

DAL DATO GREZZO AL SENSORE VIRTUALE

*5 Maggio 2016, REI, Reggio Emilia
INFORMATION TECHNOLOGY in AUTOMOTIVE
e nei veicoli HEAVY DUTY*

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AttainIT S.r.l. – Software and Control division

Summary

- **COMPANY INTRODUCTION**
- **COMPLEXITY OF THE NETWORKS WITHIN THE VEHICLES**
- **APPROACHES TO TRANSFORM DATA TO INFORMATION**



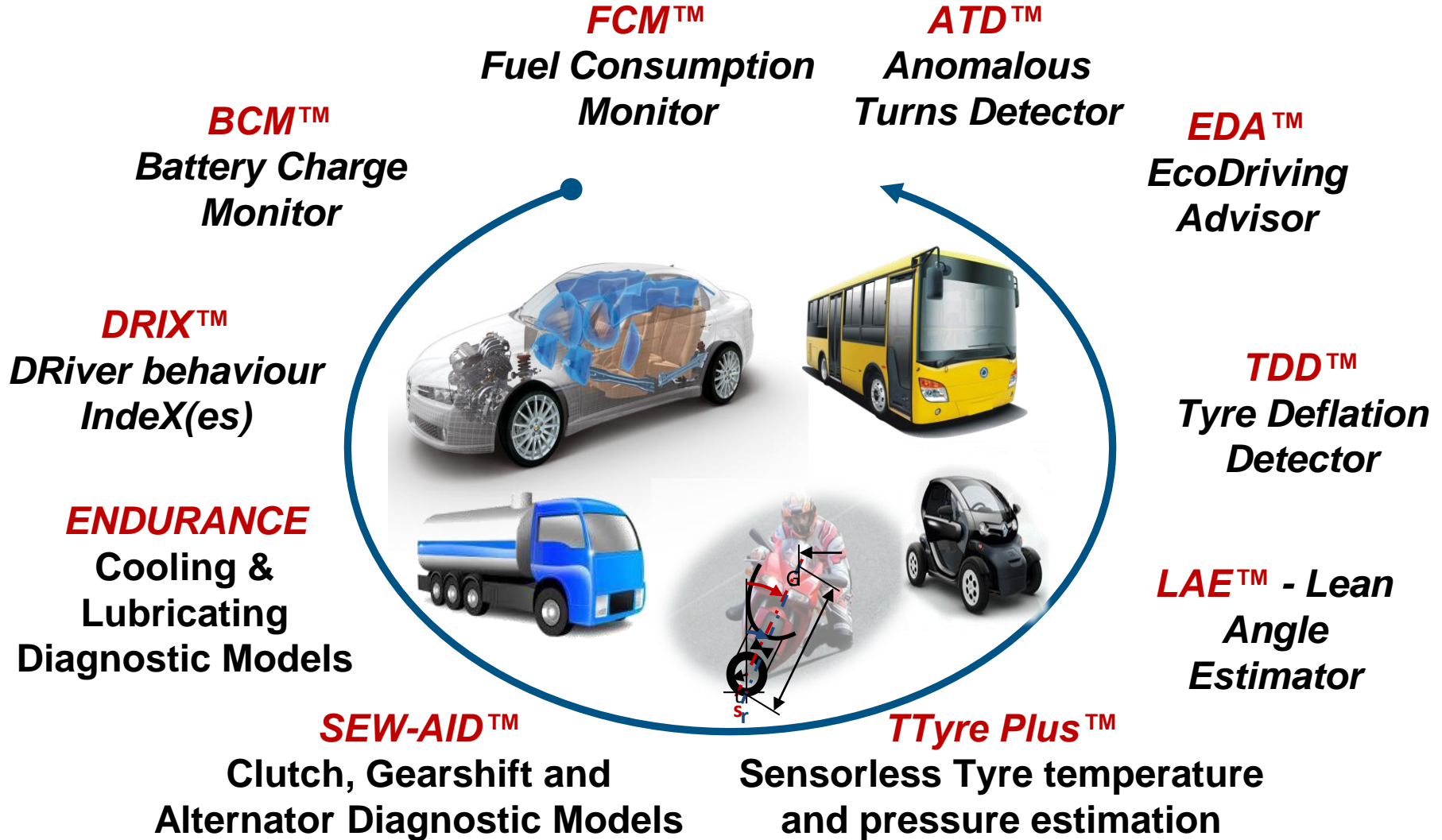
Attain IT profile

- **Attain IT S.r.l. (www.attainit.eu) founded in January 2011 is an Information Technology company specialized in the development of SW products and services for the acquisition and processing in real-time of data from mobile systems (such as vehicles) and by means of mobile devices (such as smartphones and embedded systems).**
- **Attain IT is a spin-off of S.A.T.E. (www.sate-italy.com), an R&D and engineering company providing model based design solutions for the automotive, oil&gas, energy and space industry, with customers in Europe and Asia.**
- **Both companies are located in the historical center of Venice, Santa Croce 664/A.**



