



TRIMM is supported by funding from the 7th Framework Programme Call: SST.2011.5.2-2.
Theme: Advanced and cost effective road infrastructure construction, management and maintenance



Task 4.5. – Deliverable 4.4. Fleet Monitoring of Road Comfort

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Road Comfort



- ▶ We only consider road comfort issues due to longitudinal unevenness.
- ▶ We consider longitudinal evenness expressed by the “weighted longitudinal profile”: WLP.
- ▶ We consider accelerations as the source of lack of comfort.

Fleet Monitoring



- ▶ Common practice by road managers:
 - Sophisticated measurement devices do “annual” surveys of longitudinal (un)evenness.
 - Results in IRI, WLP or other technical indices.
 - Used in PMS.

- ▶ Fleet monitoring is:
 - “Constant” but “approximate” surveys by ordinary vehicles;
 - Currently not really exploited for road management;
 - Complementary to “annual” precise measurements;
 - Extra input on low trafficked roads where the sophisticated devices “never” come.

Approaches in TRIMM

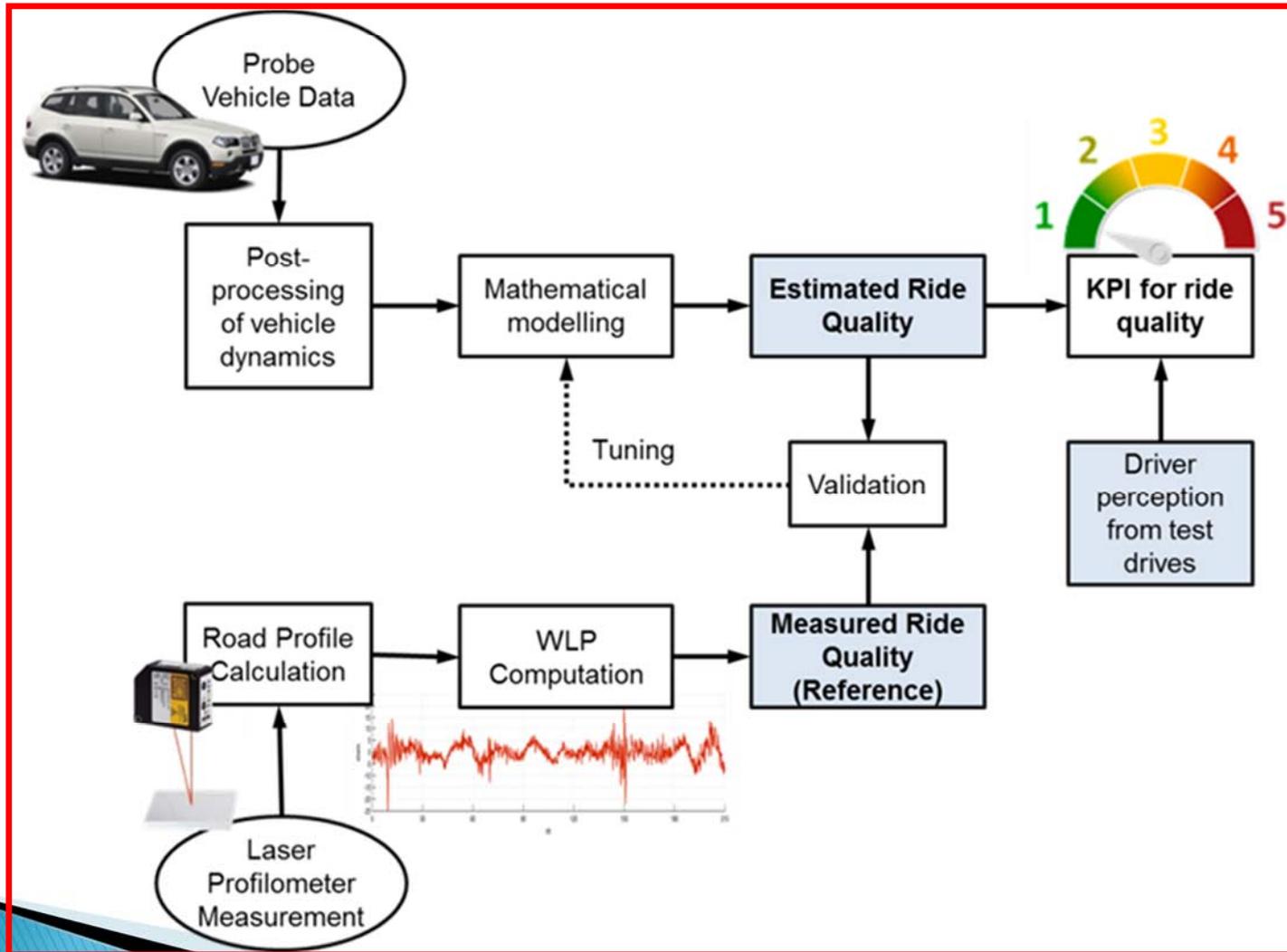


- ▶ Prove vehicle data:
 - To be collected from “ordinary” cars;
 - In TRIMM study: cars specially equipped for “research”;
 - CANBus, GPS and accelerometer data interpreted (by AIT) so that they allow the classification of roads in the road network.

- ▶ Smartphone data:
 - Smartphone with app (from VTI) in ordinary car or truck;
 - Treatment of 3D accelerations and GPS position;
 - Expression of “vertical vibration” in a “score” expressing “road comfort”.
 - But what is the reproducibility and the repeatability, and thus in some sense the reliability of the approach?

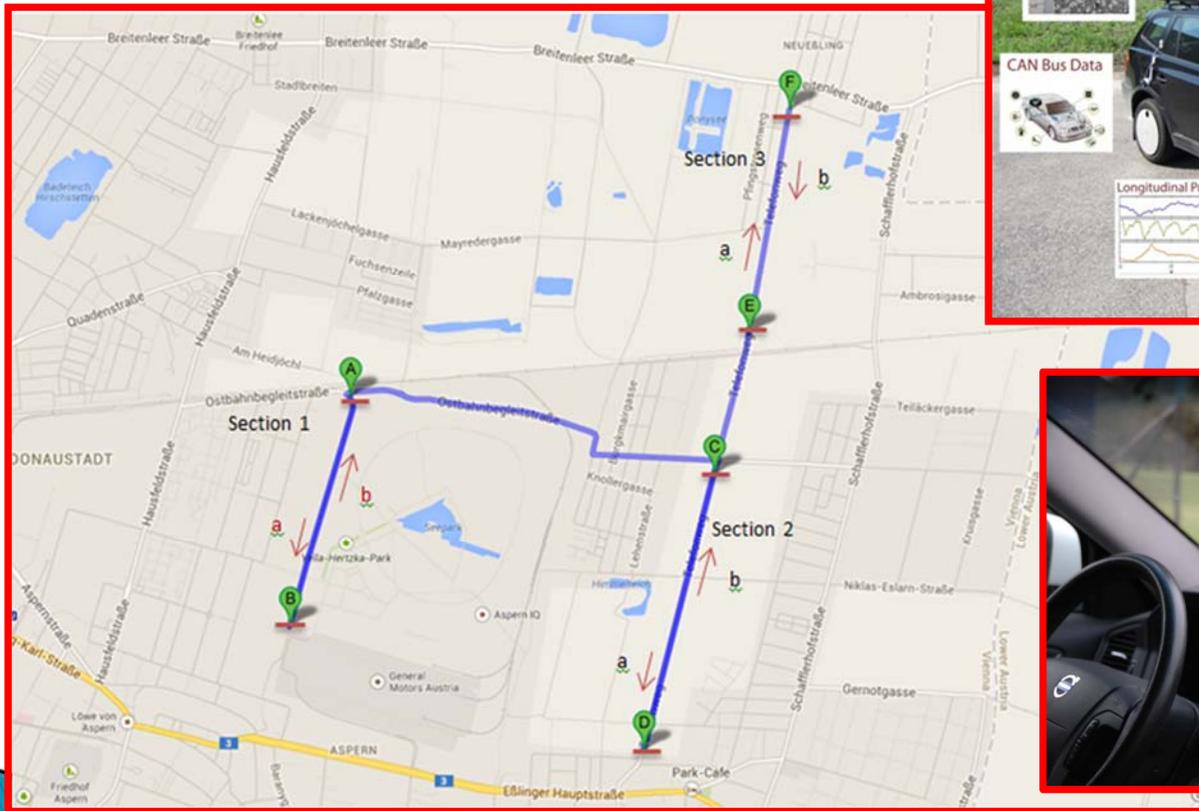
- ▶ Questionnaires:
 - Some “passengers” in the cars answered a few questions about their feeling of comfort;
 - The objective was to have some feed-back of some ordinary road users.

