

Cross-wind on vehicles

Group J

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Topic Explanation and Main Analysis Goals

Wind effects on a truck considering different conditions:

Metereological Conditions



Load Fraction



Lane Changes



Roll Stiffness Distribution (front and rear axis)



Entry and Exit from a tunnel

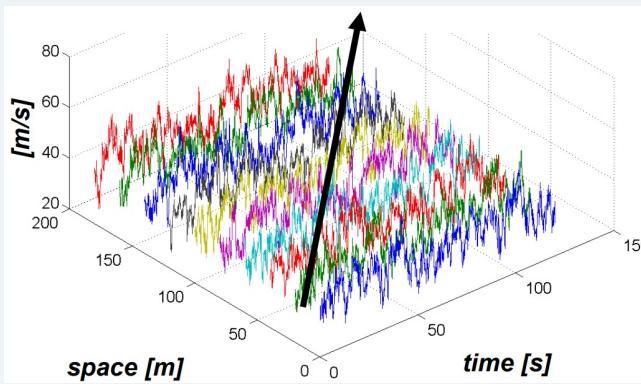


Methodological Approach

- Aerodynamic coefficients from Wind Tunnel tests



- Consider 6 different strong wind conditions, with different characteristics:



-  Mean wind speed U
-  Turbulence intensity lu
-  Integral scale length Lu

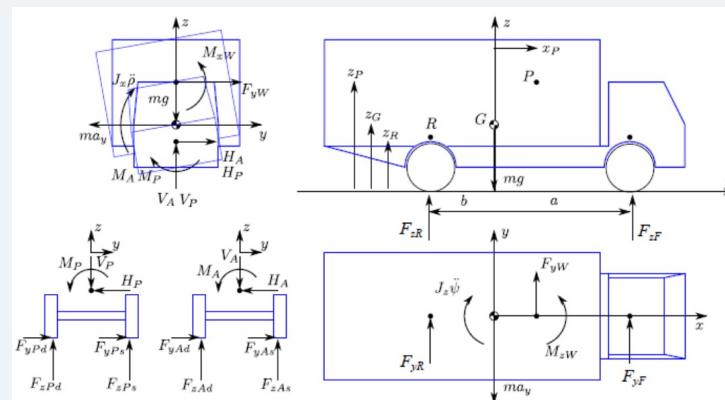
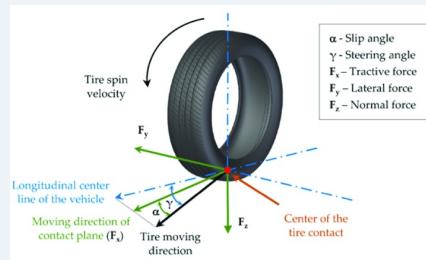
- Evaluation of aerodynamics loads, with a 3 dofs model for the track (vehicle lateral speed, yaw rate, roll rate)

Methodological Approach

- Equilibrium:

→ Along z-axes

→ Moment along roll (overturning) and yaw axes



Sideslip is caused only by
F_y and yaw moment.

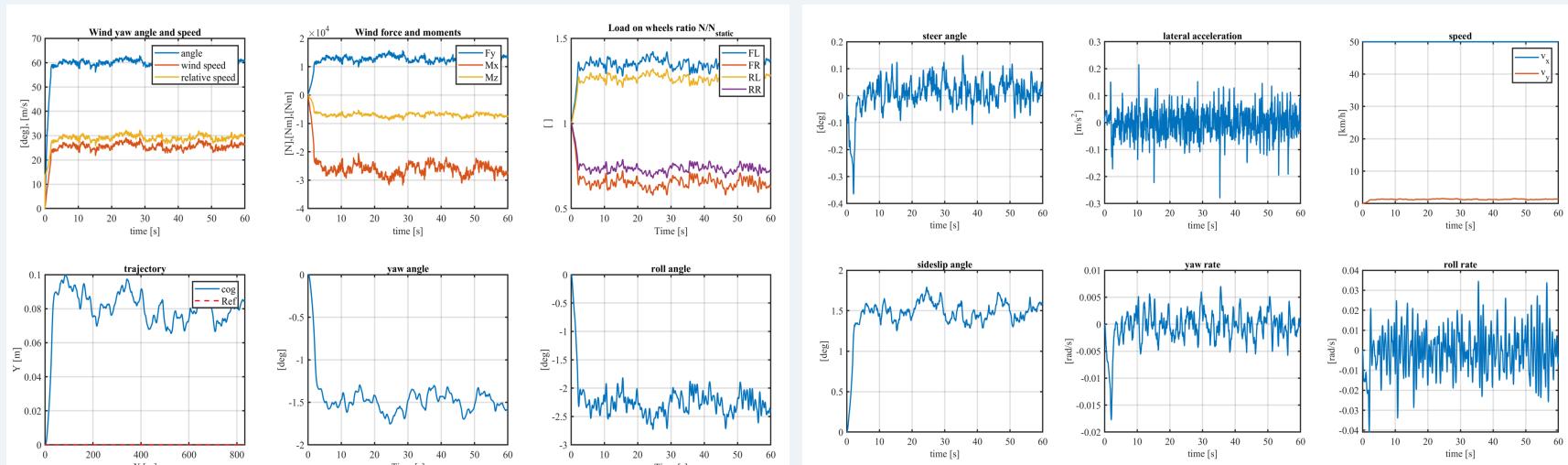
- Calculation of reaction between ground and wheels, taking in account Pacejka model and slip angle
- Use of ode45 function to integrate the equation of motion
- Modelling of the driver as a path follower proportional-derivative control (PD control), having in input the trajectory followed by the truck

