



HYPERCAR TIRE DEVELOPMENT USING ADVANCED ACTIVE SYSTEMS ON A DRIVER-IN-THE-LOOP SIMULATOR

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Pirelli



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PAGANI

PIRELLI

TIRE DEVELOPMENT USING ADVANCED ACTIVE SYSTEMS ON A DRIVER-IN-THE-LOOP SIMULATOR

1999



ZONDA C12

2000



ZONDA S

2003



ZONDA ROADSTER

2005



ZONDA F

2006



ZONDA ROADSTER F

2009



ZONDA CINQUE

2009



ZONDA R

2010



ZONDA CINQUE ROADSTER

2010



ZONDA TRICOLORE

2011



HUAYRA

2013



ZONDA REVOLUCIÓN

2016



HUAYRA BC

2017



HUAYRA ROADSTER

2017



ZONDA HP BARCHETTA

2019



HUAYRA ROADSTER BC

2019



ZONDA REVO BARCHETTA

2020



PAGANI IMOLA

2020



HUAYRA TRICOLORE

2021



HUAYRA R

2022



HUAYRA CODALUNGA

2022



PAGANI UTOPIA



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CHALLENGE

- ✓ To develop a new tire spec for the Pagani Utopia, so as to enhance the performance's envelope and driving emotions



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CONSTRAINTS

1. Short available time for development, allowing for half the joint test sessions normally, using traditional methodology.
2. Mechanical balance should remain as close as possible to the baseline, limiting vehicle set-up interventions
3. No previous co-design of tires on the virtual domain nor DIL

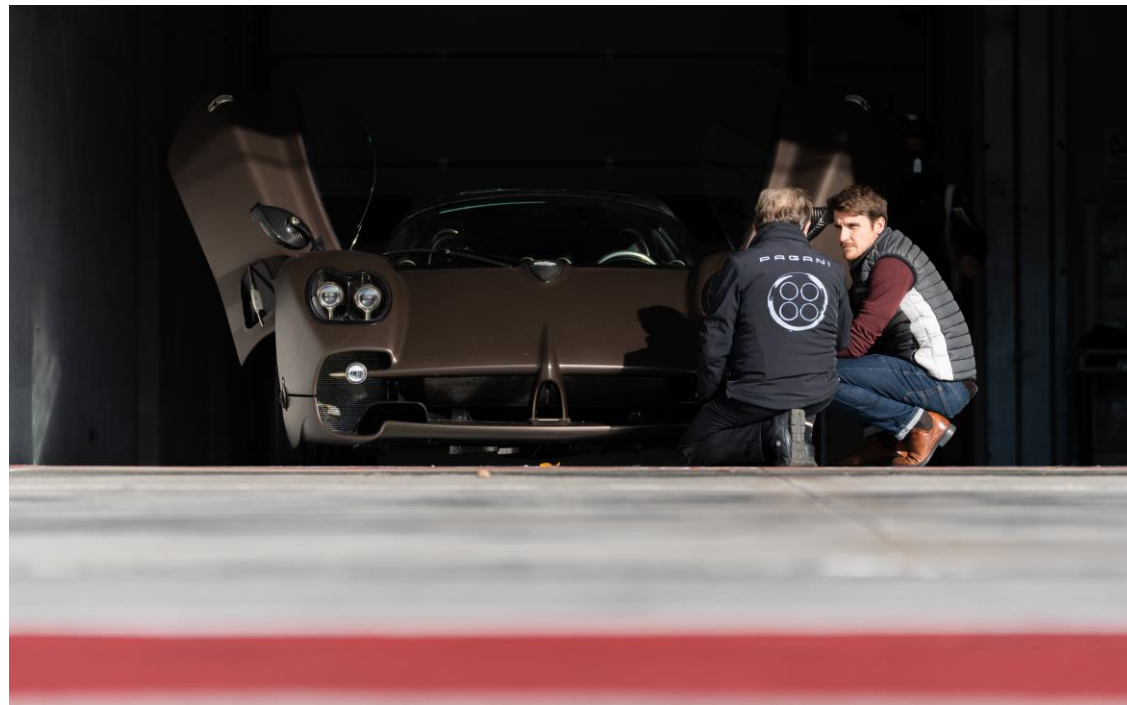




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PROCESS

1. Integration of advanced active systems and calibrations on the vehicle's digital clone, in CRT (In house --> Lean process)

2. Share of the obfuscated vehicle model and all active systems.

3. Outdoor vehicle characterization, correlating the vehicle's dynamics with objective maneuvers and subjective handling driving, for a Baseline tire spec.