From "Probe vehicle data"



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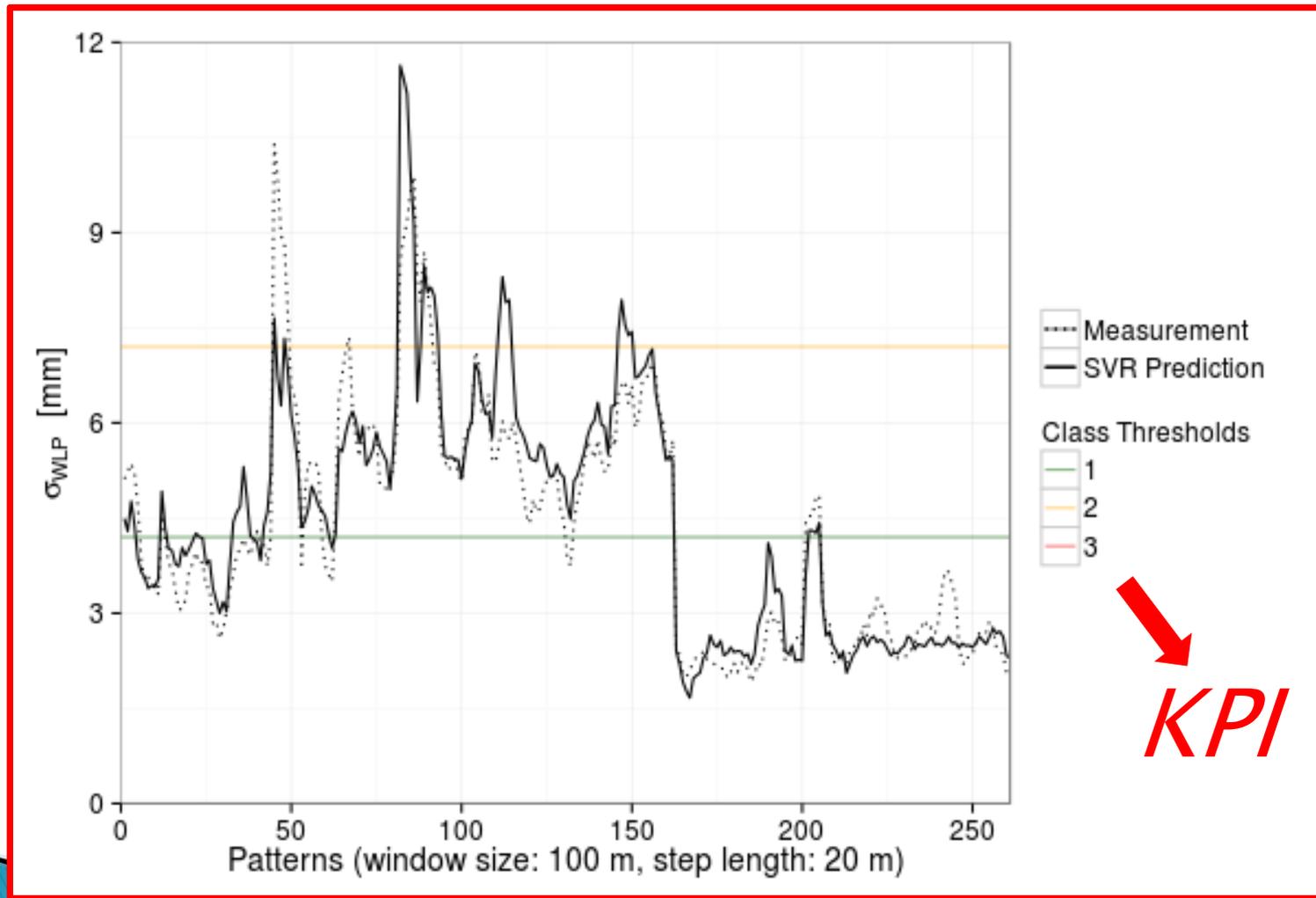
Test drives in A, B, S



