

High Speed Stability On Dual Sport Motorbike

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1-Objectives

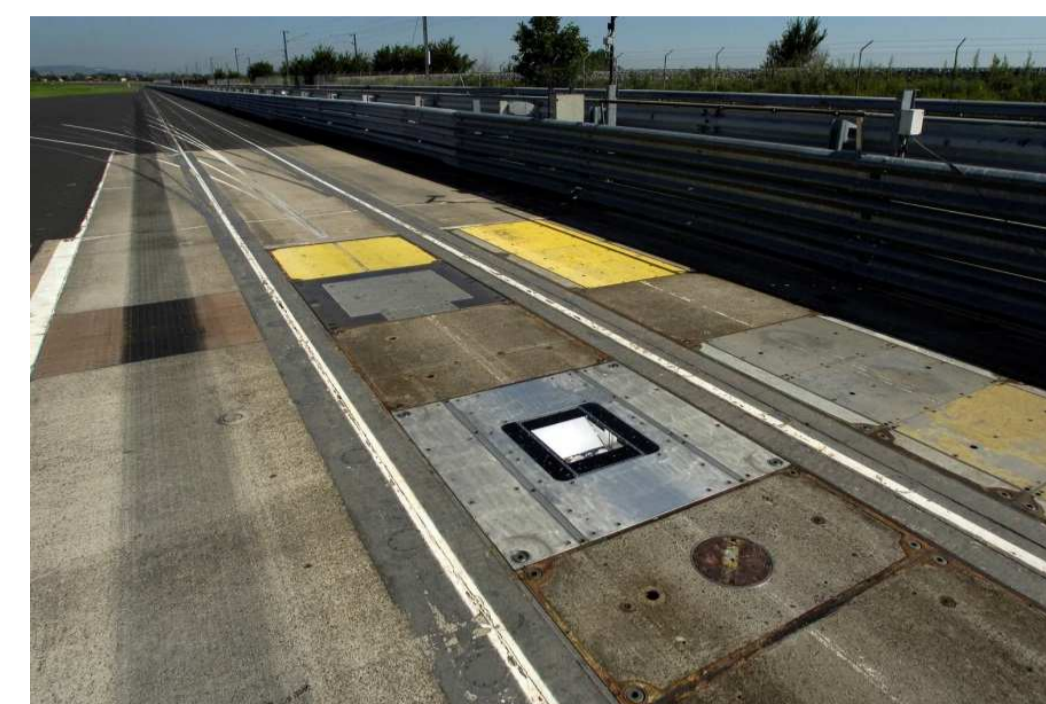
- Analyse and understand the **influence of front tire** and **rider behaviour** on motorbike dynamics
- Develop simulation process** to predict the tire impact on the rider-motorcycle system high speed stability