Methodological Approach

- Setting up:

Time	Vehicle Speed
60 s	50 km/h

- For each wind history and for each condition, graphs show:



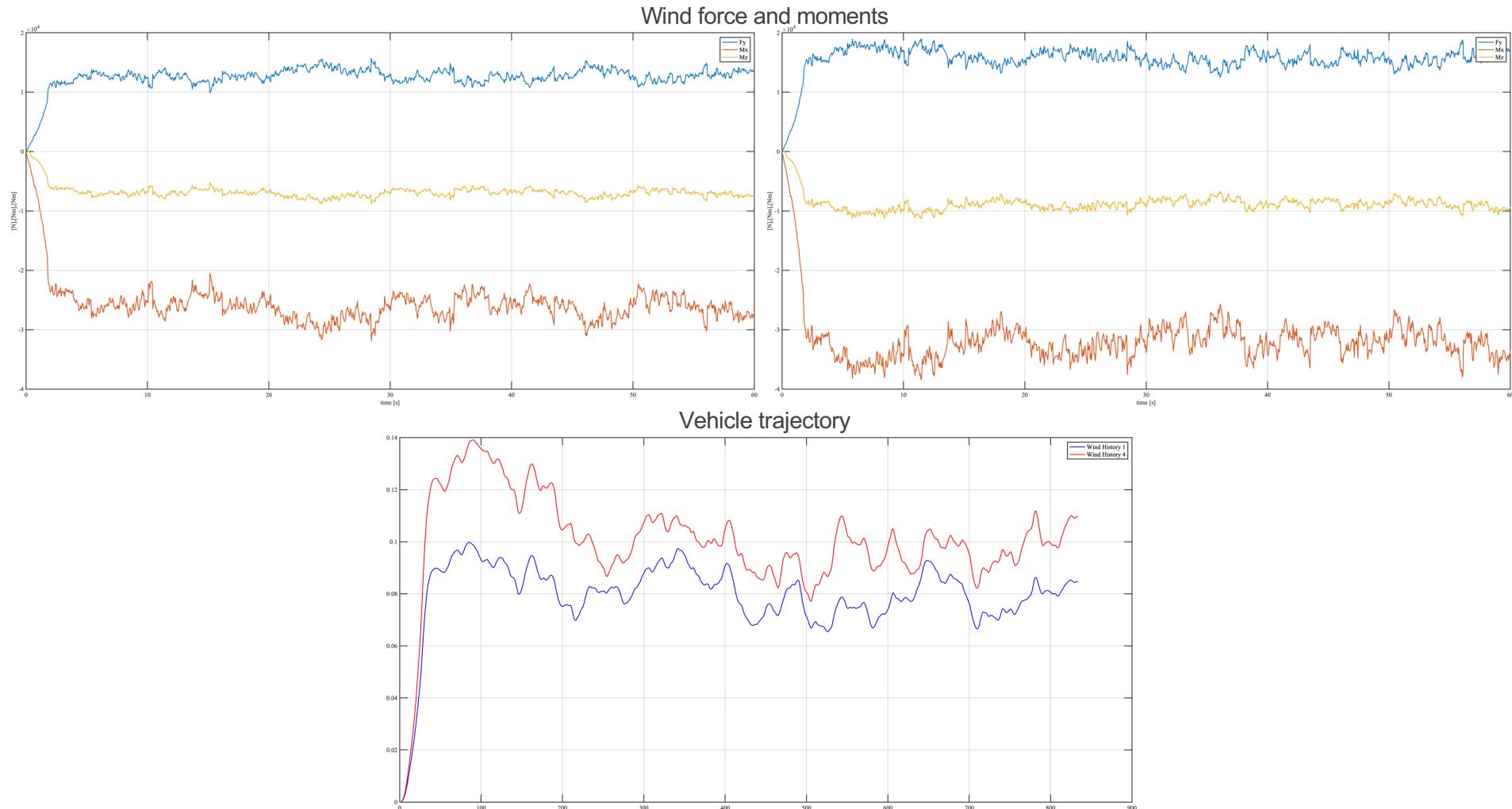
- Analyses of change of lane: change of the y and variation of the trajectory
- Analyses of entry and exit from a tunnel: no wind from 20 to 40 seconds in wind history 6

Main results analysis

Analysis of six different wind histories in different meteorological conditions (dry, wet and snow)