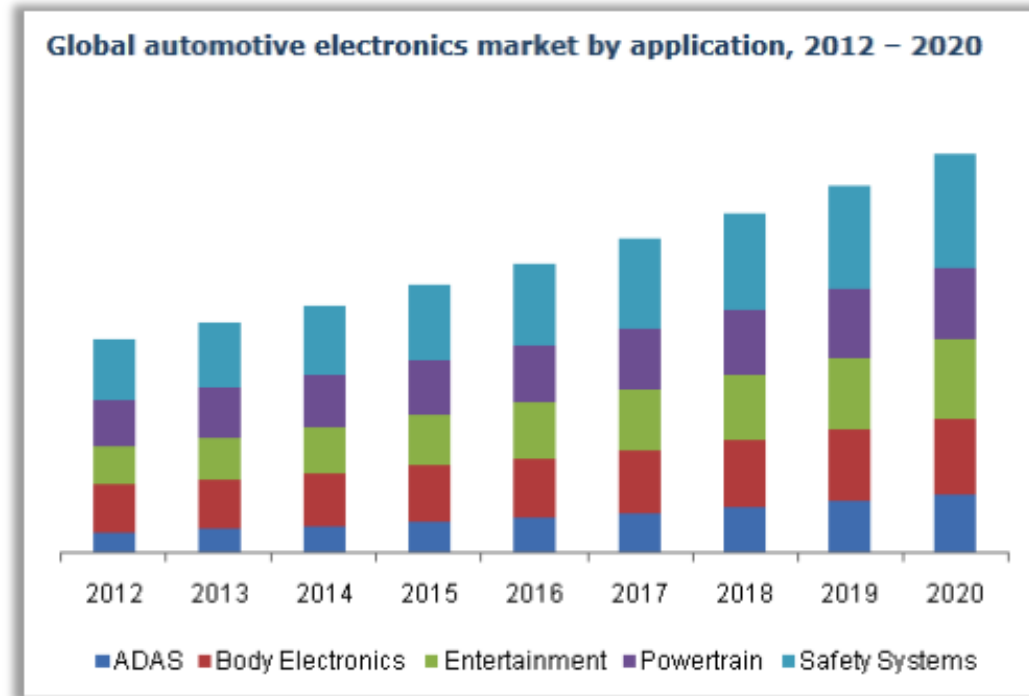
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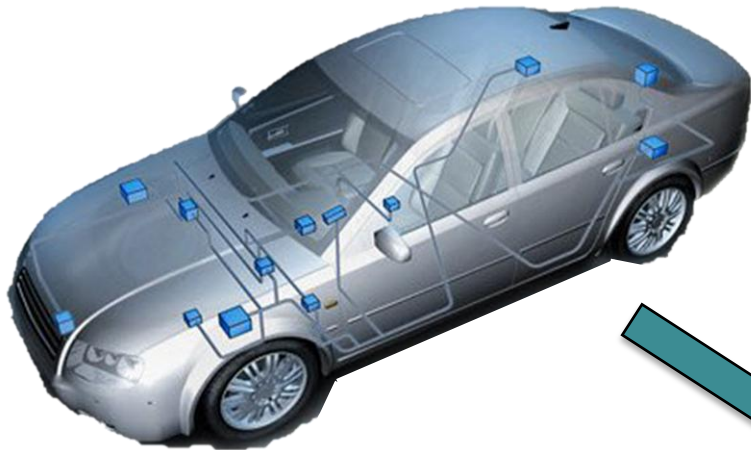


Vehicle Networks become complex...

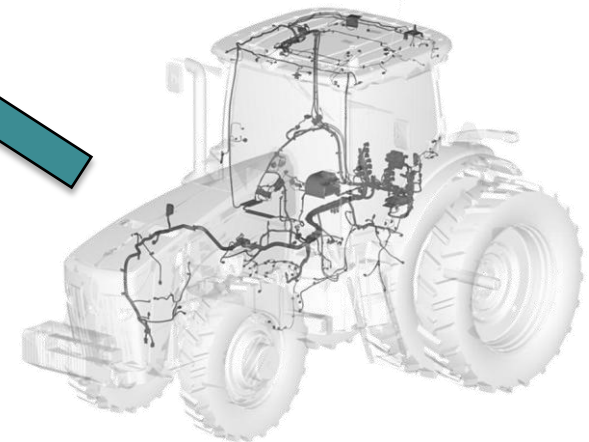
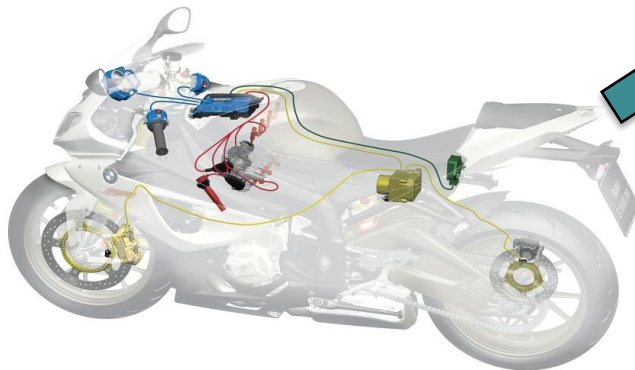
- *There is an increasing number of ECUs*
- *There are many subnets within the vehicle*
- *New protocols lead to more functions with higher speeds*



...more data are available!



Mo...	Length	Data	Period
040h	6	00 00 00 00 00 00	100
045h	6	00 00 00 00 00 00	8
170h	8	0F A0 6E 3C 00 00 14 00	8
180h	3	00 00 00	16
300h	5	05 DC 93 00 00	10
300h	7	9C 78 50 3C 68 71 86	100
300h	8	7F FF 00 7F FF 03 7F FF	10
320h	5	00 00 01 01 F2	100
325h	2	64 00	20
326h	8	00 80 00 00 00 00 00	15
332h	8	7F FF 7F FF 7F FF 00 C0	8
333h	1	00	50
400h	7	20 00 3C 00 00 A0 07	10
420h	8	00 00 0A 00 1F 40 04 4C	16
422h	2	00 1E	48
425h	8	00 00 23 28 02 58 00 00	16
430h	8	FC E7 00 00 00 00 00 00	100
450h	7	1F 40 00 00 0F A0 00	16
470h	7	37 37 40 3F 00 00	100
480h	8	27 10 27 10 27 10 27 10	10
4FFh	8	30 31 46 4D 59 55 00 79	248
500h	8	46 14 39 37 64 00 00 53	96
510h	3	46 10 24	48
575h	8	00 00 00 00 00 00 00 16	



Summary

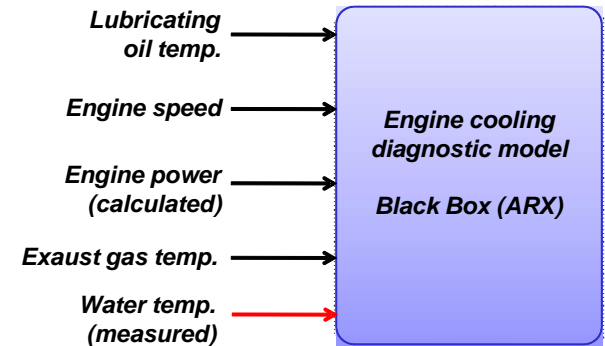
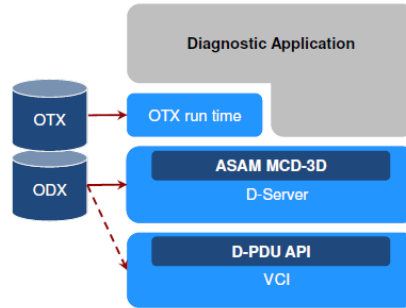
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Data and information relationship

- **The extraction of information from data requires:**

- **Know How**
- **Tools**
- **System Design**



There are different solutions:

- **Information “is” the data itself**
- **Information “is calculated” from the data**
- **Information “is derived” from the behaviour over time of more data**