4. Precise working conditions for the tires where to improve

5. Pirelli creates virtual models of the new spec tires, in different specifications

6. Tire subjective/objective evaluation through DiL Session

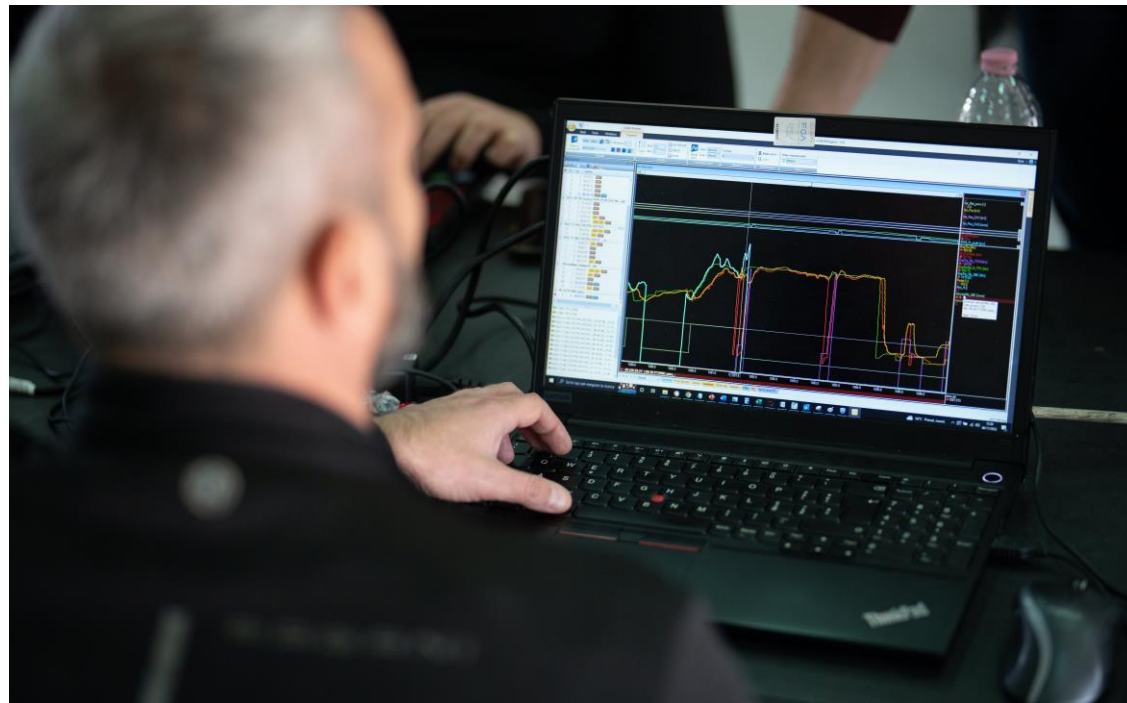
7. On vehicle validation through outdoor testing activities (objective and subjective)



