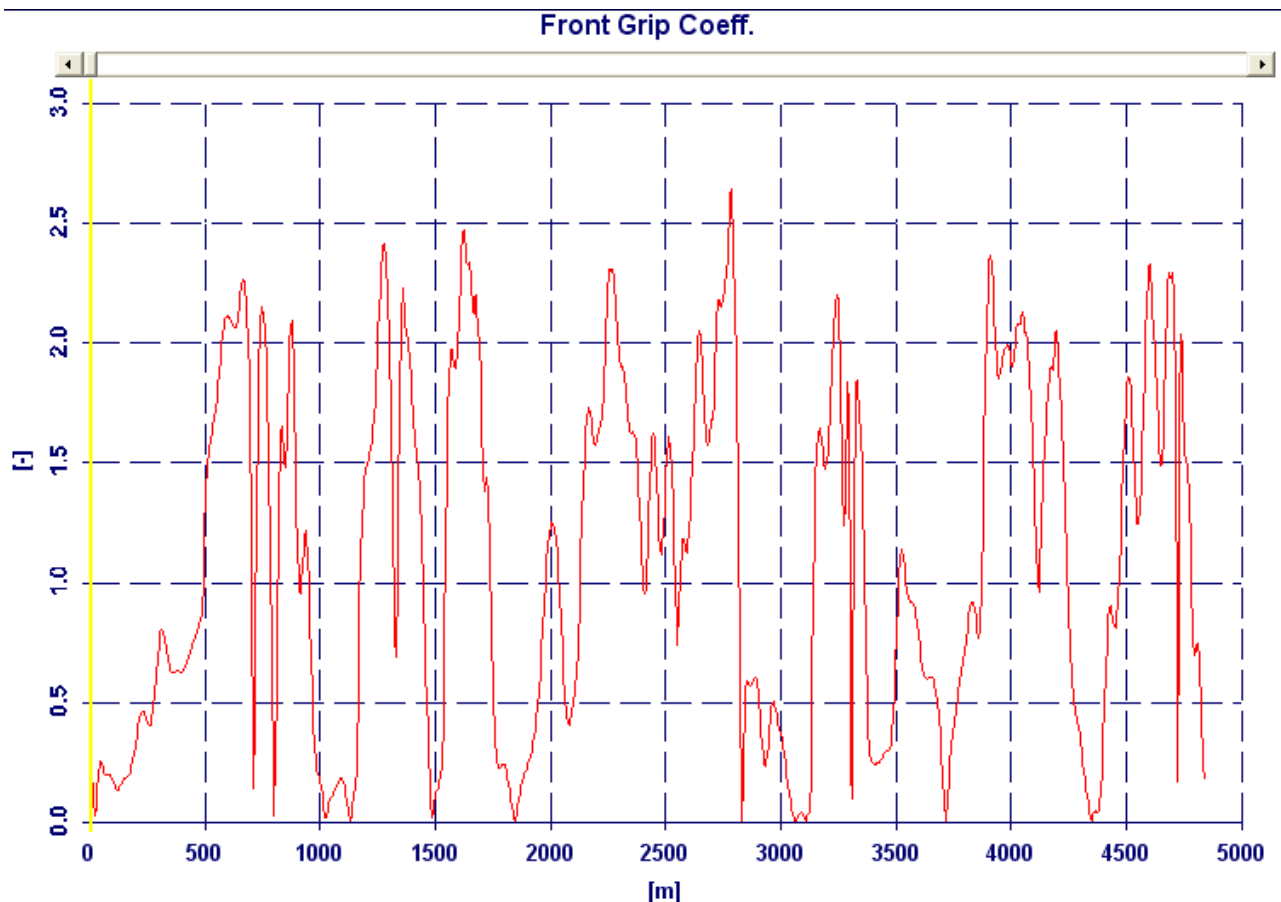
REAR SLIP ANGLE

MOTORBIKE SLIP ANGLE

so you can see point by point the values and the entity of the problems that you've at the front, and at the rear of the motorbike