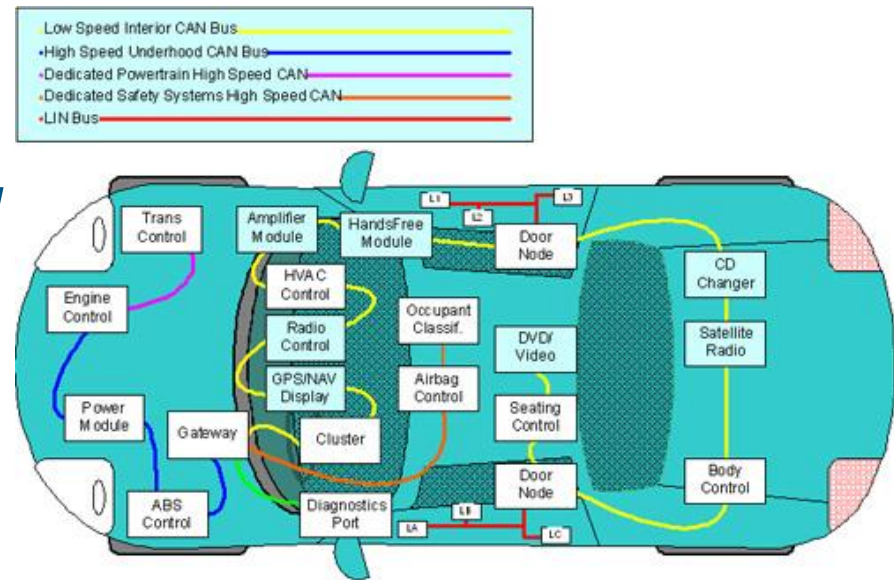


Information “is” the data

Information requires “only” to read and to decode the data.

Two Networks:

- Diagnostic (Off Board)
- Legislated OBD protocol
- Proprietary protocol
- In Vehicle (On board)

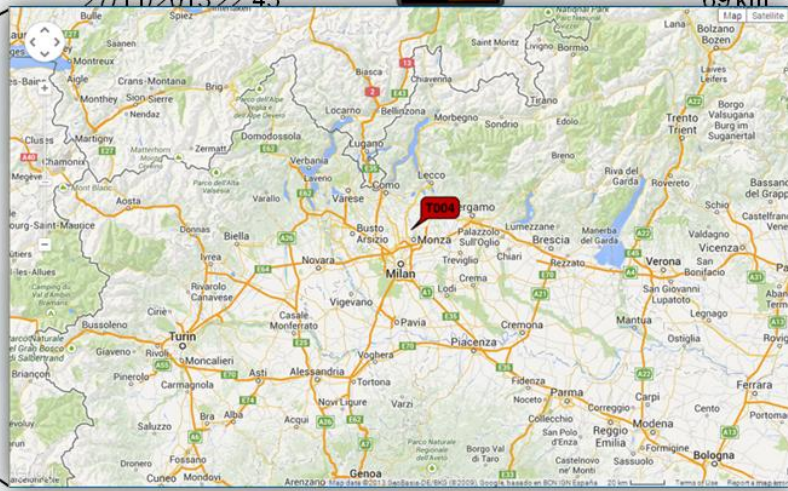


Information "is" the data: Fleet BCM

Aggiorna mezzi selezionati

Periodo di aggiornamento dati 1 min 30 min

Stato del mezzo (acceso/spento)	ID mezzo ▲	Data ultimo aggiornamento	Livello di carica	Raggio d'azione residuo	Selezionare mezzi da aggiornare
	T001	28/11/2013 13:34	 87%	85 km	<input type="checkbox"/>
	T002	27/11/2013 22:45		69 km	<input type="checkbox"/>
	T003				<input type="checkbox"/>
	T004				<input type="checkbox"/>
	T005				<input type="checkbox"/>
	T006				<input type="checkbox"/>
	T007	27/11/2013 22:30	 69%	65 km	<input type="checkbox"/>



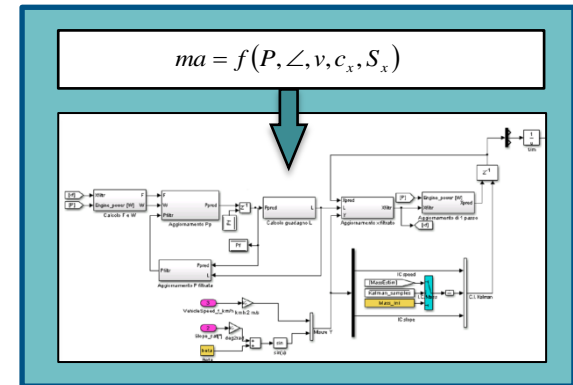
[Seleziona tutti](#) [Deseleziona tutti](#)

Information "is" the data: Fleet BCM

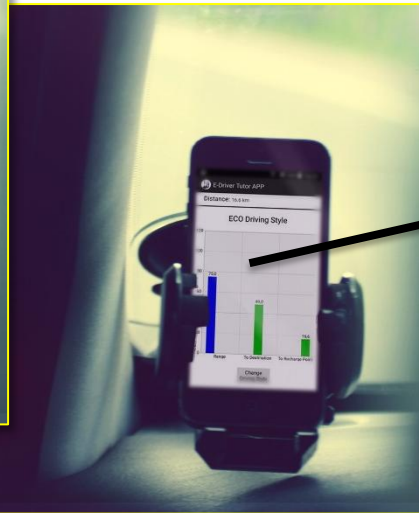
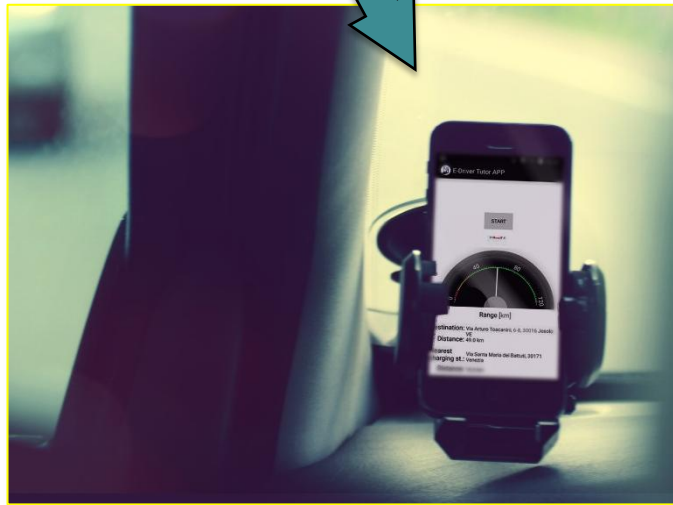
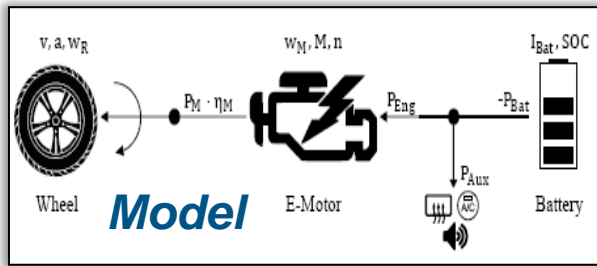