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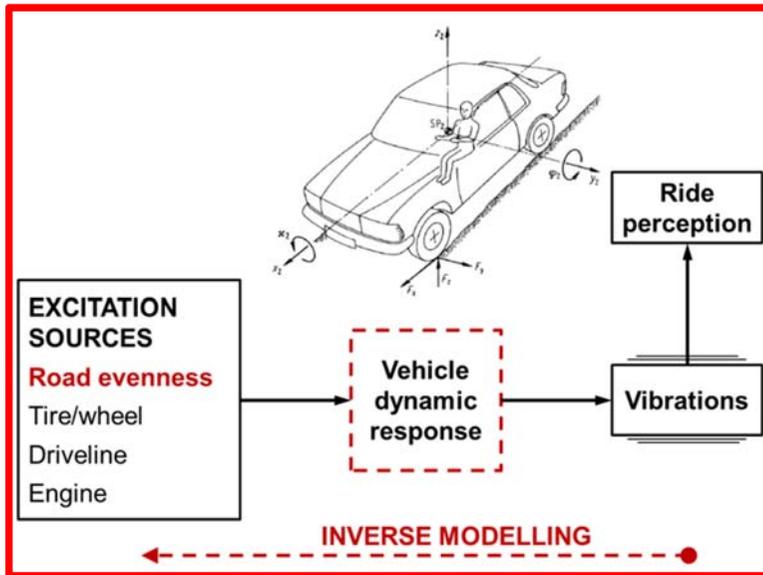
Estimation of σ_{WLP} checked with motorway validation set



Probe data 2 Indicator



- ▶ Probe data through ANN to estimated WLP.



Road Type	Target	ρ	L1 error [mm]	L2 error [mm]
Motorways	Δ_{WLP}	0.879	6.556	100.414
	σ_{WLP}	0.931	0.487	0.7132
Urban roads	Δ_{WLP}	0.902	16.402	25.230
	σ_{WLP}	0.973	1.492	2.012

Indicator/class	1	2	3	4
IRI [m/km]	$0 \leq \text{IRI} < 1$	$1.0 \leq \text{IRI} < 3$	$3 \leq \text{IRI} < 4.5$	$\text{IRI} \geq 4.5$
Δ_{WLP} [mm]	$0 \leq \Delta_{WLP} < 25.2$	$25.2 \leq \Delta_{WLP} < 42.5$	$42.5 \leq \Delta_{WLP} < 75$	$\Delta_{WLP} \geq 75$
σ_{WLP} [mm]	$0 \leq \sigma_{WLP} < 4.2$	$4.2 \leq \sigma_{WLP} < 7.2$	$7.2 \leq \sigma_{WLP} < 12.5$	$\sigma_{WLP} \geq 12.5$

Conclusions

“probe vehicle data”



- ▶ The proposed method enables road network monitoring done by conventional passenger cars.
- ▶ Ride quality of roads can be precisely evaluated and classified by using a probe vehicle approach.
- ▶ The estimator was found accurate for very rough and very smooth road sections (and less accurate for medium evenness).
- ▶ In future (beyond TRIMM):
 - Use recursive feature selection to reduce the high-dimensionality in the probe data;
 - Collect and exploit a much larger data set;
 - Try the method on other than CANBus data (e.g. from a smartphone) so that it gets independent from car manufacturers.

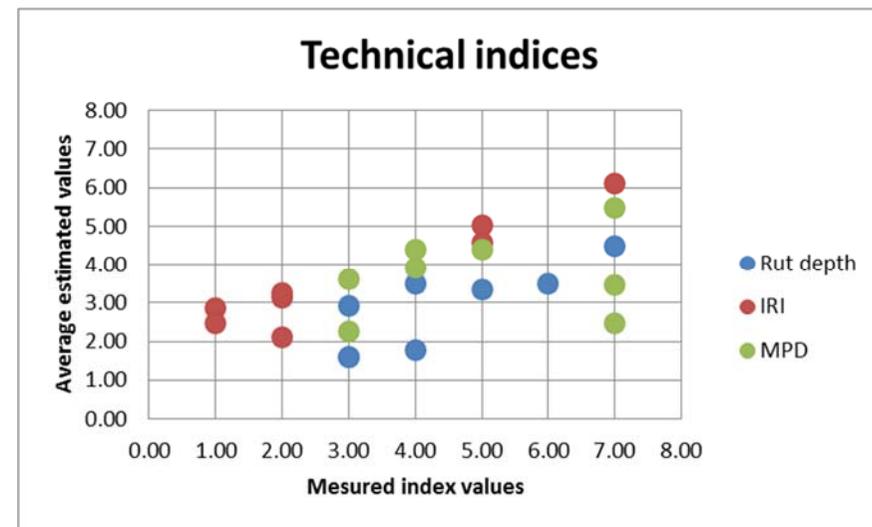
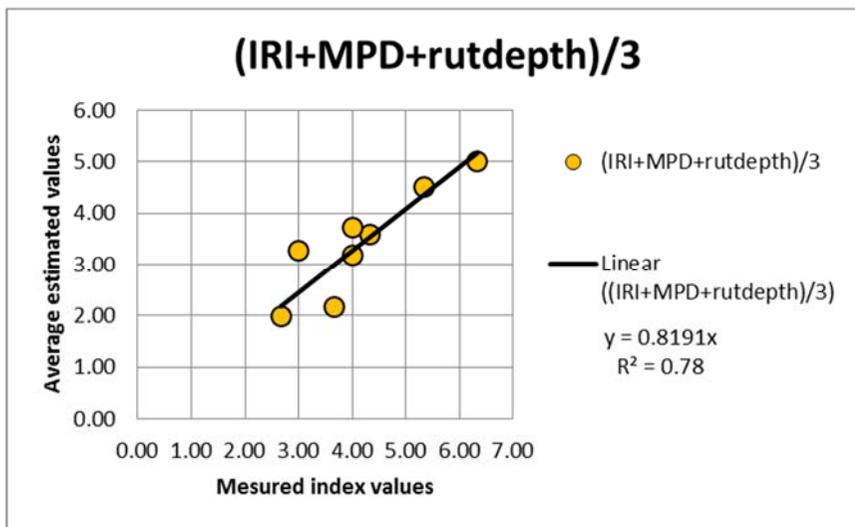
Questions to passengers

