ESR₁₃: **Federico Perrotta**

University of
Nottingham
UK | CHINA | MALAYSIA

Using truck sensors for road pavement
performance investigation
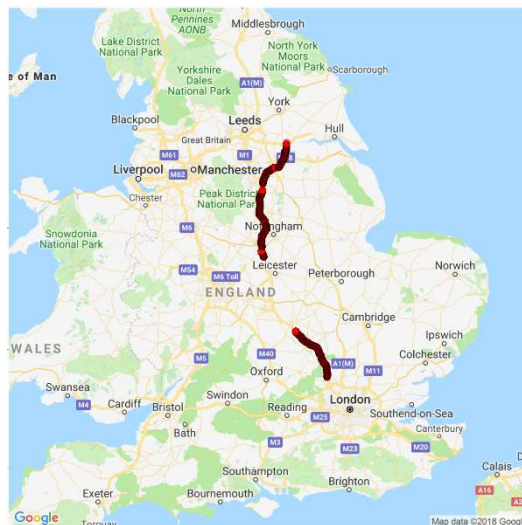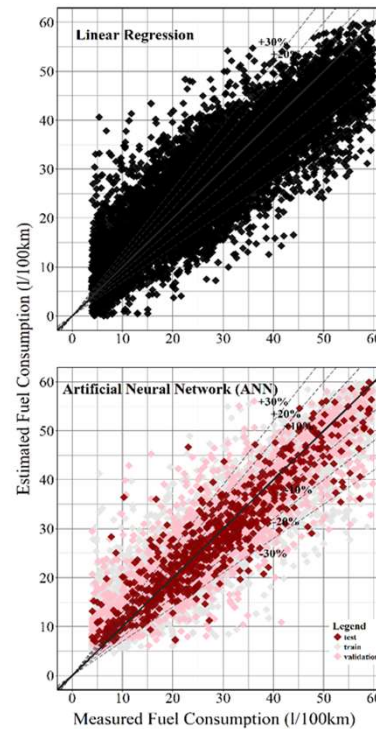
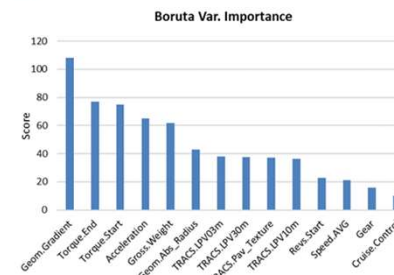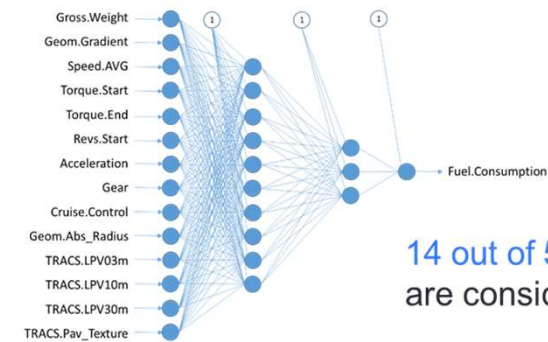# Initial results

Modelling

14 out of 56 variables
are considered

- M1 and M18 (~ 300 km);
- 1,110 heavy Heavy Trucks;
- 14,281 records;
- 2 weeks in October 2016;
- Constant speed;
- 56 measured variables.