## TIRES ANALYSIS

The software calculates the front and rear global adherence coefficient longitudinal and lateral grips that the tires were able to offer in the lap. You can therefore see the adherence level that the tire compound and the ground condition have allowed to obtain, and analyzing the maximum values in the lap, is possible to evaluate how the driver has been able to exploit this adherence, both in braking and acceleration phases, both on corner. In addition to these results, using the structural data of the tires, the software calculates also slip angle and slip ratio in each point of the track, in this way it will be possible to have a [picture complete on how the set-up used is making work the tires](#).



front grip coeff.	2.59
max use front grip [%]	100.0
max use front lat. grip [%]	89.1
max use front lon. grip [%]	83.3
rear grip coeff.	2.92
max use rear grip [%]	100.0
max use rearlat. grip [%]	74.3
max use rear lon. grip [%]	86.9

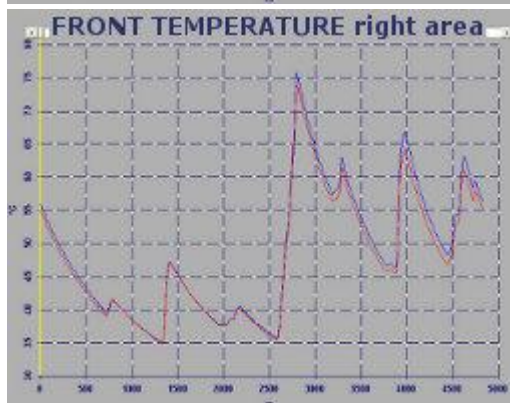
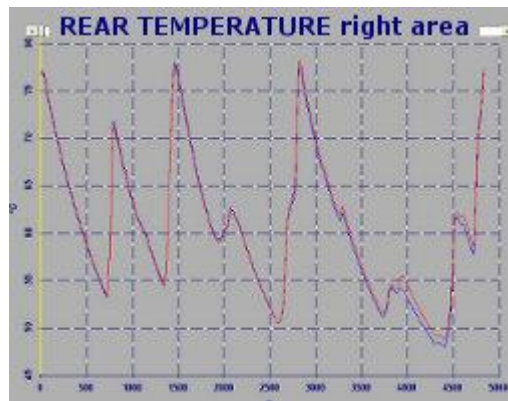
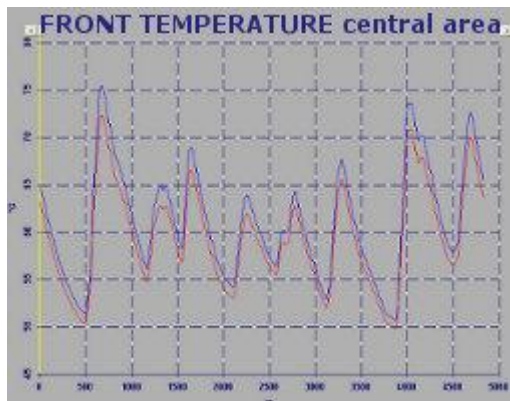
### TYRES ANALYSIS

	MIN	MAX
Front Slip Angle [deg]	-0.52	2.07
Front Slip Ratio [-]	-0.10	0.00
Rear Slip Angle [deg]	-0.56	1.98
Rear Slip Ratio [-]	-0.03	0.10

In addition to these results, the software also allows you to analyze in detail the SLIP RATIO values of the front and rear tires at each point of the track.