Comparison between wind history 1
and 4 in dry condition

Wind History	Wind Speed [m/s]	Turbulence Intensity
1 (on top)	25	7%
4 (bottom)	30	7%



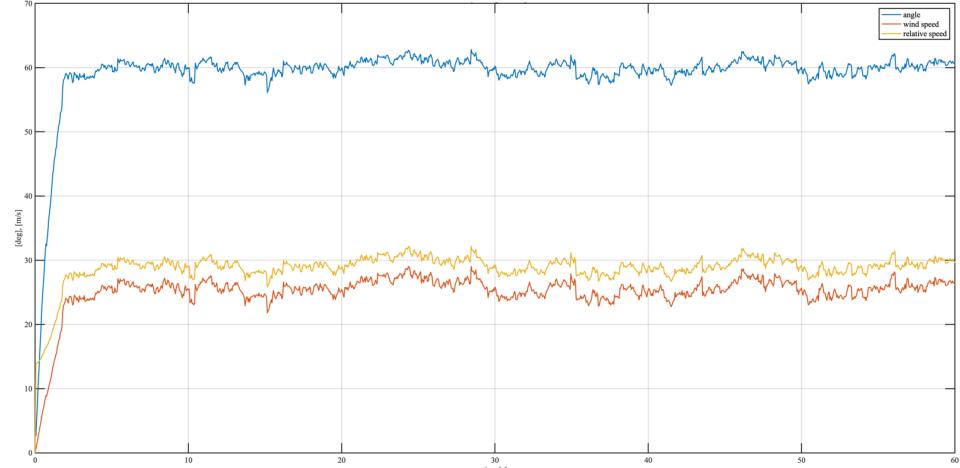
Main results analysis

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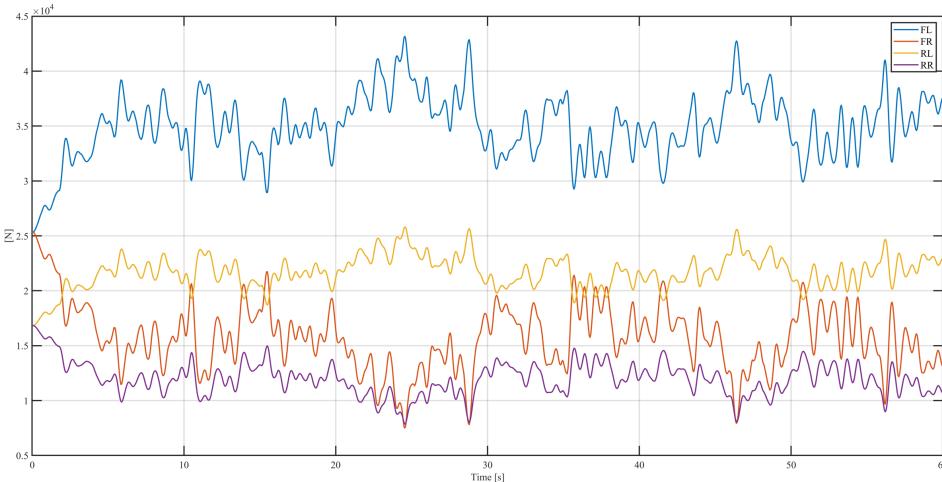
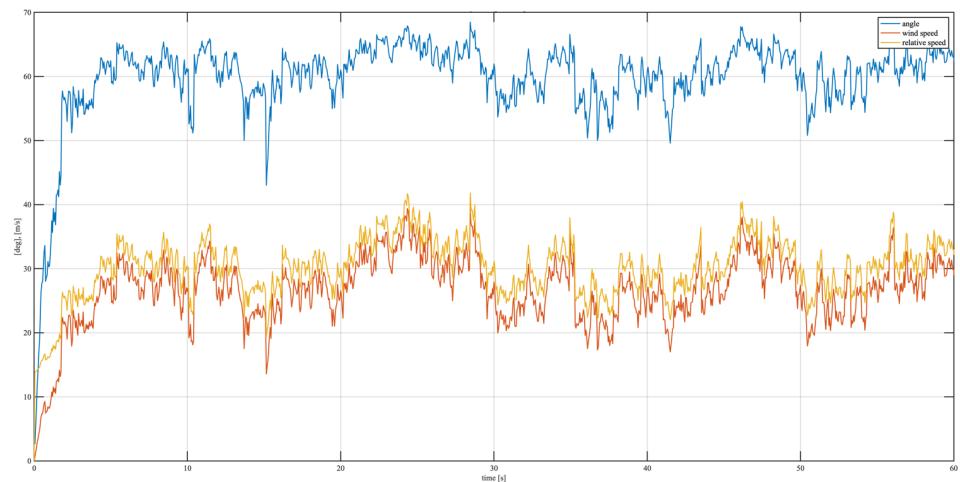
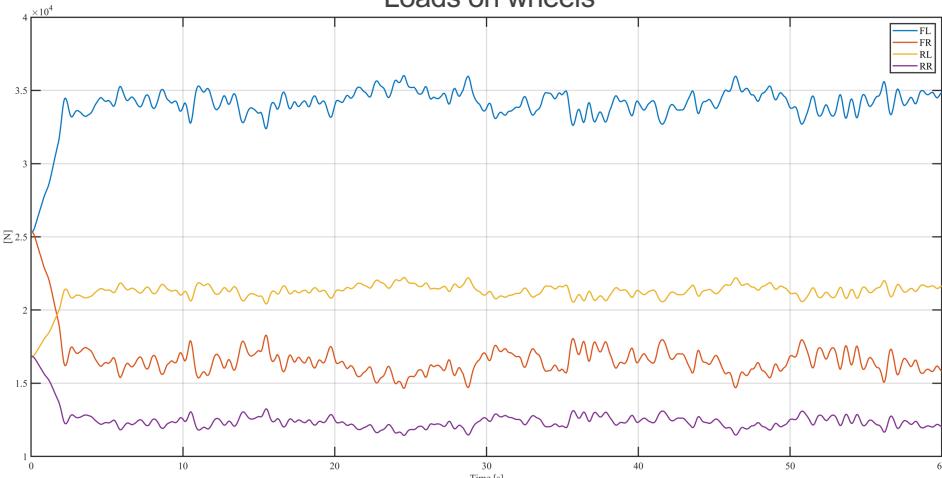
Comparison between wind history 1 and 3 in dry condition