Model	RMSE	MAE	R^2
Linear reg.	6.02	4.42	0.76
ANN	4.88	3.46	0.85

Current work

Validation of Method

22 out of 75 variables are considered

Parametric Analysis

- 50 values between 5% - 95%
- Comparison between models
- Allows interpretation
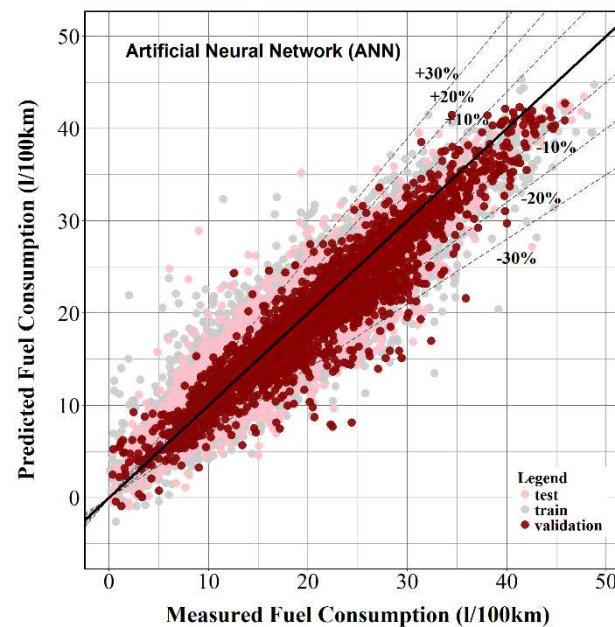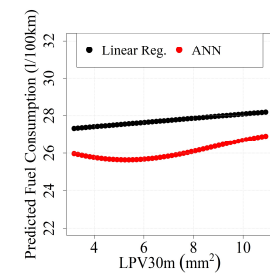

- ~ 900 km of M and A roads;
- 61,410 records;
- 3 months Jan - Mar 2017;
- 75 measured variables including weather conditions.

- RMSE: 2.69 l/100km
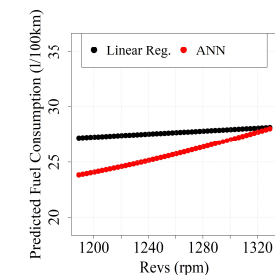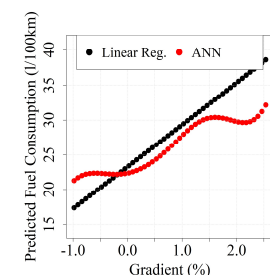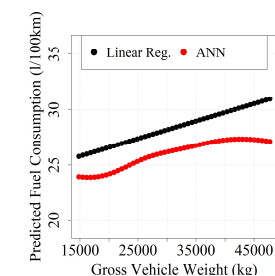- MAE: 1.95 l/100km
- R^2: 0.90
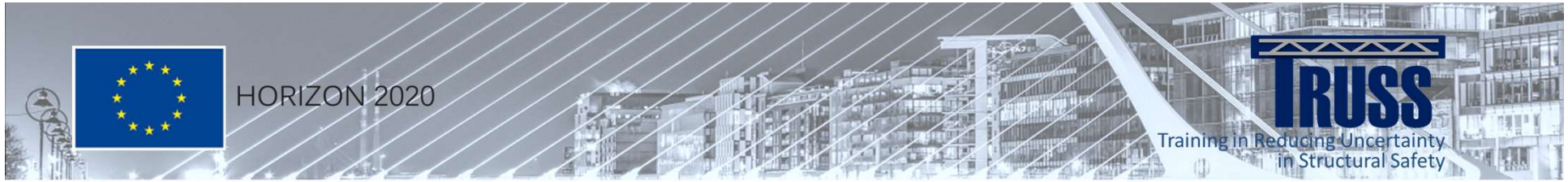
Conclusions & Recommendations

- The study shows how the large quantity of data currently available in the database of vehicle fleet managers, pavement engineers and weather agencies can be used to model the fuel consumption of heavy trucks driving on motorways in England accurately;

- The study shows how a parametric analysis can be used to estimate the impact of various factors including road surface conditions on vehicle fuel consumption. That allows interpretation of the developed "black-box" models;

- A new fuel consumption model including the effect of road surface and weather conditions has been developed for heavy trucks driving on motorways (M) and primary roads (A) in England (UK);

- Results shows that road conditions can affect the fuel consumption of the considered fleets of truck at high speed (> 50 km/h) M and A roads in England (UK);

- Results, which can be considered representative of England (UK) only, partially confirm the conclusions of existing studies but shows non-linear correlations among the variables considered in the study;

- Further investigation requires:

1. Analysis of data from different vehicle types (including cars);

2. Exploration of a wider range of conditions (e.g. urban driving, lower speeds, worse pavement, etc.);

3. Adaptation of the method to other countries other than England and the UK;

4. Adaptation of the method to different fuel sources other than Diesel.
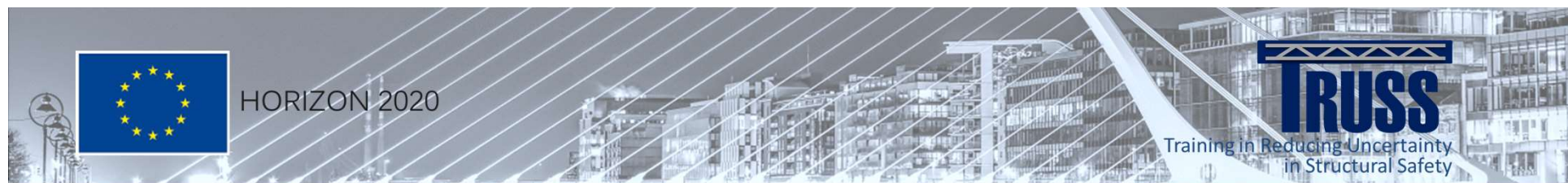
Training

Type of Activity	Start date	End date	Title of course/conference/activity and location	No. hours
Conference publication	18/06/17	22/06/17	ESREL 2017, Portoroz, Slovenia	30
Outreach(o, day, talks)	30/06/17	01/07/17	1st Open Day UoN 2017	16
Outreach(o, day, talks)	15/09/17	16/09/17	2nd Open Day UoN 2017	8
Meeting	20/11/17	20/11/17	Meeting with Microlise for 2nd data collection	1
Workshop	23/11/17	24/11/17	ROSE Workshop 2017	12
Conference	10/12/17	13/12/17	IEEE Big Data 2017	
Course (>1 day)	06/12/17	07/12/17	Induction to the use of the UoN High Performance Computer (HPC)	4
Conference	07/01/18	11/01/18	Transportation Research Board (TRB) 2018	32
Conference	16/04/18	19/04/18	Transportation Research Arena (TRA) 2018	32
Tutorial/Sup	24/05/18	24/05/18	Introduction to Blogging and Use of Social Media in SciComm (SMARTI ETN)	1
Course (>1 day)	11/06/18	14/06/18	QQI Level 6, Project Management	32
Outreach(o, day, talks)	29/06/18	30/06/18	1st Open Day UoN 2018	16
Examination	02/08/18	02/08/18	QQI Level 6, Project Management (Exam)	40
Workshop	29/08/18	30/08/18	CERI 2018	16
Conference	28/10/18	31/10/18	IALLCE 2018	32
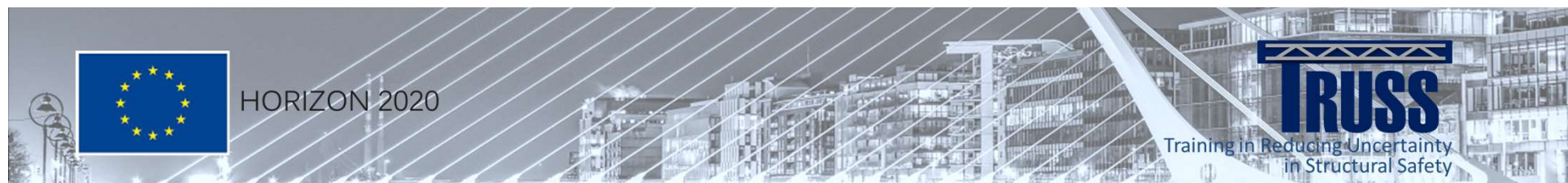
Dissemination