2-On-vehicle and instrumented track measurements



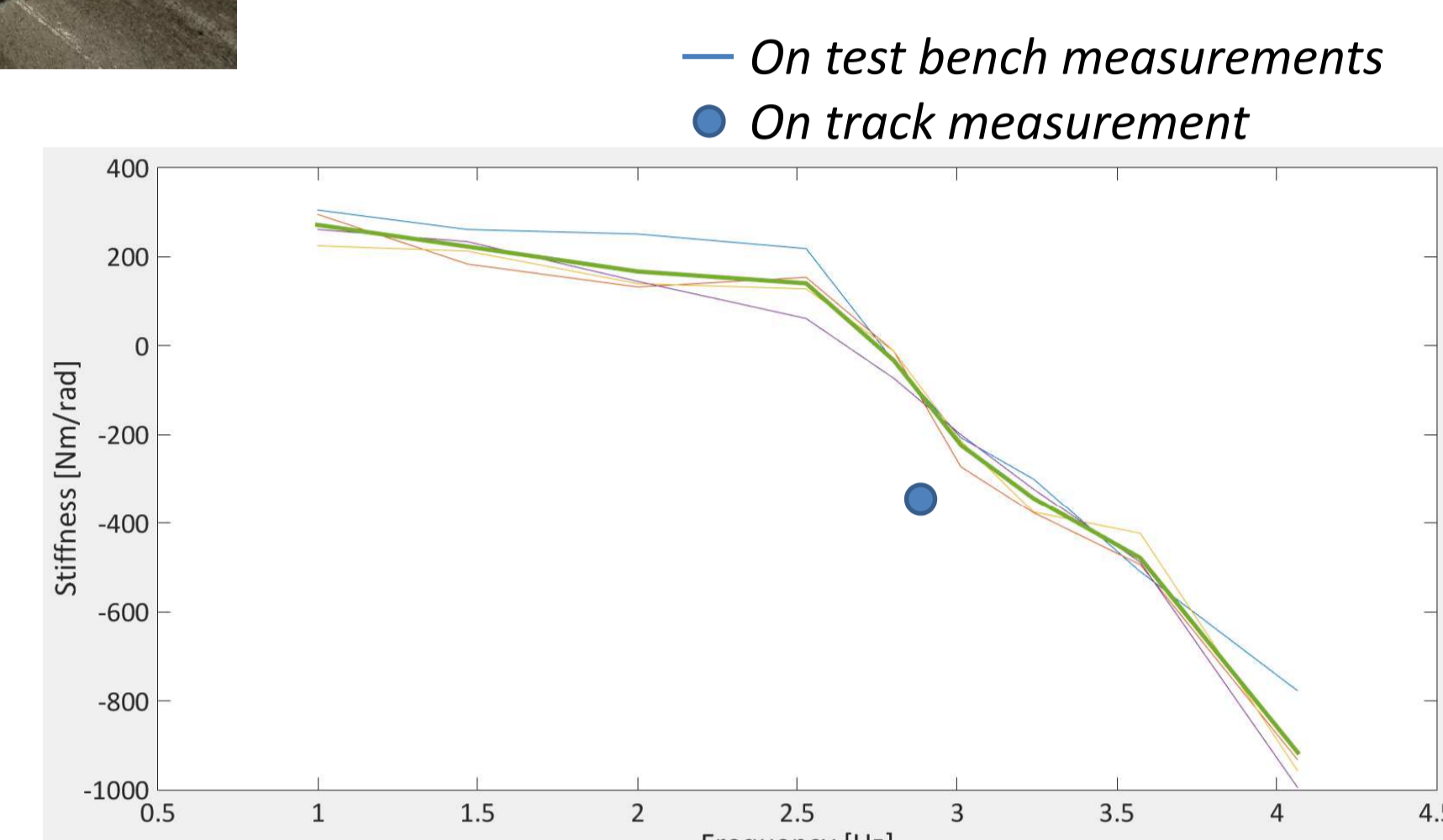