- ▶ During test drives:
 - some passengers gave their opinions on the “comfort feeling” due to “unevenness” of the road.
 - extra in Sweden: passengers gave their “IRI”, “MPD” and “rut depth” perceptions.
- ▶ Objective:
 - Only to get some feeling on how “people” judge, and to compare it to evenness measurements.

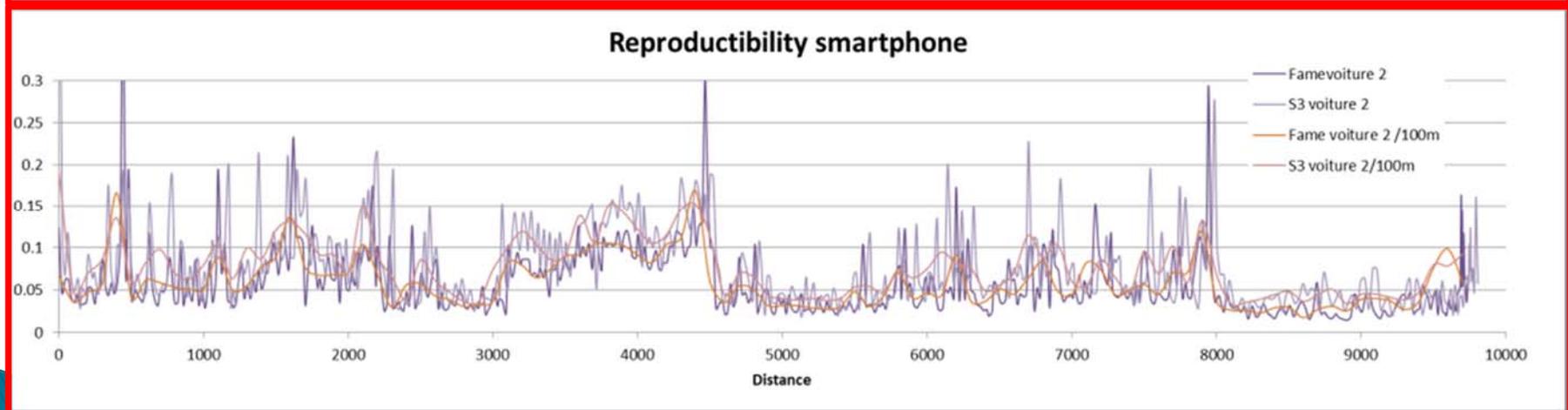
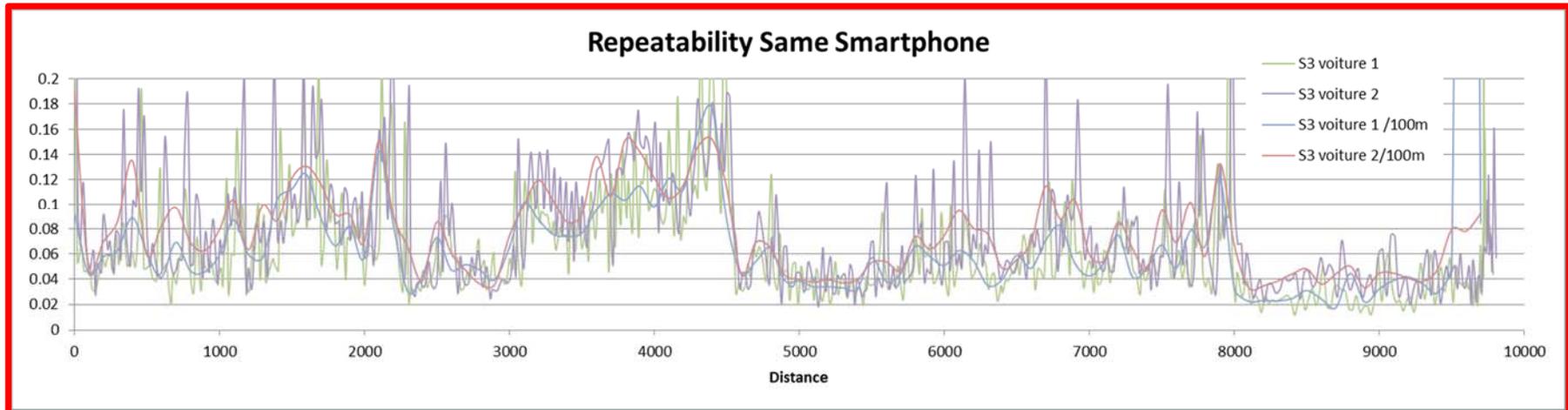
Conclusions questionnaires