Wind History	Wind Speed [m/s]	Turbulence Intensity
1 (on top)	25	7%
3 (bottom)	25	25%

Wind yaw angle and speed



Loads on wheels



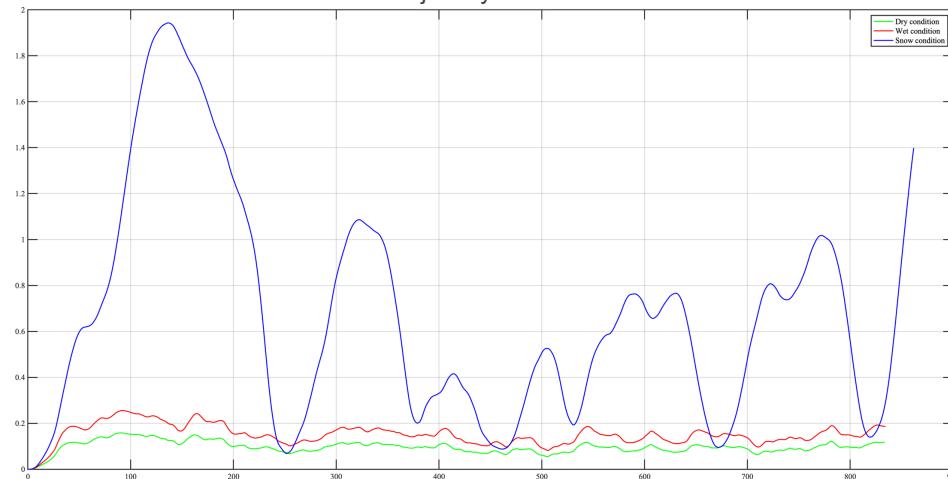
Main results analysis

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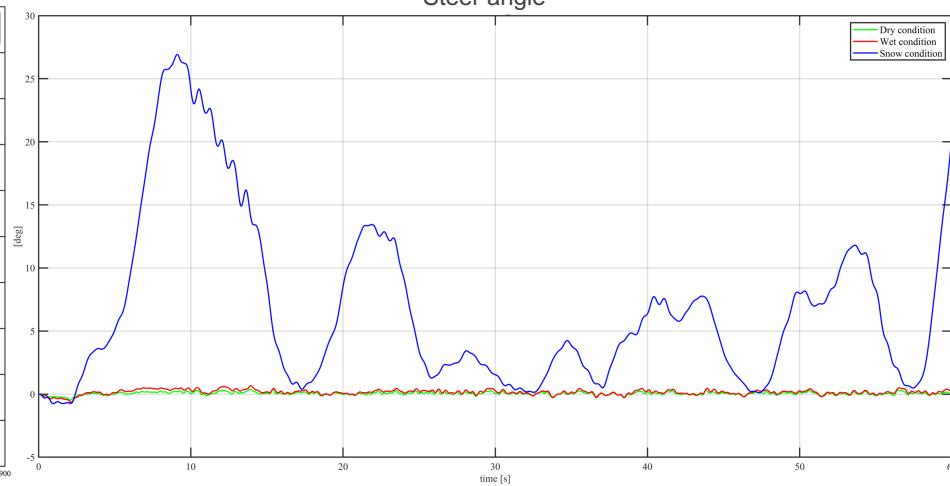
Comparison between dry, wet and snow conditions results taking in account wind history 5

Surface condition parameter q	Dry (green line)	Wet (red line)	Snow (blue line)
	0.9	0.6	0.3