## TIRES TEMPERATURE

The SET-UP Motorbike Simulator software on the base of the acquired data and of the dynamic calculation, calculates the trend of tire temperature during the lap and how it grows lap by lap. This is crucial both in the analysis phase for understand how the tires are working at every point of the track, both when you want to compare different set-up to see how these affect the temperature of the tires

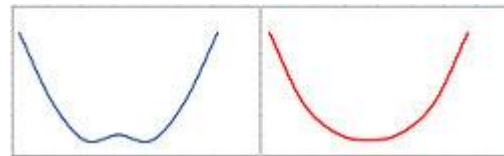
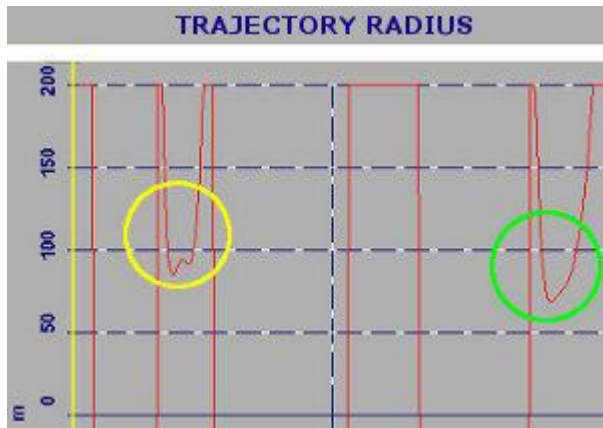


Each tire is divided into three areas, thus will be possible analyze the specific temperature of the part that is working.

	MIN	MAX	MED
front pressure [bar]	2.09	2.09	
front temperature - left [°C]	36	79	54
front temperature - center [°C]	50	72	61
front temperature - right [°C]	35	74	49
rear pressure [bar]	2.29	2.32	
rear temperature - left [°C]	63	119	80
rear temperature - center [°C]	81	102	90
rear temperature - right [°C]	49	78	61

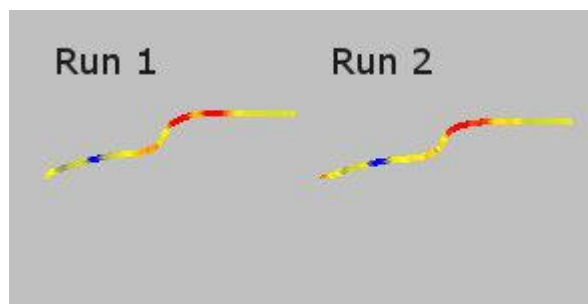
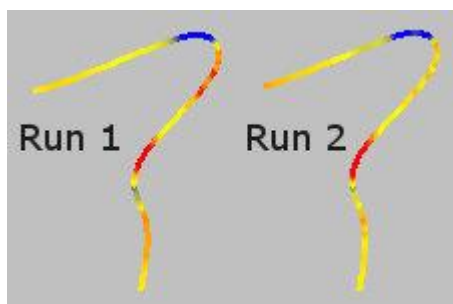
## TRAJECTORY LINE ANALYSIS

Thanks to special filtering algorithms comes **calculated the radius of curvature and this is fundamental to understand how the rider is driving**, in fact from the analysis of the radius of curvature it is possible to see in which corners the rider is in difficulty, and where his guide is not clean.



In the example we clearly see how thanks to this calculation is **easy to identify the curves where the rider has had difficulty** (yellow circle), compared to where it took the apex point without problems (green circle)

In addition to having immediate answers from the analysis of the results of a single session, the SET-UP Motorbike Simulator software, is fundamental also to **clearly understand the improvements and the worsening that occurred between two different set-up**. In fact often in the comparison of two sessions usually are compared the lap times, and the feeling of the rider, but run by run the conditions change therefore isn't easy to do evaluations objective, instead **comparing the results calculated by the software Racing Bike Analysis you can have clear information on the problems emerged in the different sessions**.



As you can see in this example, thanks to the software, it is immediately clear how the changes made to the **set-up used in Run 2 have allowed to reduce understeer at some points in the track** and this is essential to orientate the subsequent interventions.

The same can be done by analyzing the calculated information on the tires, comparing the values of grip and their trend, and so on for all the others data calculated.