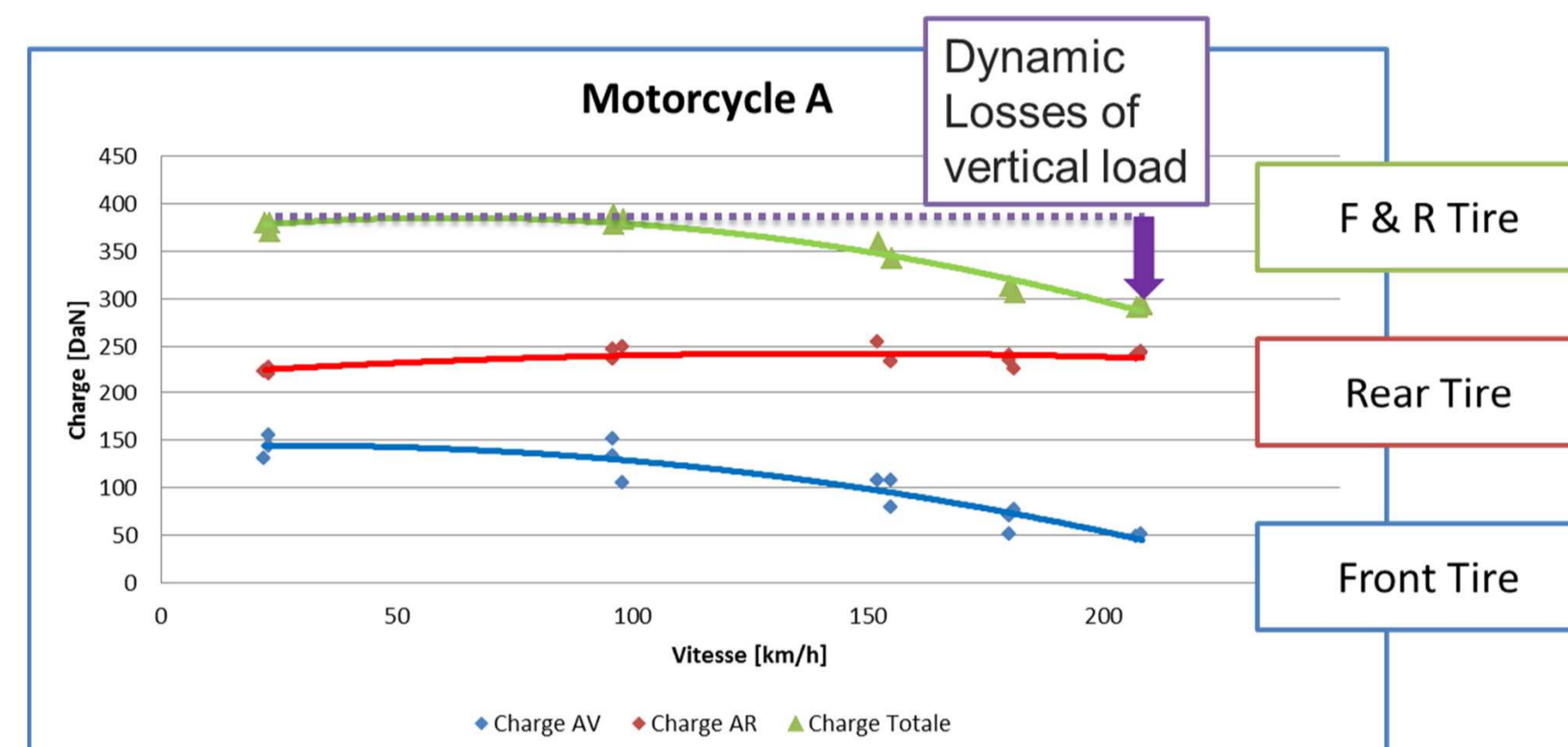
Strain gauges and angle sensor on handlebar