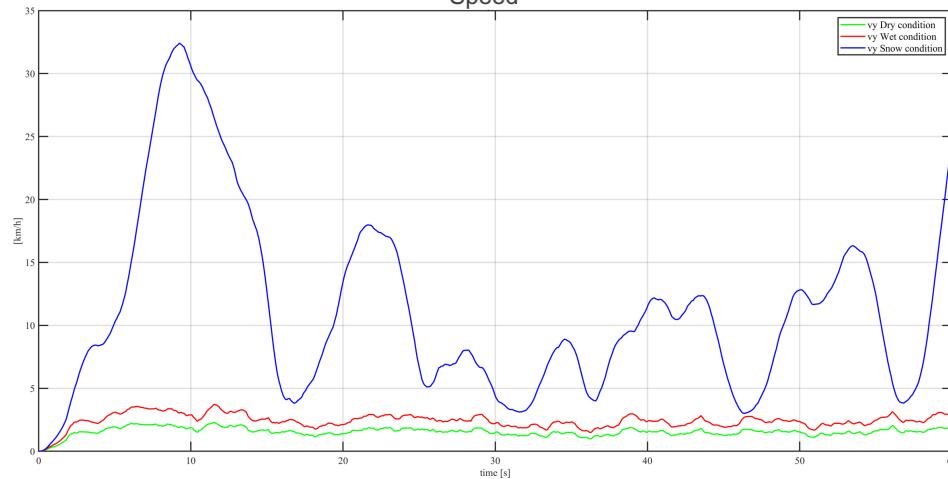
Vehicle trajectory and orientation



Steer angle



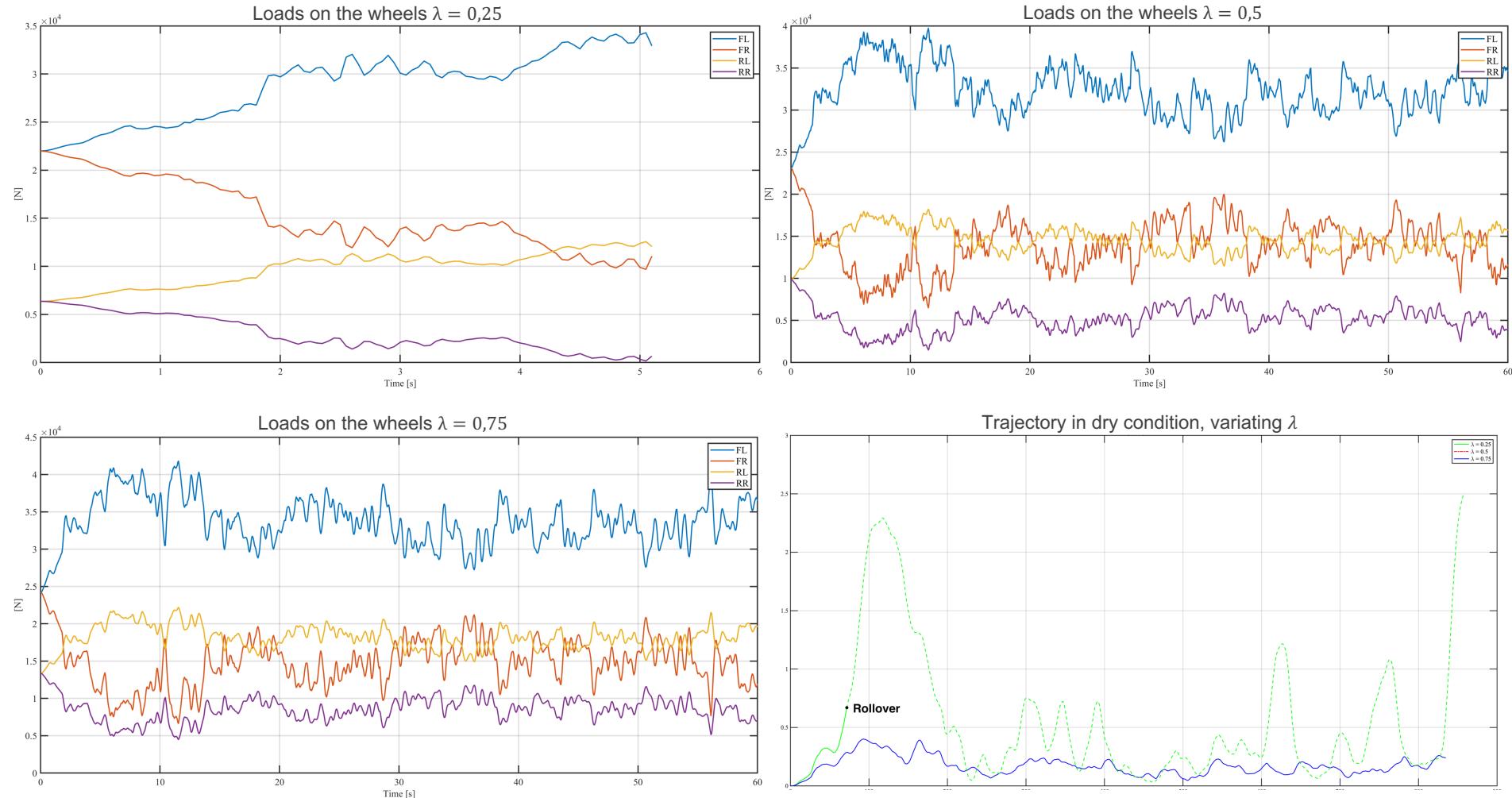
Speed



Main results analysis

Analysis of six different wind histories in different meteorological conditions (dry, wet and snow)

