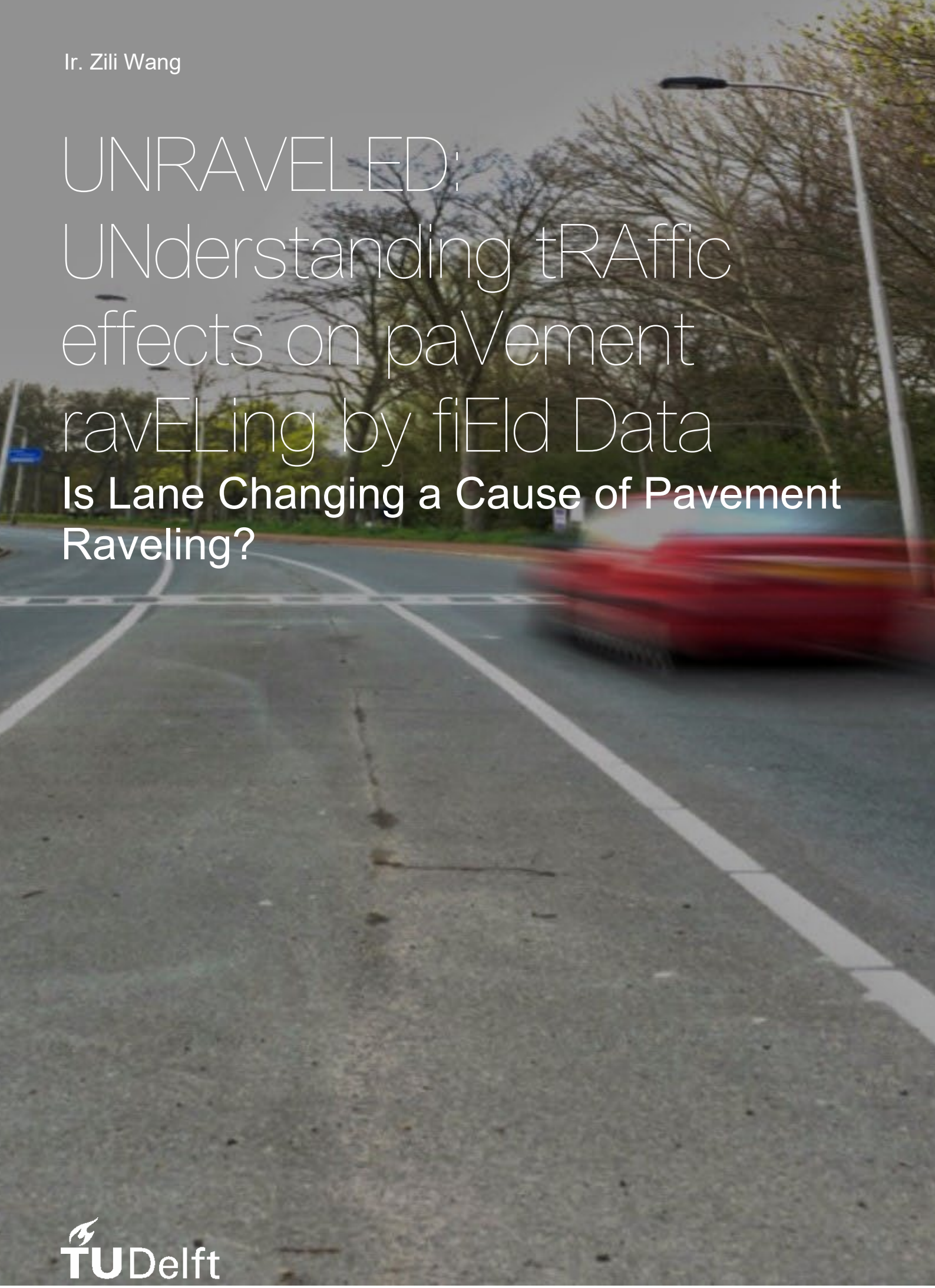
Ir. Zili Wang

UNRAVELED: UNderstanding tRAffic effects on paVement ravELing by fiEld Data

Is Lane Changing a Cause of Pavement Raveling?



