Research Problem Statement

ODOT Research Section
555 13th Street NE; Ste 2
Salem OR 97301-5192

Phone (503) 986-2700
Fax (503) 986-2844

I. TITLE

17-065 Enriching Condition Scoring over Oregon Pavement Defects using Simulations

II. PROBLEM

Pavement continuously deteriorates after exposure to environmental elements and after wearing from use; and this process is multidimensional and multi-scale, and is extremely complex to quantify. Consequently, preventative maintenance needs to be strategically planned to avoid high road replacement cost when it has to be executed. Scientific description of the current states and historic measurements of the pavement condition is needed for decision making. Currently, in addition to indexing pavement defects, a condition score is given by ODOT Pavement Service Unit Personnel when conducting pavement distress surveys. In the proposed research, we will develop tire simulations over defected pavements in Oregon and measure changes in key tire performance such as tire wear and noise. These changes will lead to modifications to baseline driving speeds that are associated with driving quality. The updated theoretical driving speeds will be provided a priori to facilitate the grading process to aid with safety for the drivers and consistency in their measurements.

III. PROPOSED RESEARCH, DEVELOPMENT, OR TECHNICAL TRANSFER ACTIVITY

Tires wear differently while rolling over smooth surfaces and cracked or uneven surfaces. This information enables tires to be somewhat a sensor to road conditions. Furthermore, drivers can see pavement surface defects some time, but can feel the defects through the contact between the tires and roads. As the tire performances are known parameters to drivers when they purchase tires, our tire simulations will be comprehensible and the analysis can lead to corroborations with the subjectively derived scoring on road conditions.

We first will define two baseline sections of roads. One will be newly made and the other will be recently maintained, i.e., chip sealed. We will then design a pairing elimination process over the five distress indices: rut, fatigue, patch, ravel and no load measured for Oregon roads to establish distinct tire performance signatures. These signatures will be translated to quality driving speeds on defected road segments and provided for Oregon Service Unit Personnel. As a result, a mathematical relation between various road defect indices to grading through driving can be potentially derived.

Existing images and scans will be utilized for modeling realistic pavements using finite element methods, an established tool in the fields of computational mathematics and engineering. Pavement composition information will be sought through material records at ODOT and be approximated through calculations to complete the description of the pavement. Tire selections will be done by considering the availability of geometry and material characterizations in order to build the numerical models. To measure the noise performance, we will evaluate existing sound intensity systems and insulated microphones that have been presented in the literature of transportation.

IV. POTENTIAL BENEFITS

Pavements are changing continuously. By enriching the condition score of the roads and by ensuring its consistency over different evaluations at different years, we can dynamically improve road design and maintenance.

V. IMPLEMENTATION

Numerical models of tires characterized for Oregon roads will be produced. Road noise signatures due to tires rolling over defected pavements will be recorded.

VI. LIST OF REFERENCES *(optional)*

[List the references you identified when you searched for completed and current research.]

P.R. Donavan and D.M. Lodico, "Measure Tire-Pavement Noise at the Source", NCHRP Report 630, 2009

R. Bernhard and R.L. Wayson, "An Introduction to Tire/Pavement Noise of Asphalt Pavement", Institute of Safe, Quiet, and Durable Highways, Purdue University, 2005.

J. Slama, "Evaluation of a New Measurement Method for Tire/Road Noise", Master's Degree Project, KTH Engineering Sciences, Sweden, 2012.

J.O. Allen, O. Alexandrova, K.E. Kaloush,"Tire Wear Emissions for Asphalt Rubber and Portland Cement Concrete Pavement Surfaces, Arizona Department of Transportation, 2006.

VII. CONTACT INFORMATION

Your name: __Yue Zhang _____
Affiliation: Oregon State University
Telephone: 541 737 0478
Email: zhangyue@oregonstate.edu

Person Responsible for Implementation: _____
Affiliation: _____
Telephone: _____
Email: _____