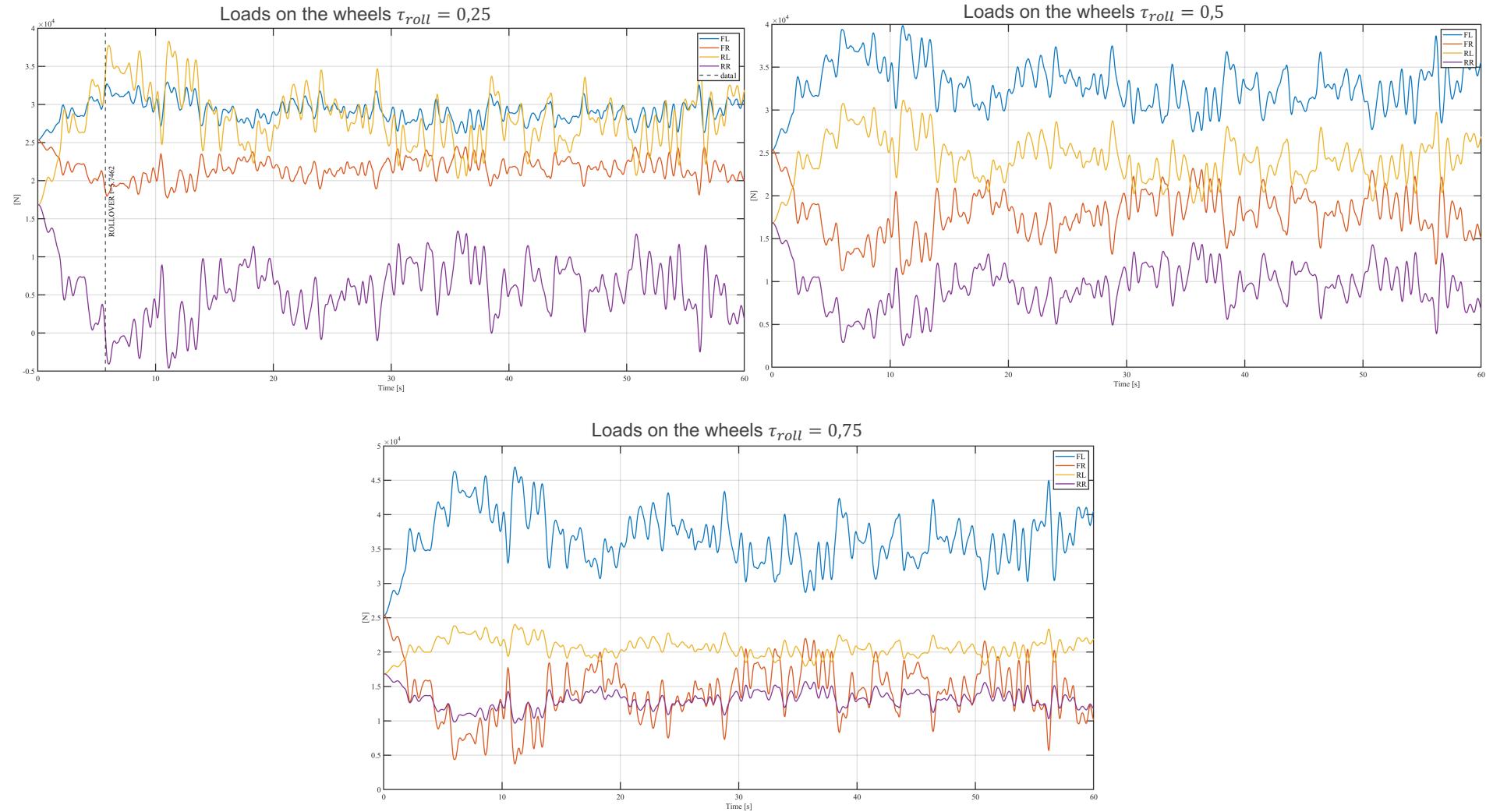
Variation of the load ratio between 0 and 1 taking in account wind history 6



Main results analysis

Analysis of six different wind histories in different meteorological conditions (dry, wet and snow)

Variation of the stiffness ratio between 0,25 and 0,75 taking in account wind history 6