Information “is calculated” from data

- **Information is extracted from an instantaneous model**
- **“Simple” calculation**
- **Synchronous data**
- **It requires few computation resources**
- **Very low cost solution**
- **Easy to be integrated in any device**



Information "is calculated" from data



Range estimation
depending on the
driving style:

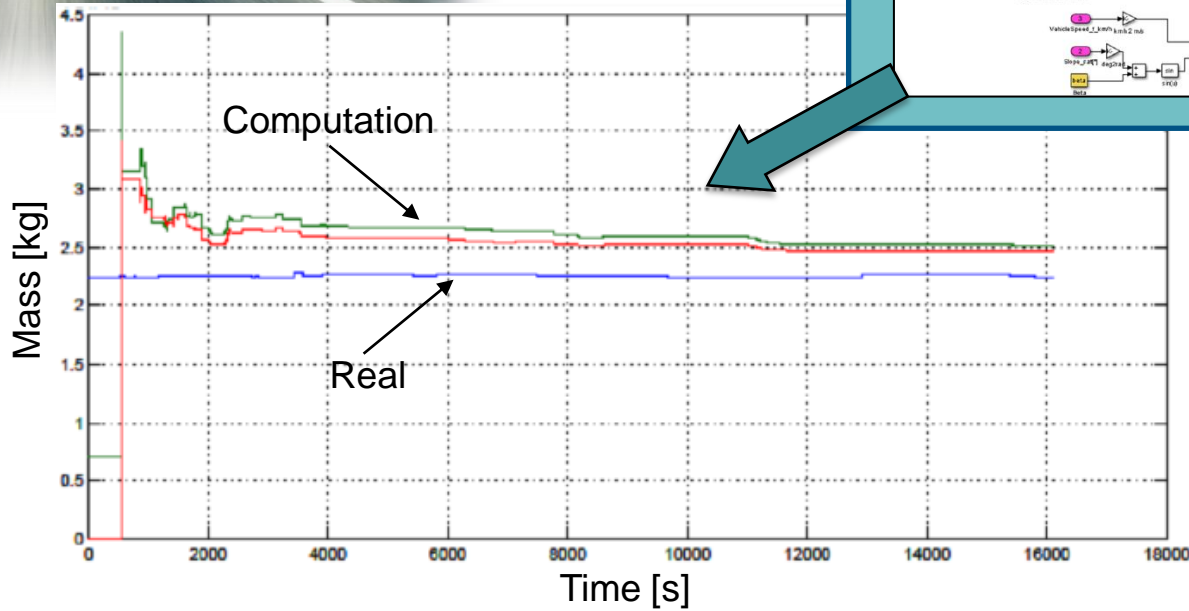
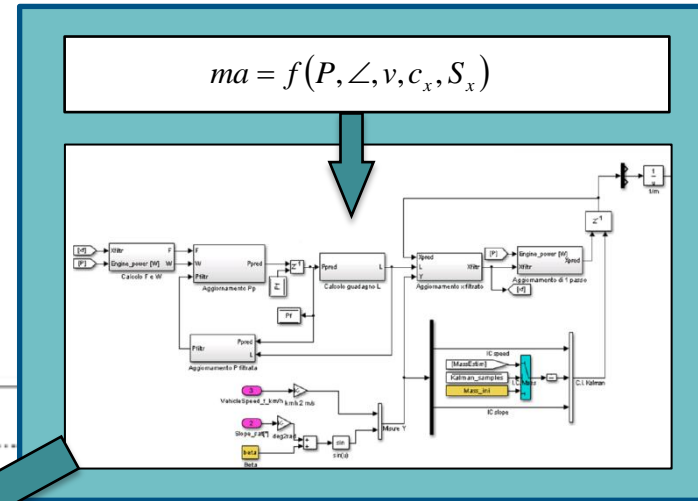
- Eco
- Normal
- Sport

Information

Information “is calculated” from data



Model

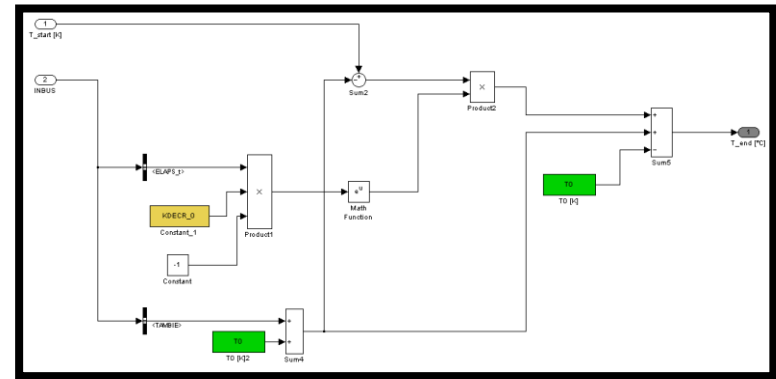


Mass computation
from available data:

- **Engine power**
- **Road slip**
- **Speed & acceleration**

Information “is derived” from data

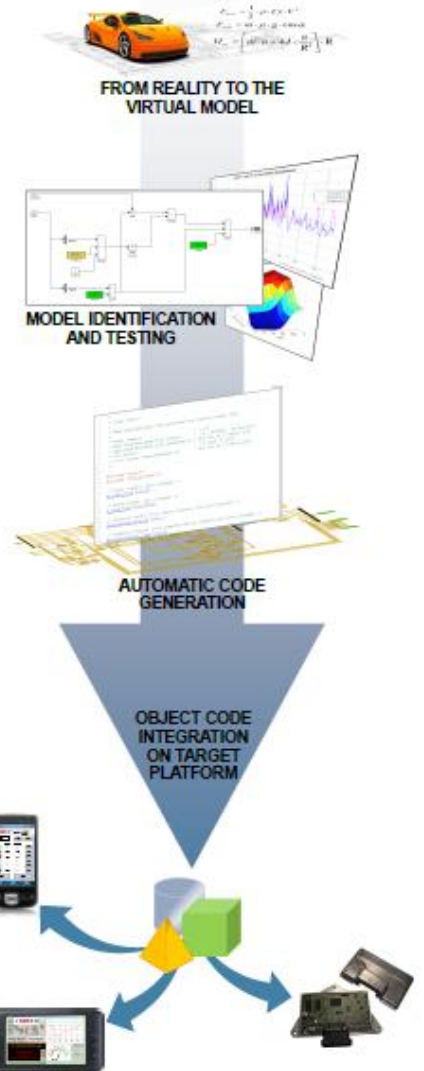
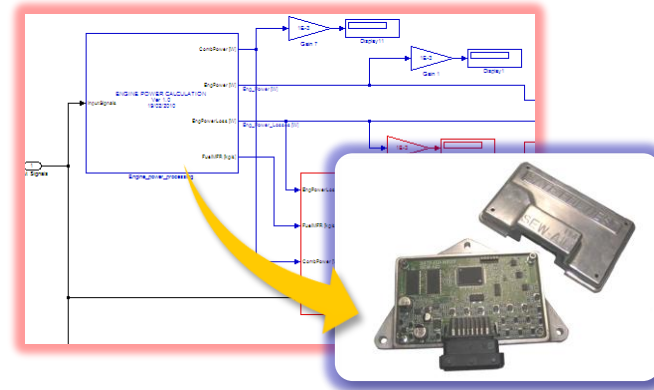
- **Information is extracted from a dynamical model**
- **More complex calculation**
- **Real time requirements**
- **It requires some computation resources**
- **Suitable for 16/32 bit uController**
- **Easy to be integrated in Body controller/Multimedia/Dashboards**