## SUSPENSIONS CALCULATION

If you've entered also the data of chassis and suspensions setup, and performed the suspensions calculation the software will give these results:

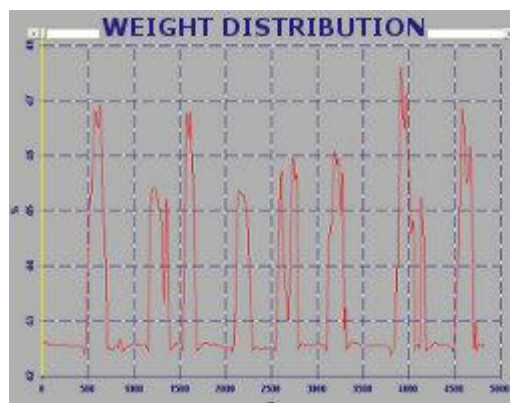
SUSPENSIONS ANALYSIS		
	MIN	MAX
Chassis Rotation [deg]	0.07	2.40
Wheelbase [mm]	1380.79	1399.55
Coord. X Gravity [mm]	634.96	651.95
Coord. Y Gravity [mm]	462.98	536.60
Rear Arm Rotation [deg]	8.89	16.48
Fork Movement [mm]	1	88
Shock Movement [mm]	0	33
Front Total Load [N]	211	2364
Rear Total Load [N]	497	2889
Fork Load [N]	200	1970
Shock Load [N]	998	4608
Susp. Effect Front Load [-]	0.69	1.06
Susp. Effect Rear Load [-]	0.92	1.05
Simulated Speed [Km/hr]	66.12	236.60
Simulated Time [s]		117.85

In the first tab of the results there are summarized the quantities calculated with the minimum and maximum values.

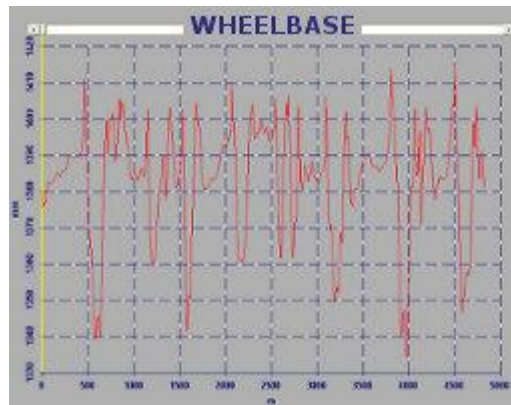
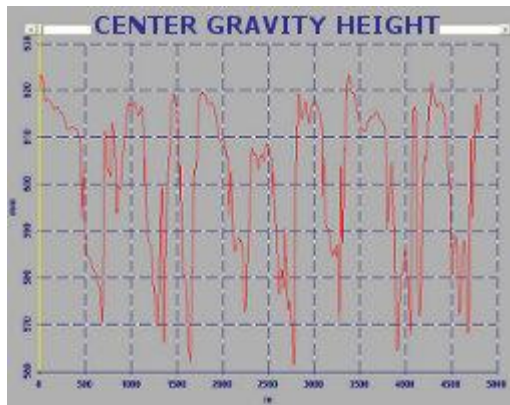
Moreover there are the graphs of all these quantities in function of the track space, so is possible analyze the behavior in each point of the track.

## BALANCE ANALYSIS

Thanks to the software you can then see how changes the balance of the motorbike at each point of the path, being able to analyze in the detail how change weight distribution, the gravity and the wheelbase, in relation to the suspension set-up that is been used.