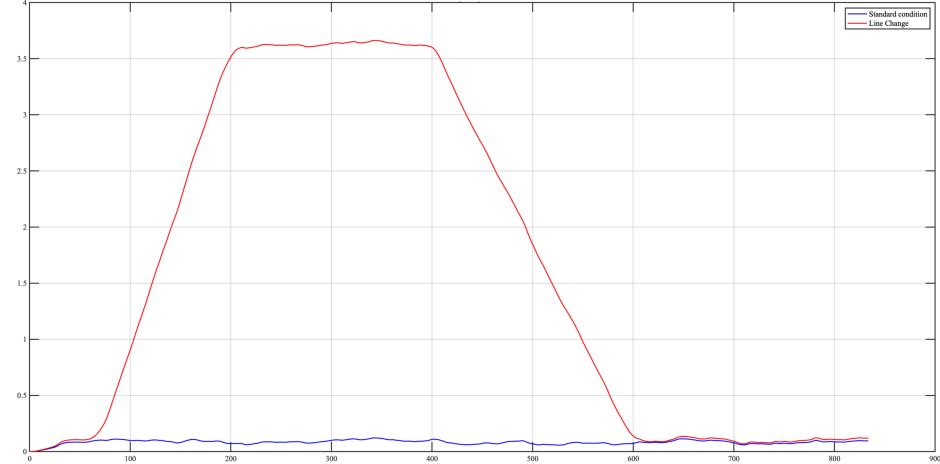
Main results analysis

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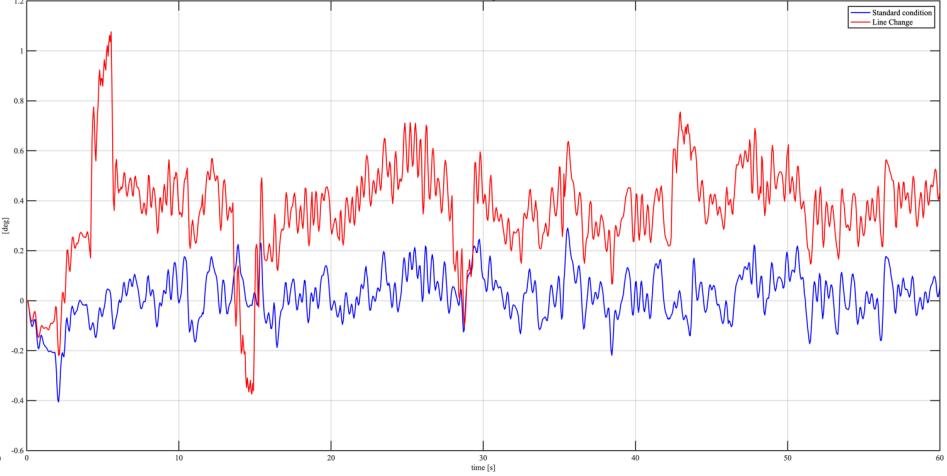
Lane change taking in account wind history 2

Lambda	Tau roll
0,75	0,75

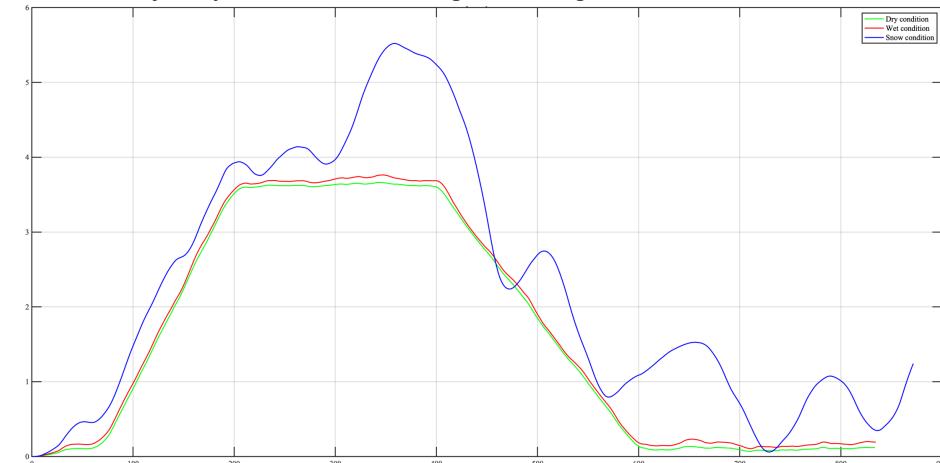
Vehicle trajectory and orientation during lane change vs standard case



