Using Beam Bridging Filter on Airport Pavement Roughness

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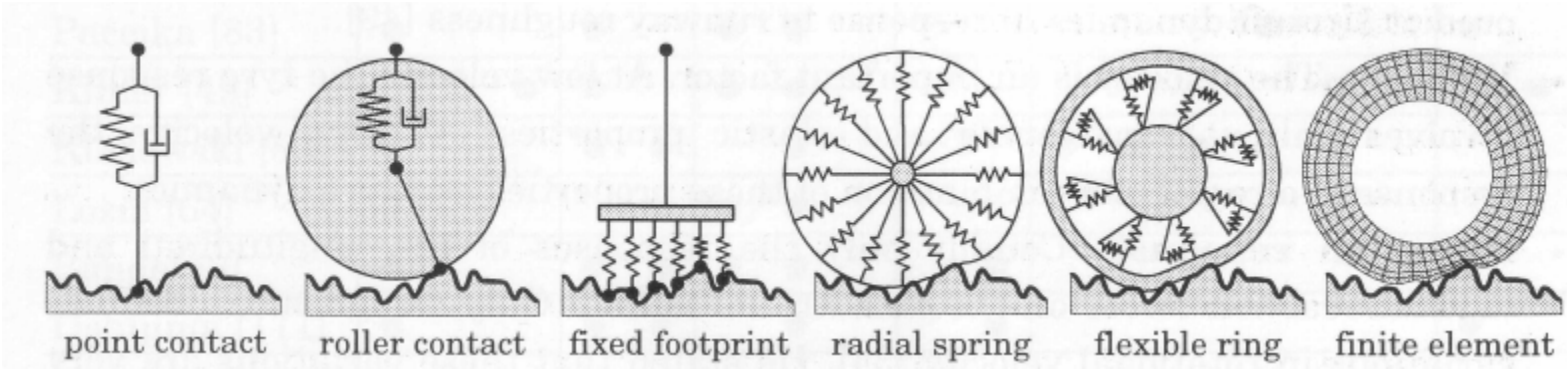
Tire Contact Models

Many researchers have studied vehicle tire and pavement interaction and have developed different mathematical models.

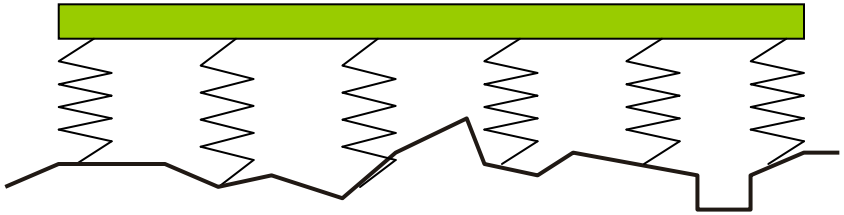
This paper proposes a new type of tire bridging filter using a mechanical model to reduce the influence of short dips in the measured profiles.



Reference:
•K.M. Captain & et al. *Analytical Tire Models for Vehicle Simulation.* Vehicle System Dynamics 8, pp. 1-32. 1979.
•*S. M. Karamihas. Critical Profiler Accuracy Requirements. The University of Michigan Transportation Research Institute Report, Sept., 2005.*