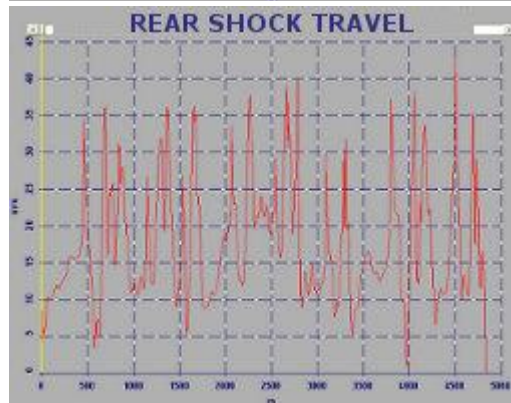
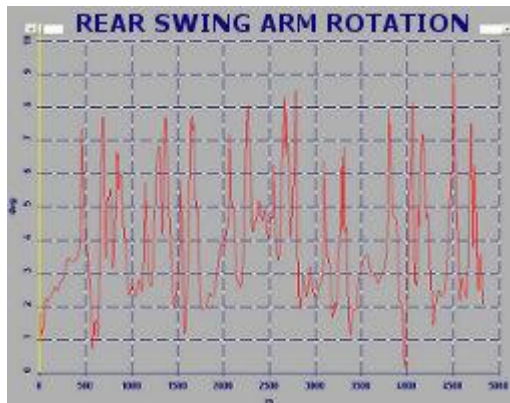
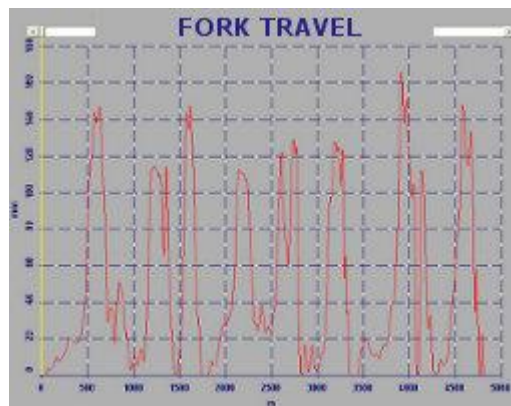






## SUSPENSIONS BEHAVIOR

The movement of the fork and of the rear shock are fundamental because have a significant influence on the dynamic behavior of the motorbike, for this the SET-UP Motorbike Simulator software calculates the operation of the suspensions based on the acquired data and the settings set, and shows the graphs to see at each point of the track how they are working.



## LOAD ANALYSIS

Thanks to results you can also analyze the loads act, on the wheels (are the total loads due the gravity, inertia, drag, braking, and traction forces), and on the suspensions.

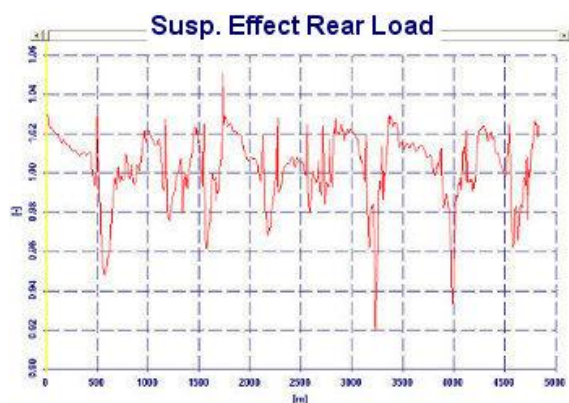
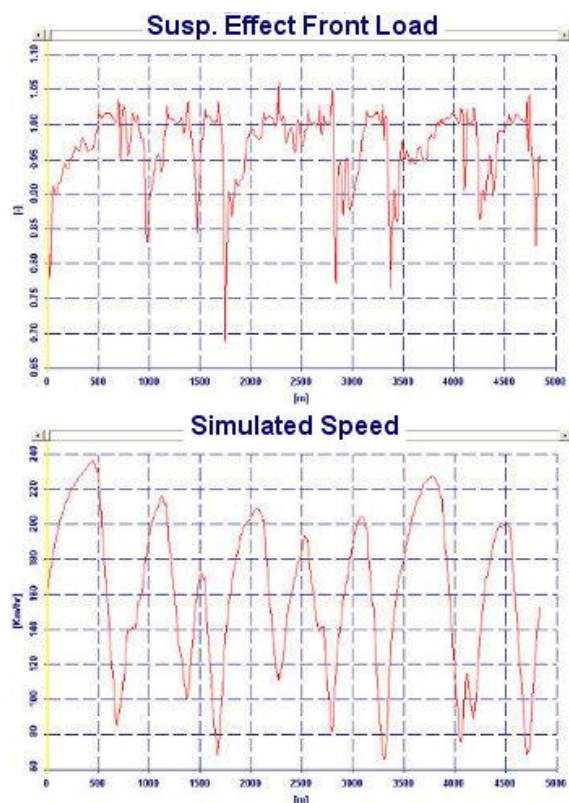
## PERFORMANCE SIMULATION FOR SUSPENSIONS SETTING