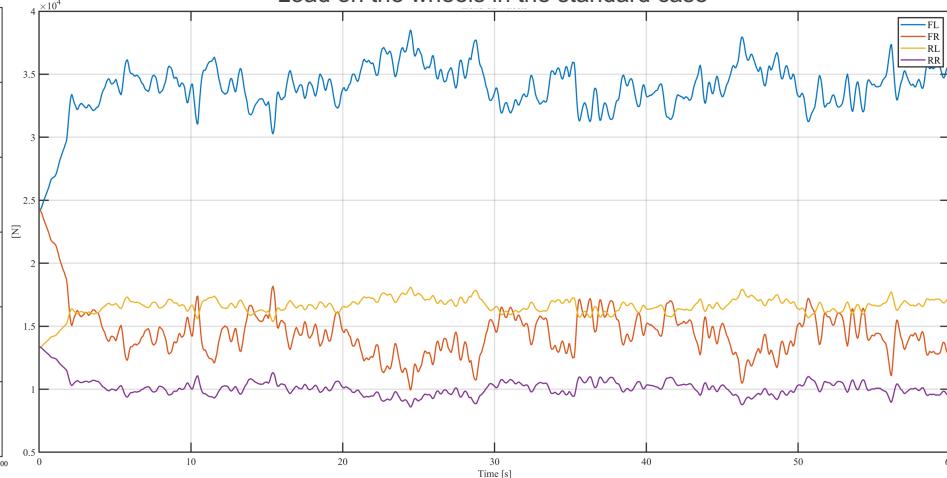
Steer angle



Vehicle trajectory and orientation during lane change in different wheatear conditions



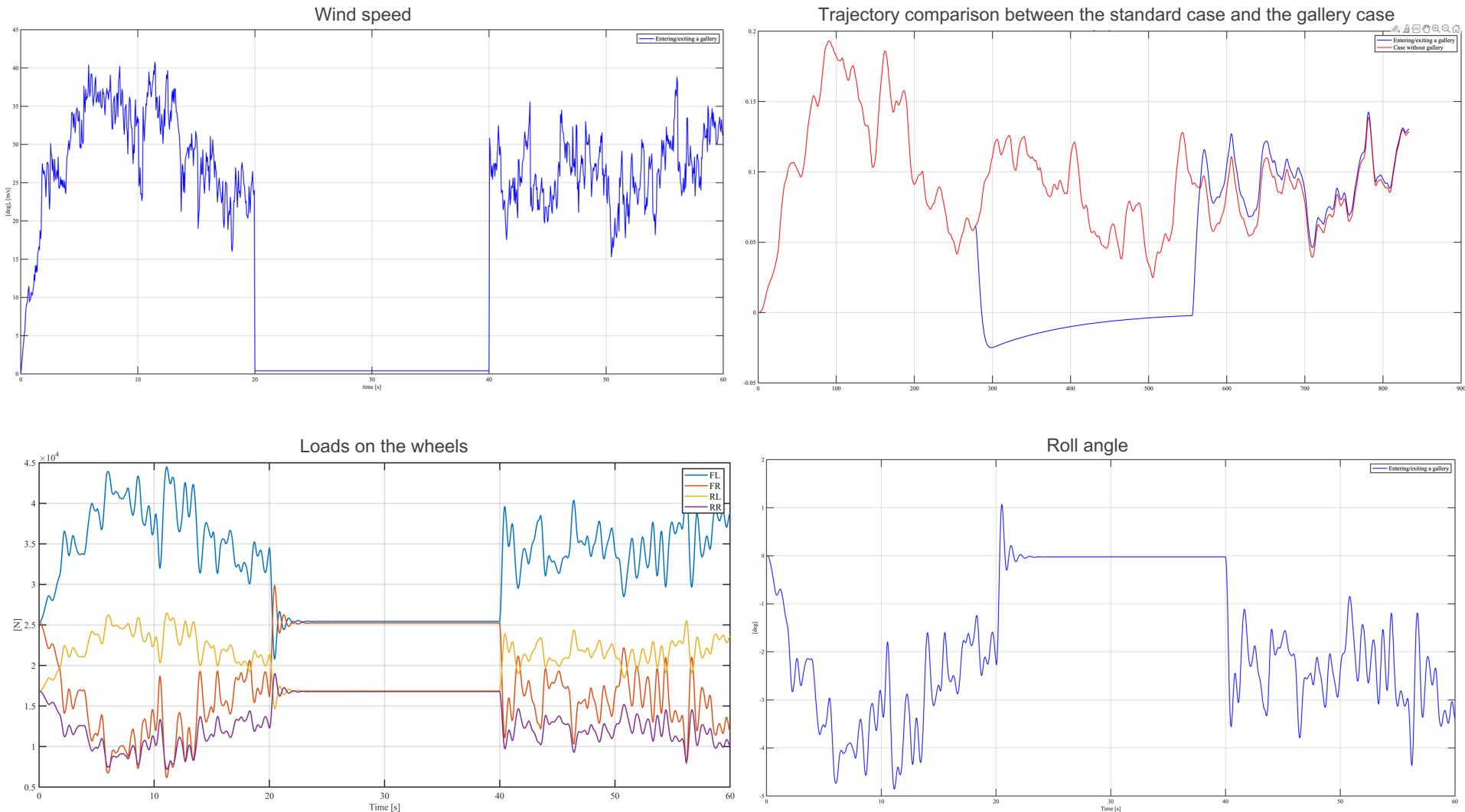
Load on the wheels in the standard case



Main results analysis

Analysis of six different wind histories in different meteorological conditions (dry, wet and snow)

Case study: entering or exiting a gallery taking in account wind history 6



🚚 Thank you for your attention! 🚚