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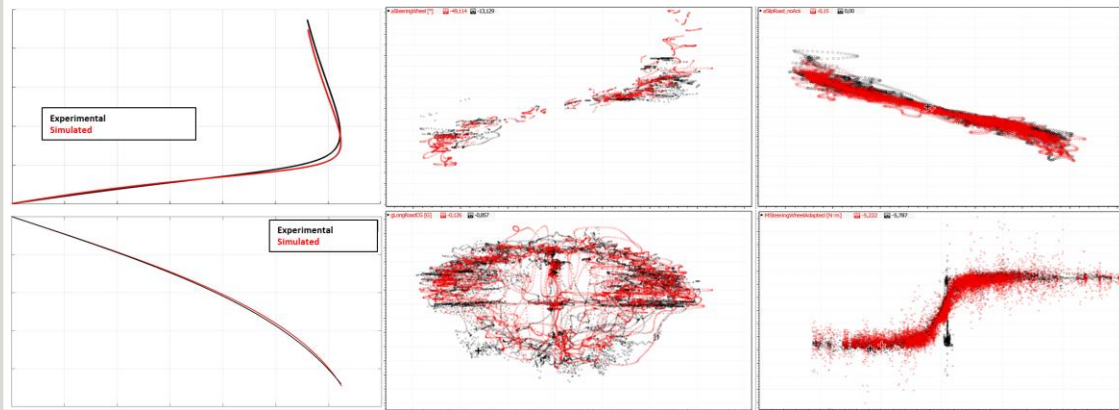
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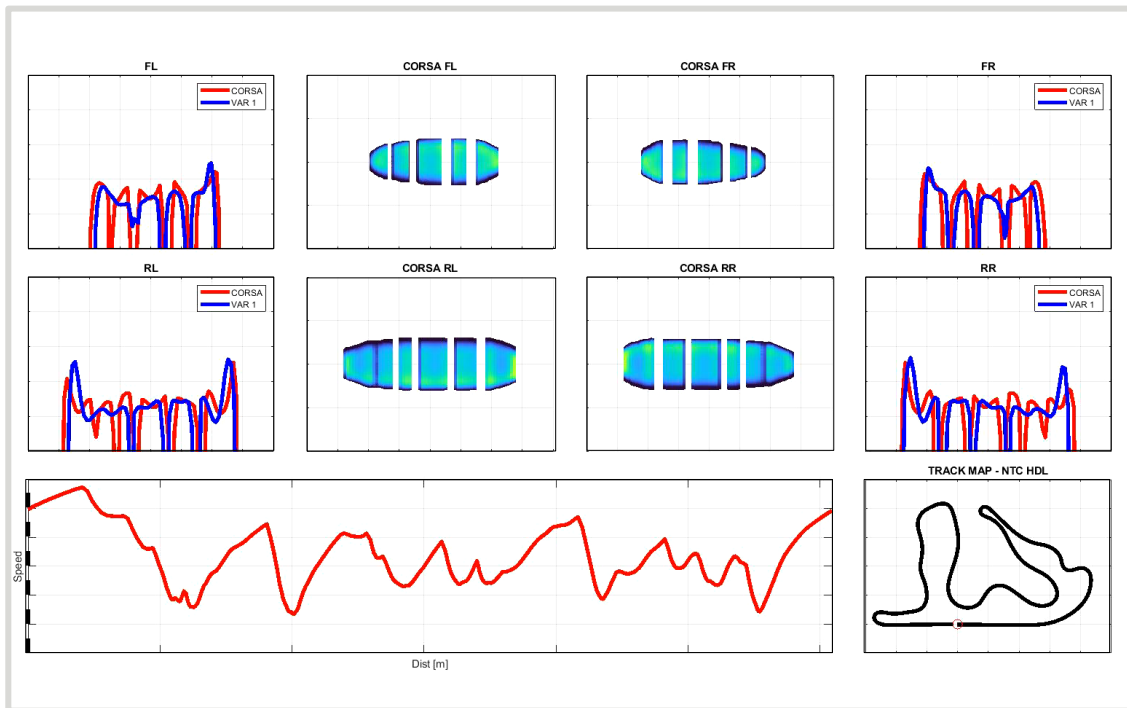
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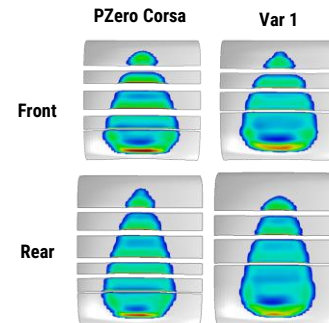
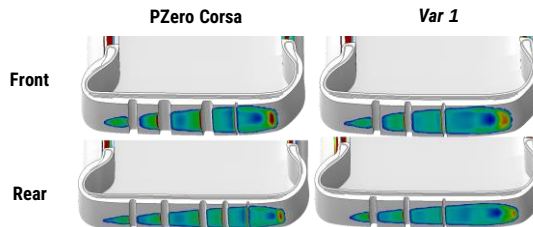
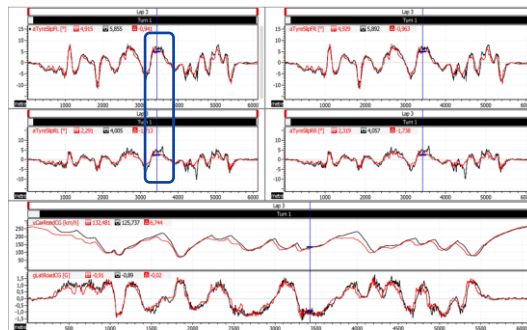
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Var 1:

- +11% contact area front
- +7% contact area rear
- Better contact pressure

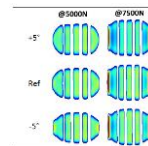


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FEA SIMULATIONS



VEHICLE SIMULATIONS

KPI LIN		FRONT			
	Base	Var 1	Var 2	Var 3	Var 4
REAR	Base	100.0%			
	Var 1		93.9%	92.9%	96.6%
	Var 2		93.0%	91.6%	94.0%
	Var 3		92.9%	84.8%	93.9%

KPI NON LIN		FRONT			
	Base	Var 1	Var 2	Var 3	Var 4
REAR	Base	100.0%			
	Var 1		86.5%	81.3%	68.3%
	Var 2		96.4%	94.7%	86.8%
	Var 3		98.8%	99.2%	87.9%

KPI LIN		FRONT			
	Base	Var 1	Var 2	Var 3	Var 4
REAR	Base	100.0%			
	Var 1		95.0%	94.9%	94.8%
	Var 2		96.3%	96.3%	95.5%
	Var 3		96.1%	105.6%	95.5%