Instrumented track



Conclusions

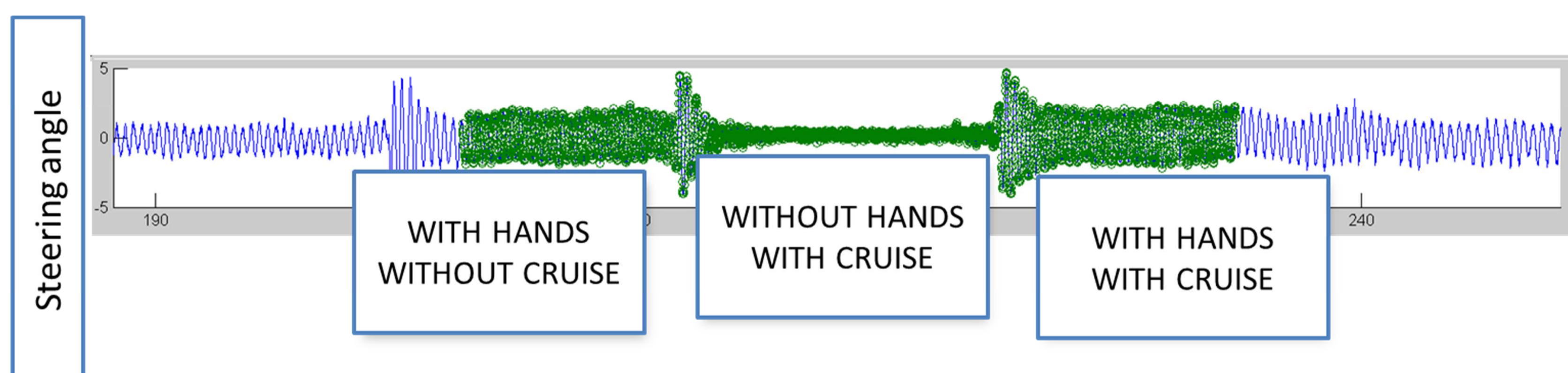
- At maximum speed, aerodynamic measurement highlight a significant air lift on the front side of the vehicles.
- Rider's arms stiffness depends on the excitation frequency of the steering part.



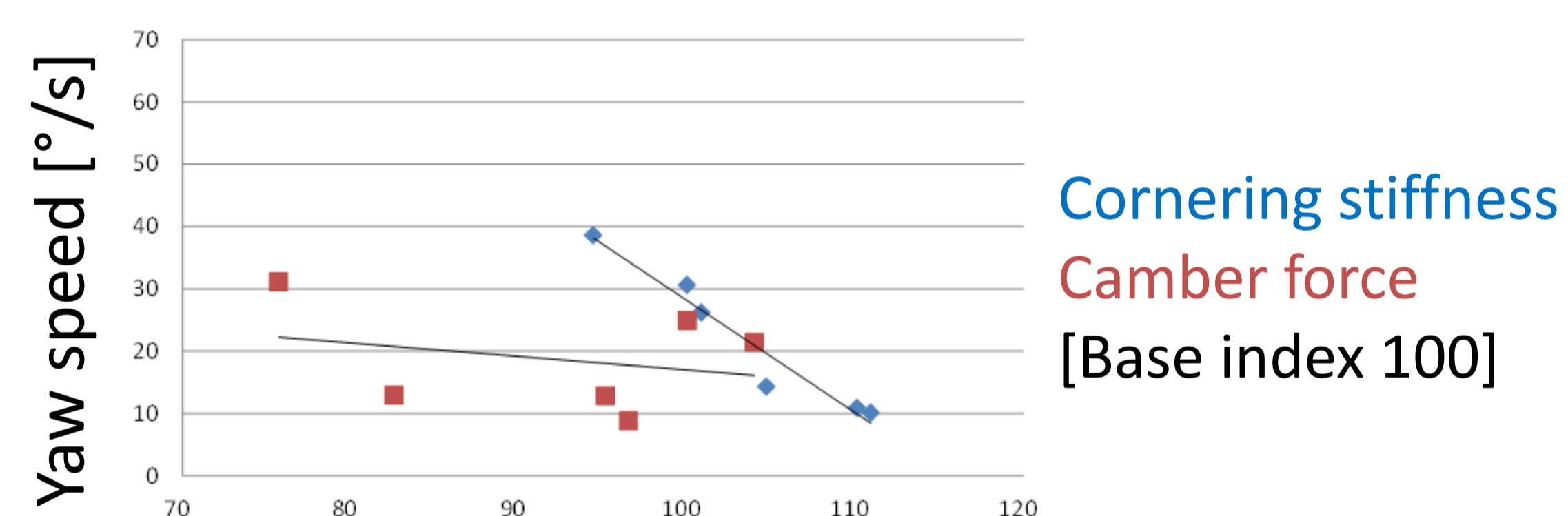
3-Subjective rider evaluation and objective assessment