In addition to these results, the software perform also a calculation of the motorbike performance in function of the suspensions setup that has been entered.

The suspension behavior is closely linked to the rider's driving style, so the only way to evaluate a setup is to tie it to the specific driving style. The software then uses the rider's driving style acquired from the acquisition file to assess how the performance changes based on the suspension setup being used.

The software calculates how the available load changes at the front and rear due to the presence of the suspensions and the setup used. Thanks to this, it simulates the speed you could have when braking, turning and acceleration, due to the different load generated by the suspension setup, and the relative lap time. It will therefore be easy to compare the different setups and understand what can be effective for the specific driving style of the rider.

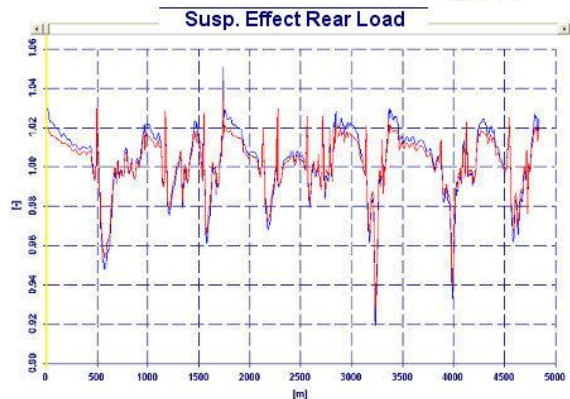
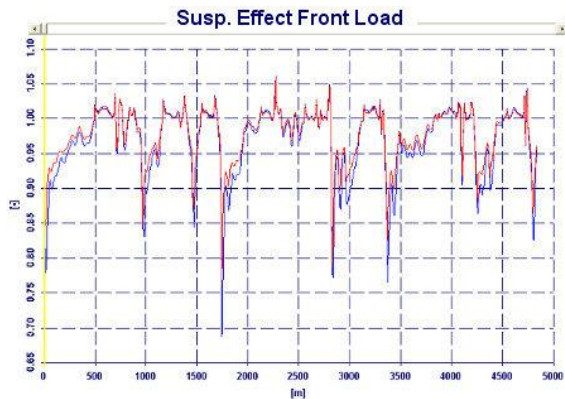
	MIN	MAX
Susp. Effect Front Load [-]	0.69	1.06
Susp. Effect Rear Load [-]	0.92	1.05
Simulated Speed [Km/hr]	66.12	236.60
Simulated Time [s]		117.85



By comparing the results with those obtained with the initial set-up, you can see in advance if the choices that you are making are in the direction that you want, and in any case evaluate the pros and cons of each set-up.

#### SUSPENSIONS ANALYSIS

	MIN	MAX
Susp. Effect Front Load [-]	0.76	1.06
	0.69	1.06
Susp. Effect Rear Load [-]	0.93	1.04
	0.92	1.05
Simulated Speed [Km/hr]	66.16	236.01
	66.12	236.60
Simulated Time [s]		117.94
		117.85



#### POWER CALCULATION

Together with the dynamic and suspension calculation, the software SET-UP Motorbike Simulator performs also a precise calculation of the torque and power chart, using the data acquired from your acquisition system.



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SET-UP MOTORBIKE SIMULATOR  
NT-PROJECT di Tabacchi Omar