- ▶ Human perception: more than evenness.



Smartphone app tests



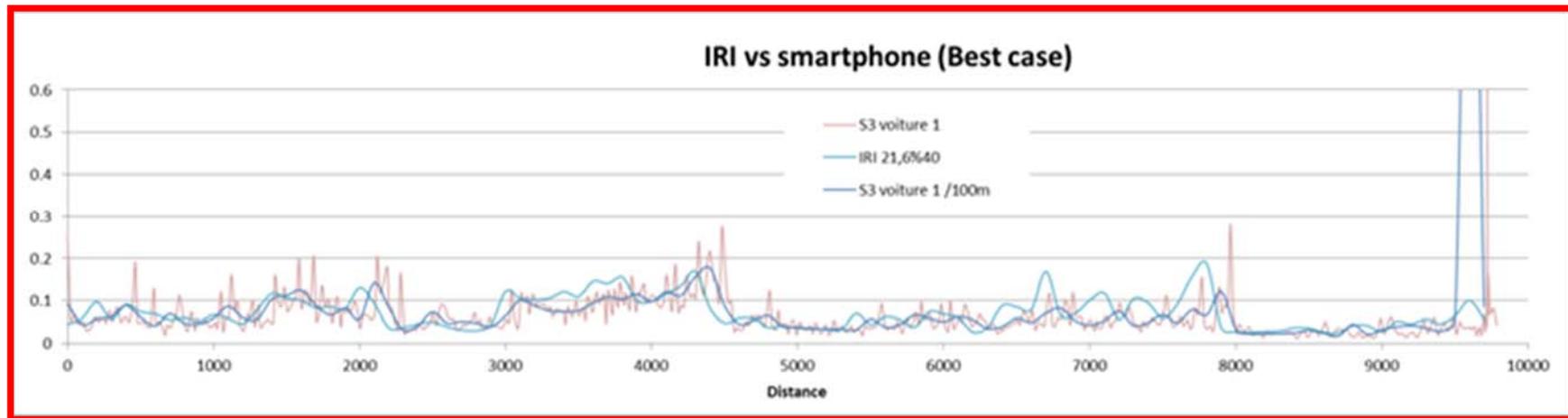
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Conclusion Smartphone



- ▶ Promising.



- ▶ Issues:
 - Type/brand of smartphone,
 - How it is fixed,
 - Type of vehicle (suspension,...).

Dissemination



- ▶ TRIMM Deliverable 4.4
- ▶ ARRB 26th conference
 - <http://www.26arrbconference.com.au/>
 - Sydney: 19–22/10/2014
 - Nitsche Ph., Van Geem C., Stütz R., Mocanu I., and Sjögren L., *Monitoring Ride Quality On Roads With Existing Sensors In Passenger Cars.*
- ▶ TRIMM/ERPUG meeting
 - www.erpug.org & <http://trimm.fehrl.org/>
 - Brussels Conference and Business centre: 23–24/10/2014
 - Final results of TRIMM & European Road Profile Users' Group. *Presentation about Task 4.5 / Deliverable 4.4*