Test Protocol

- Loaded vehicle riding on a straight track
- Analytical rider's manoeuvre on the motorbike
- Three test sequences with a constant speed on the motorbike:
 - WITH hands on handlebar and WITHOUT cruise control
 - WITHOUT hands on handlebar and WITH cruise control
 - WITH hands on handlebar and WITH cruise control



	Front tire	Rear tire
1	Road 4 Trail	
2	Anakee III	
3	Anakee Adventure A	
4	Anakee Adventure B	Road 4 Trail
5	Road 5 Trail A	
6	Road 5 Trail B	
7	Road5 Trail B with 500g of lead	



Conclusions

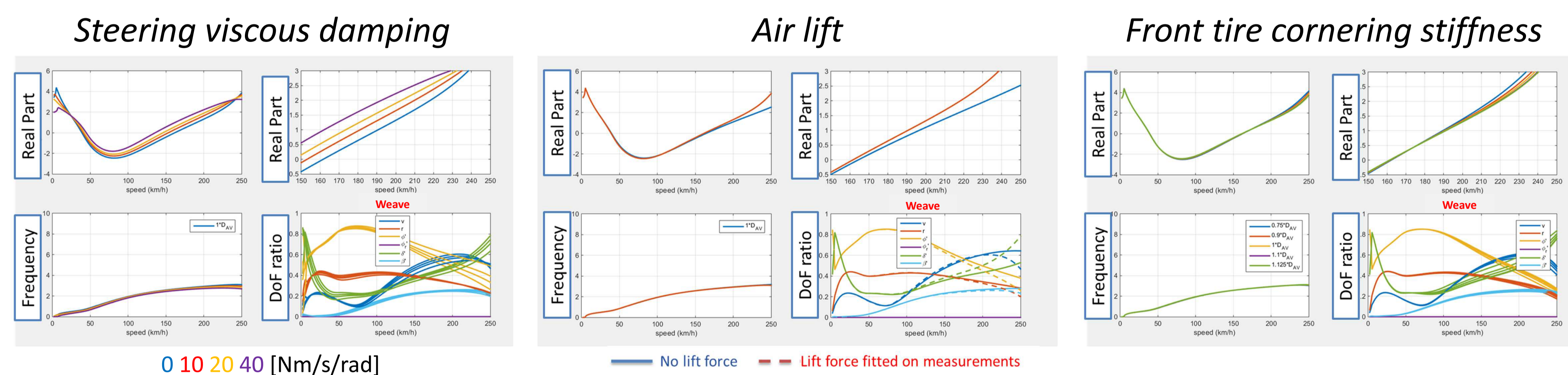
- Without rider's hands on handlebar, all tire configurations are STABLE.** It is the rider action on handlebar which starts the weave instability.
- This perturbation comes from the front frame to the rear frame.
- Subjective rider's evaluations are well correlated to motorcycle dynamics: yaw rate, inclination rate and steer angle.
- Estimation of **rider's viscous damping**: it **depends on rider and front tire**, value is in the range [0;40] Nm/s/rad.
- Few correlation with Force & Torque tire characteristics: correlation in straight line with the front tire cornering stiffness is only identified.

4-Simulations

Based on H.Pacejka's model

Motorcycle modelled as a multi-frame body:

- Main frame with lower rider
- Upper torso rider
- Upper Front frame
- Lower front frame



Conclusions

- The steering viscous damping measured on motorbike with a rider has more impact than the front tire design parameters.
- Key parameters we have to study are stiffness and damping response of the rider for several displacement magnitudes, several frequencies, ...

5-Prospects

- Work on motorbike and rider's characterizations
 - ✓ Instrumented track to evaluate the loads on F&R tires (available)
 - ✓ Measurement of the global motorbike inertia and geometrical characteristics (available)
 - ✓ Motorbike measurement with and without rider on machine to better understand the rider's influence (under progress in 2019)
- Improve simulation process to take into account the influence of rider and front tire on motorcycle high speed stability