Information “is derived” from data

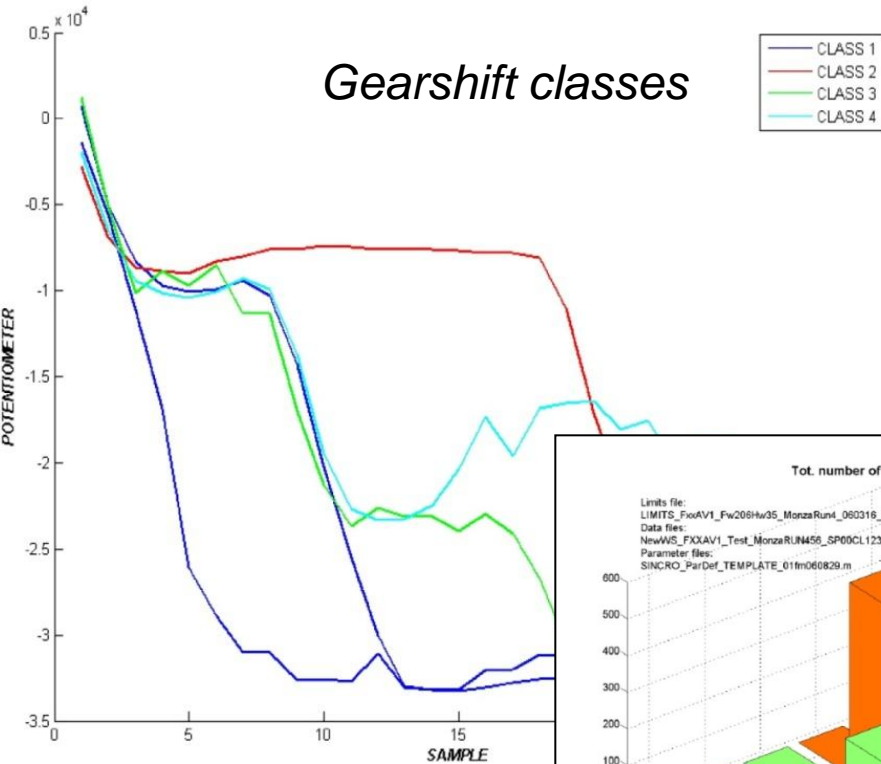
Application fields:

- Predictive fault detection and isolation
- Virtual sensors
 - Tyres Temperature
 - Lean angle
 - Tyres Pressure