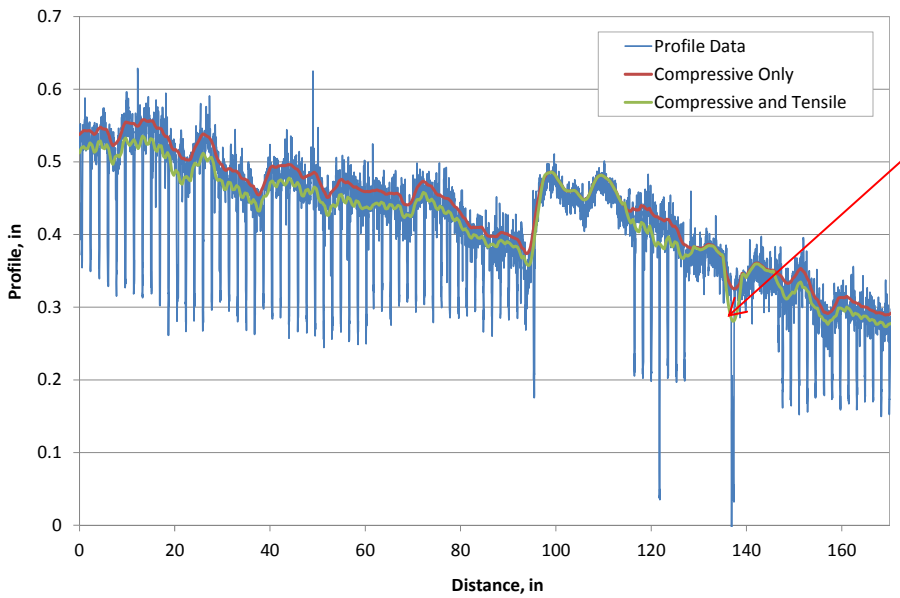
Model of Beam Bridging Filter

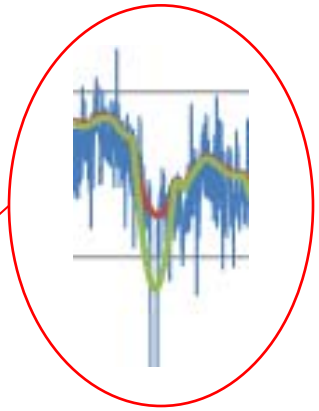
- Adjusts the effect of the contact between a tire and the road surface by modeling the contact area as a beam element with a series of compressive springs.
- Remove the tensile spring stress so that only compressive stress exists in the simulated contact element between the tire and the pavement surface.
- Computational efficiency is also considered in the bridging filter algorithm by moving stiffness matrices out of the loop of multiple iteration steps and analytically derived inverse function of the stiffness matrices.



Comparison Of Contact Models

The improved model with only compressive springs brings an upper envelopment which is higher than the first model with both compressive and tensile springs. The phenomenon is more obvious as the curve moves over the deep dips.

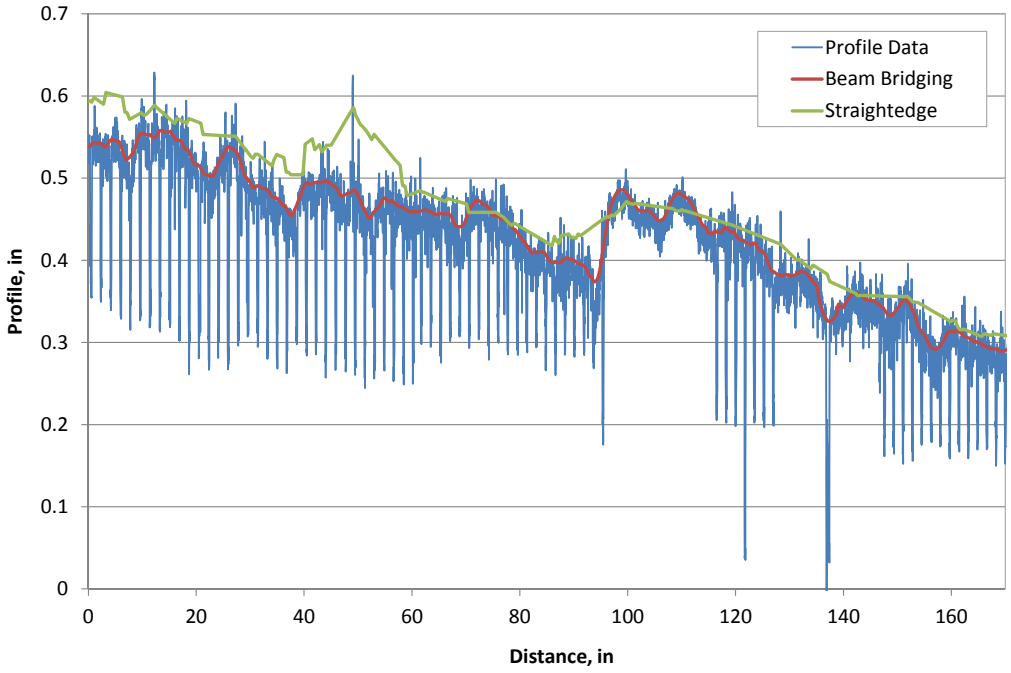




Comparison With Other Filters

Example: Straightedge filter

As an example, we set straightedge length equal to the tire footprint length, 1.5 feet (0.46 m).



Summary of Beam Bridging Filter

- A new filtering method, known as a "Beam Bridging Filter" was developed to improve the filtering quality of using existing filters. It can be implemented to the program of runway roughness analysis and groove identification.
- The contact model of Beam Bridging Filter is designed to mimic the contact phenomenon between a tire and the pavement surface by using a series of compressive springs on the beam element.
- The Beam Bridging Filter is compared with other bridging filter types and shown to be more suitable for processing of runway profile testing data.

Thanks!

More Information:

Wang, Q. & Hayhoe, G. *Development and Implementation of a Beam Bridging Filter for Use in Airport Groove Identification*. 2013 TRB Annual Meeting, Journal of the Transportation Research Board.