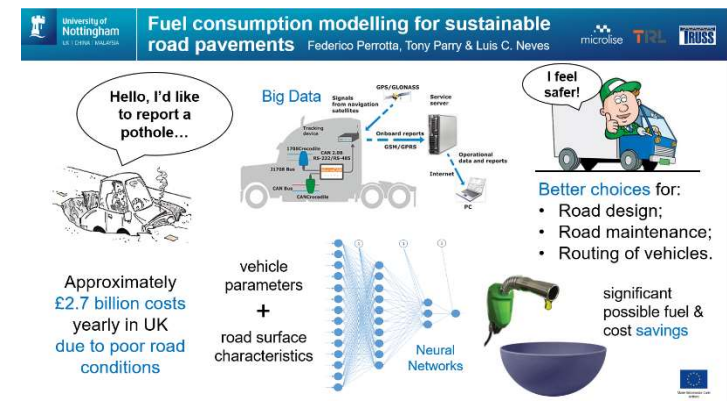| Type of publicati...	Start date (only if confere...	End date	Title of Publication	Authors (in the same order as published)	Full ref.(name,location or volume, page nos.,year)	Brief description of activity
Conference publication	10/12/17	13/12/17	Application of Machine Learning for Fuel Consumption Modelling of Trucks	Perrotta, F., Parry, T. and Neves L.	2017 IEEE International Conference on Big Data, Boston MA (USA)	Published
Poster	07/01/18	11/01/18	Comparison of HDM-4 fuel consumption estimates with real measurements from trucks on motorways: a UK case study	Perrotta, F., Parry, T., Neves L., Mesgarpour M. and Buckland T.	Transportation Research Board's 97th Annual Meeting, TRB 2018, Washington DC (USA)	Poster presentation
Magazine/N			Training the next generation	Gonzalez A.P., Perrotta F.	Impact Magazine	Published
Poster	16/04/18	19/04/18	Evaluation of road pavements fuel efficiency using truck sensors data	Perrotta, F., Parry, T., Neves L.	Transportation Research Arena, TRA 2018, Vienna, Austria	Poster presentation
Conference publication	29/08/18	30/08/18	A big data approach for investigating the performance of road infrastructure	Perrotta, F., Parry, T. and Neves L.	Civil Engineering Research in Ireland, CERI 2018, Dublin, Ireland	Accepted
Conference publication	29/10/18	31/10/18	A machine learning approach for the estimation of fuel consumption related to road pavement rolling resistance for large fleets of trucks	Perrotta, F., Parry, T., Neves L. and Mesgarpour M.	6th International Symposium on Life-Cycle Civil Engineering, IALLCE 2018, Ghent, Belgium	Accepted
Conference publication	29/10/18	31/10/18	Comparison of truck fuel consumption measurements with results of existing models and implications for road pavement LCA	Perrotta, F., Parry, T., Neves L., Buckland T., Benbow E. and Viner H.	6th International Symposium on Life-Cycle Civil Engineering, IALLCE 2018, Ghent, Belgium	Accepted
Journal publication			Verification of the HDM-4 fuel consumption model using a Big Data approach	Perrotta F., Parry T., Neves L., Buckland T., Benbow E. and Mesgarpour M.	Transportation Research: Part D	Accepted (minor revision)
Journal publication			Application of machine learning techniques to estimate truck fleet fuel consumption from telematic data and road geometry	Perrotta, F., Parry, T., Neves L. and Mesgarpour M.	Transportation Research: Part D	To submit
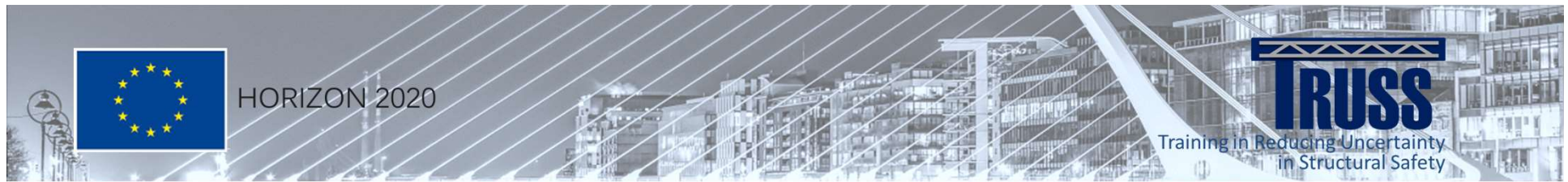
Outreach

SMARTI ETN

TRA 2018 Young Res. Competition

ROSE Workshop 2018

Open Day at UoN

3MT Challenge UoN