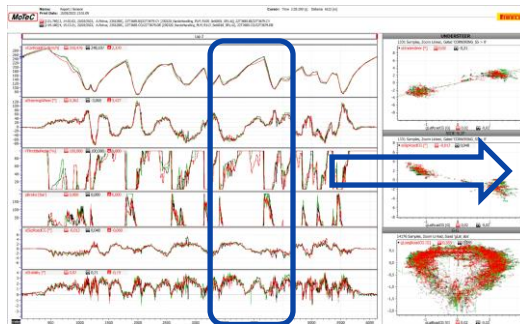
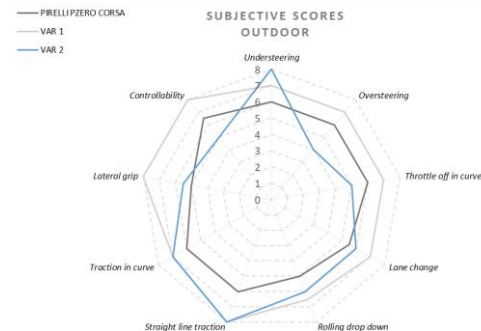
KPI NON LIN		FRONT			
	Base	Var 1	Var 2	Var 3	Var 4
REAR	Base	100.0%			
	Var 1		99.4%	99.7%	109.7%
	Var 2		92.3%	92.1%	102.4%
	Var 3		91.6%	88.3%	103.7%



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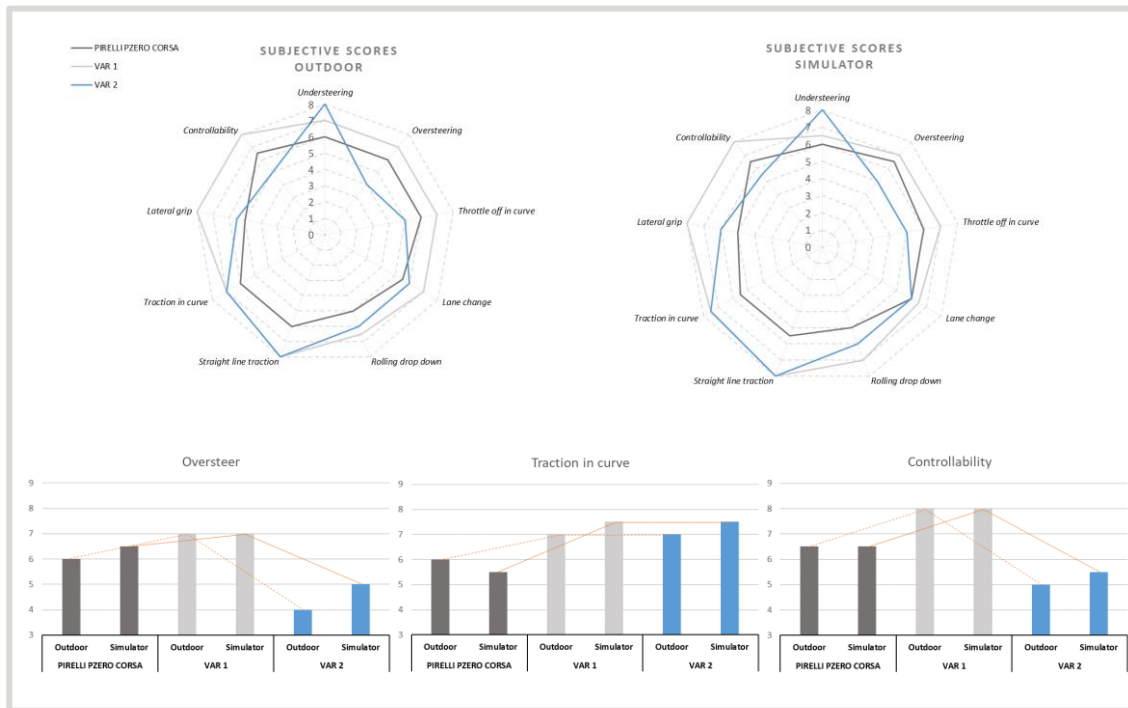


SECTOR IMPROVEMENT 1.5s out of 35s

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RESULTS

1. Effective Integration OffLine + OnLine:
 - ✓ Seamless collaboration through a shared simulation environment, Vi-Grade
 - ✓ Agile teams, lean management and results-oriented sessions
 - ✓ Quick ramp-up for DiL Simulator and Driver subjective positive assessment
2. Good consistency between DiL and Outdoor subjective feedback and objective metrics, and among different tracks



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Results

300+

Tires building saved

50%

*Of physical Joint reduction tests
vs. Traditional methodology*

30%

Development time saved

Grazie