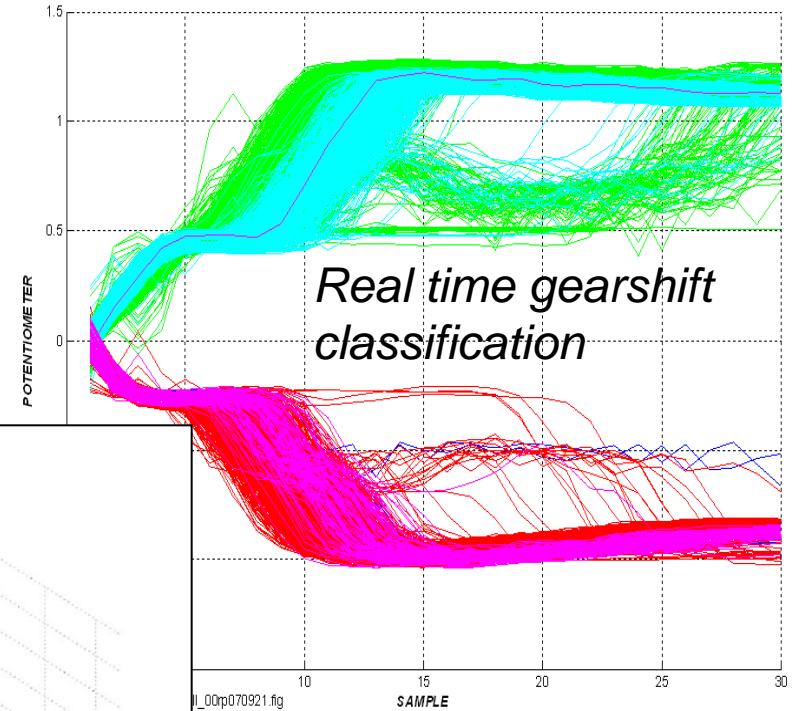


Fault Prediction: GEARBOX

Gearshift classes



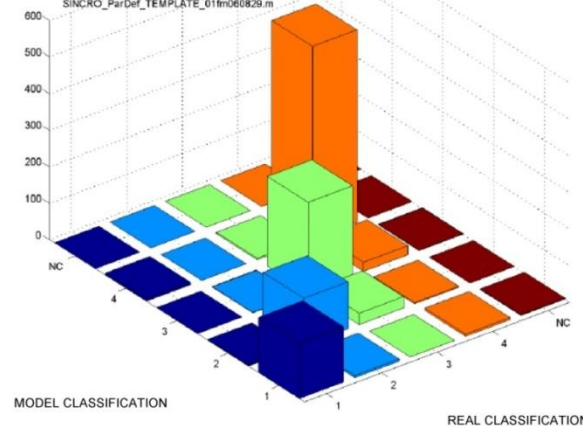
SEW-AID - SINCRO MODEL
GEARSHIFTS all



Real time gearshift classification

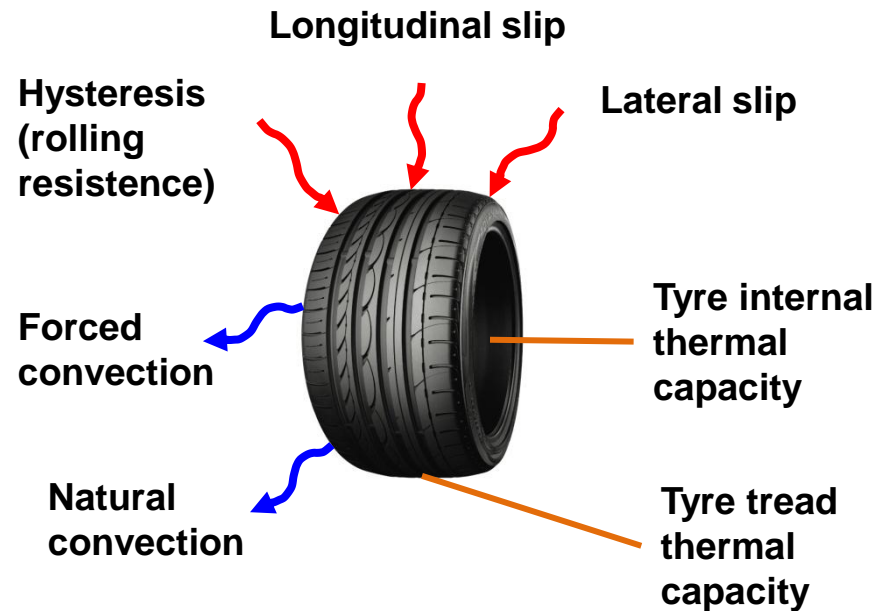
Tot. number of gearshifts: 1140

Limits file:
LIMITS_FwAV1_Fw208hw35_MonzaRun1_060316_01dc060822.mat
Data files:
NewWS_FXXAV1_Test_MonzaRUN456_SP00CL123m4_00dc060831.mat
Parameter files:
SINCRO_ParDef_TEMPLATE_01m060829.m

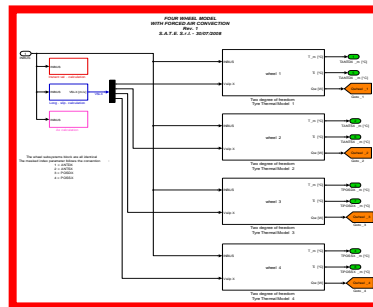


Changes of classes statistics imply synchronizers wear and symptom of ageing

Virtual sensor: TTYRE



- *long. acceleration*
- *lateral acceleration*
- *wheels speed*
- *external temperature*