TU Delft

The research proposal is in partial fulfilment of the requirements for the application of

TRAIL contribution

Promotors	
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Relevance to PhD programme

The research proposal of “Is Lane Changing a Cause of Pavement Raveling” contributes to the PhD research “UNRAVELED: UNderstanding tRAffic effects on paVement ravELing by fiEld Data”. The research on evaluating the causation between lane changing and raveling is the first goal for the PhD research that aims to explore the effects of various traffic characteristics on raveling and develop a tool that could help road managers to better predict raveling propensity of a given road with the given traffic characteristics.

1 Introduction

1.1. Research objective

On porous asphalt, raveling is one major cause of road serviceability reduction [1]. In the recent years, the asphalt has gained wide popularity because of its beneficial effects on noise reduction, skid resistance and hydroplaning. In order to have good transport service, the pavement network must be maintained as and when raveling is visibly seen. For such timely maintenance, road agencies need to plan and schedule maintenance activities well in advance (in terms of years). Therefore, accurate prediction of raveling is of prime importance for many road agencies.

To predict raveling accurately, it is important to understand the factors that can affect raveling. It is obvious that traffic characteristics would play a major role in driving raveling propensity for a given pavement. Preliminary literature reviews reveal that most of the past studies have considered raveling propensity as the factor that depends on traffic volumes and speed limits, ignoring other traffic characteristics. However, it has been observed in the Netherlands that some districts of porous asphalt located in the merging and diverging areas experienced a large amount of raveling, which showed evidence that lane-changing behavior can affect the deterioration. Additionally, the side movement of wheels generates shear forces [2] which may result in the lose aggregates in due course of time. Lane-changing behaviour would generate various shear force, depending vehicle operation characteristics, resulting in different shear force, that may affect raveling propensity in different ways. The academic gap is that lane-changing behavior might have important effects but it was not studied in the current raveling literature. Thus, the research focuses on the following objective.

Objective: Discover the causality between lane changing and raveling propensity initiation and growth

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1.2. Scientific and societal contribution

The research will contribute to the existing knowledge body of traffic impact on raveling, by studying on the effect of lane-changing behavior which has not been yet focused. Prediction of raveling will be improved by this research by considering the traffic characteristic, which supports road agencies allocating limited resource and making the budget plan optimally while maintaining the pavement networks. With the good maintenance plan in dependence to accurate prediction of raveling, road users will always have well-maintained roads to drive on. In addition, the raveling prediction by the research will aid the current Dutch PMS in validating its lifespan prediction of porous asphalt.

2 Data & Methodology

2.1. Methodology

As addressed in the research objective, the causal question is whether lane changing is the cause of pavement raveling. With the aim to answer this question, the core is to develop a causal discovery model, which can infer the causal relations between the variables from data. Every causal discovery model has the certain application requirements which will be derived from the literature review. The causal discovery model selection is dependent on the requirements that our case meet. Therefore, we will first explore the data that can be used for this causal study, and then, the statistical characteristics of the features will be computed for selecting the models.

We will at first describe the data in the traffic database and the pavement databases currently used by the main actors of the Dutch pavement management. Then a data processing method is needed to make the spatial-temporal scales of all the features consist.

Next, we will select the models to discover the causality behind raveling and lane changing. We plan to present the features based on the prior knowledge regarding the proposed causal question. It is critical to determine the confounders, in which the causality might exist between these confounders and lane changing and between these confounders and raveling. We test if the statistical values of the features in this case meet the model assumptions and application requirements, and accordingly select the appropriate causal discovery model(s).

At last, we will program the selected model(s) and apply it/them to our case. The answer to the proposed causal question will be presented.

2.2. Data

The cooperative organisations in Tab. 1 will provide the data for this research.

Tab 1- Data and data sources

Data	Data source	Data format
Pavement inspection, materials, construction, maintenance	Ministry of Infrastructure and Water Management in the Netherlands (RWS)	xlsx
Traffic flow and speed	DiTTLAB of Delft University of Technology	json
Raveling	Netherlands Organisation for Applied Scientific Research (TNO)	xlsx
Traffic flow and speed	Dutch National Road Traffic Data Portal (NDW)	csv
Lane changing	4TU.ResearchData	mat
Weather	Royal Netherlands Meteorological Institute (KNMI)	SQLite

References

1. Vos, E. and F.G.M. Bouman, *Oberflächeneigenschaften in den Niederlanden–Methoden und Ziele.* Straße und Autobahn, 2015. **1**(2015): p. 23-27.
2. J. D. Visscher, A.V., *Raveling by traffic: Performance testing and field validation.* International Journal of Pavement Research and Technology, 2017. **10**: p. 54-61.