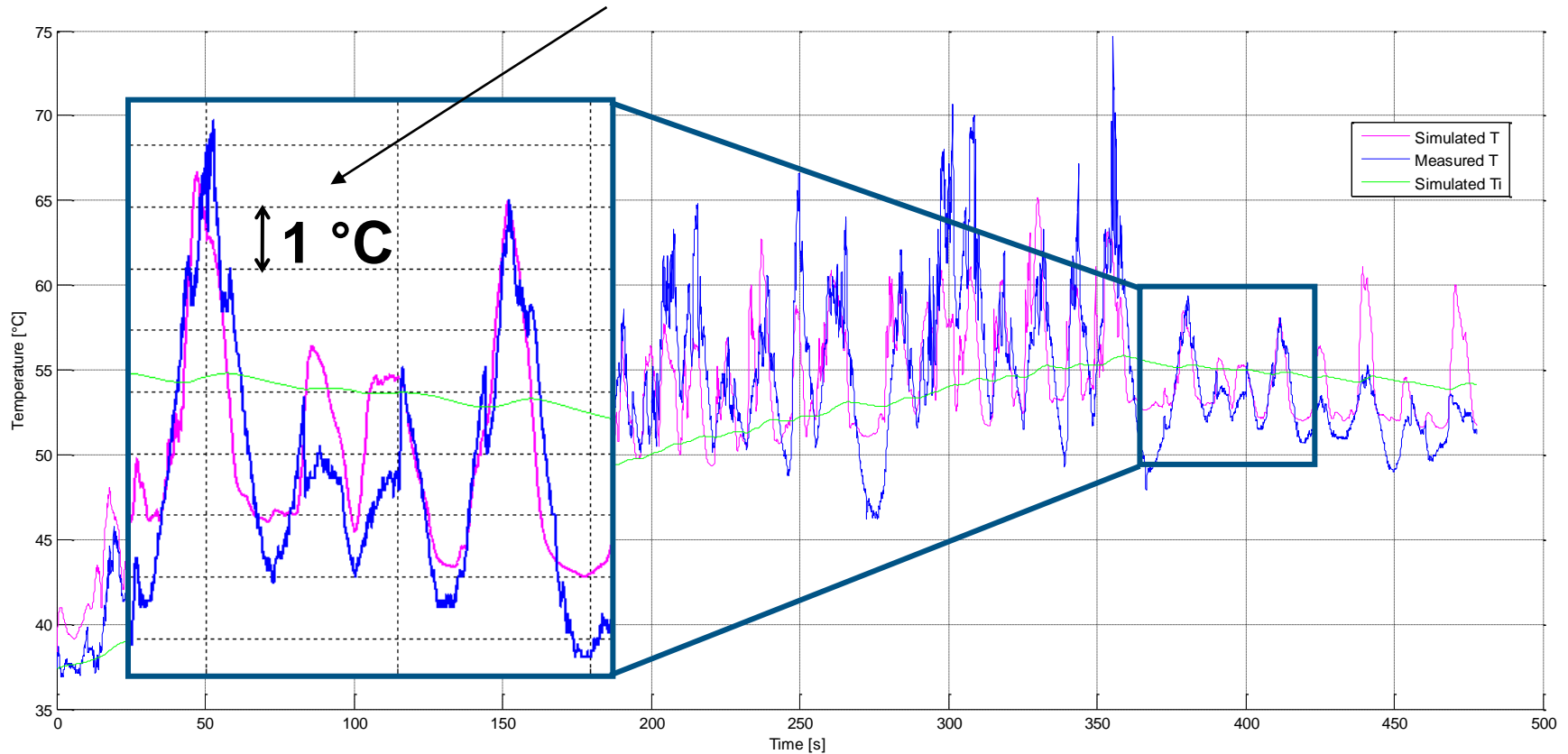
Model



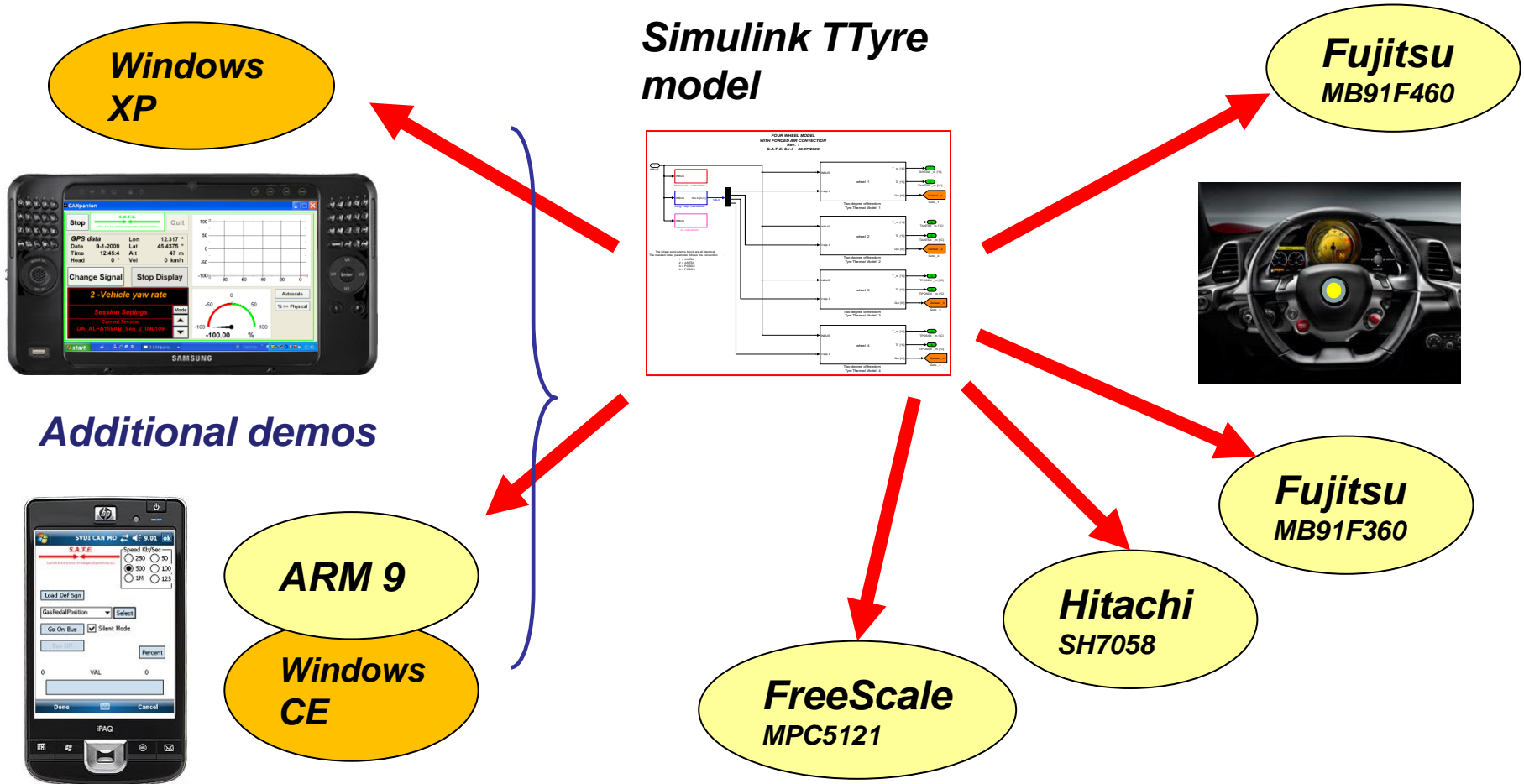
- *estimated tyre tread temperature*
- *estimated tyre internal temperature*

Virtual sensor: TTYRE

Order of model accuracy



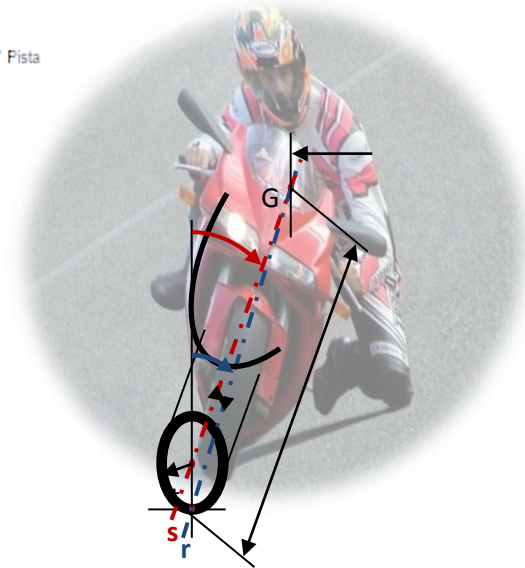
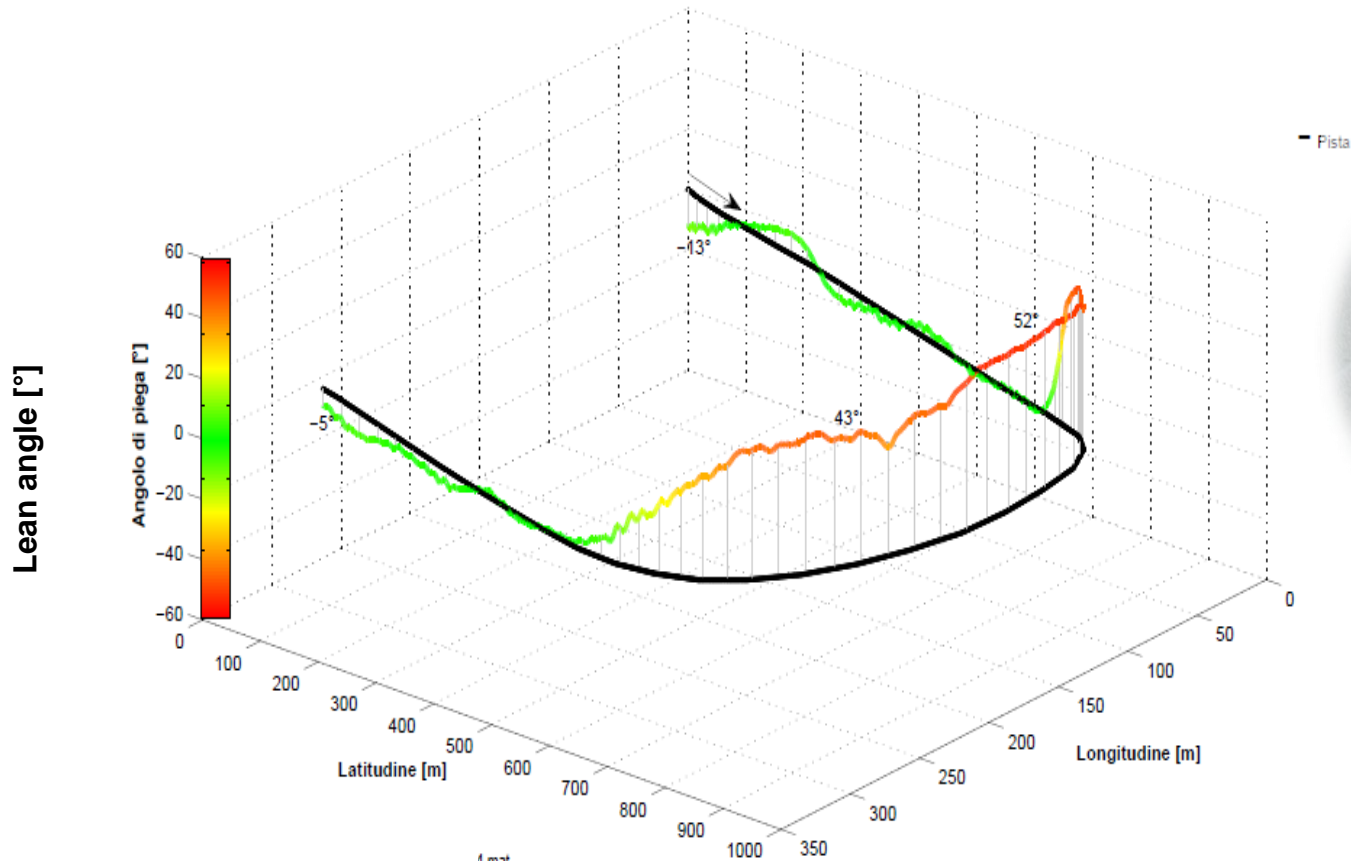
Virtual sensor: TTYRE



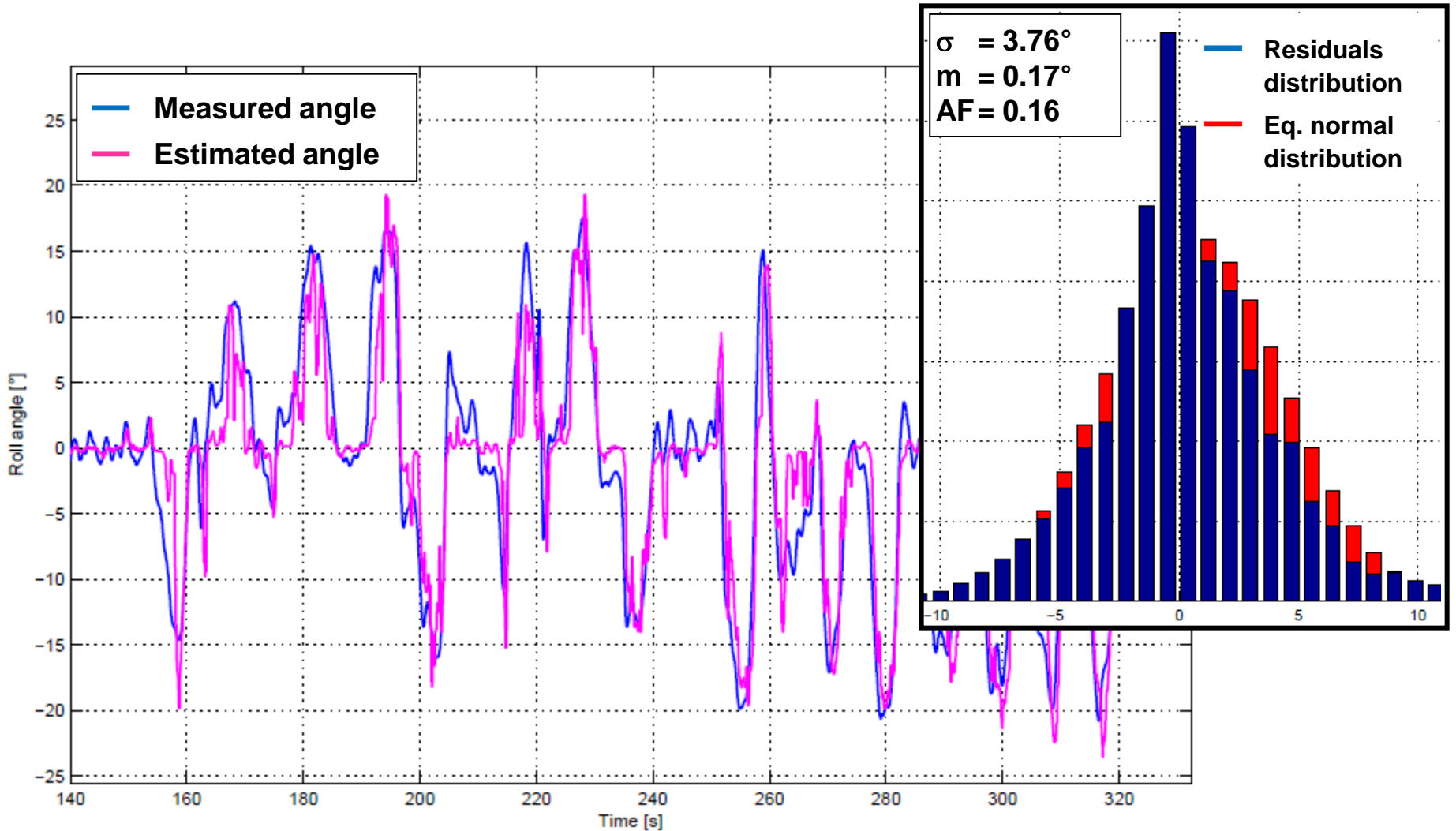
Virtual sensor: LEAN ANGLE

Lean angle – Monza circuit

BMW S1000 RR – Circuito di Monza – Curva Parabolica – Angolo di piega



Virtual sensor: LEAN ANGLE



Conclusions

- The complexity of vehicle networks offers new opportunities
 - AttainIT has already developed many solutions
 - We have the knowledge/experience to design new ones
- Virtual sensors/predictive fault detection are very promising
- Our solutions could be applied to
 - Cars
 - Heavy Duty
 - Bikes
 - Electrical Vehicles
 - ...



A satellite view of the Earth from space, showing the curvature of the planet and the blue oceans and white clouds. The text "THANK YOU! QUESTIONS?" is overlaid on the left side of the image.

**THANK YOU!
QUESTIONS?**