## PhD student:

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## Title:

Multi-scale analysis of pavement texture – effect on adhesion and rolling resistance

The surface layers of road infrastructures have the role of protecting the pavement structure while ensuring user comfort and safety. Thus, a good knowledge of the different surface properties (friction, rolling noise and rolling resistance) of road pavement is essential in order to be able to select the most relevant according to the constraints of the site (traffic, noise exposure, etc.). These properties strongly depend on surface texture and more particularly on the different scales of texture. The texture is considered here in the broad sense, namely that it includes all wavelengths from the micron (microtexture) to the meter (unevenness). However, the different surface properties tend to evolve inversely (eg good adhesion will lead to an increase in rolling resistance).
While it is commonly accepted that different scales of texture are involved in surface properties, the "relative weight" of their contribution to these properties is little known or not known. Under these conditions, it becomes difficult to optimize the properties of skid resistance, rolling resistance and noise emission of road surfaces.
This PhD thesis aims at selecting and using multiscale analysis methods (wavelets, patterns, etc.) in order to determine the texture scales involved in the tire / road contact regarding friction and rolling resistance. Thus, an analysis based on the study of the texture patterns (size, depth of the hollows, etc.) will make it possible to better understand how the friction forces develop at the tire / pavement interface according to the roughness. Optimization methods will finally be implemented to provide improved textures. These results will be applied as part of the ANR I-Street project (funded by the « Routes du Futur » program in the Future Investment Plan), in which this doctoral thesis is part of, in order to modify the formulation of asphalt mixes developed by the other partners. I-Street is a project led by Eiffage, involving Olikrom, Total and IFSTTAR.
The work program is divided into three parts:
- in a first step, a state of the art will be carried out on the various existing multiscale decomposition methods and the potential of wavelet-based and pattern-based methods for the study of road surfaces will be explored;
- in a second step, a reduced number of road surfaces will be selected and their surfaces will be mapped in 3D with an adequate level of accuracy making it possible on one hand to identify the relevant scales and on the other hand to establish relationships between the textures and the surface properties. This step will define the testing and treatment methodology to be implemented (magnification, filtering, sampling, etc.). Special attention will also be paid to the texture indicators to be selected;
- in a third step, simple analytical models, one to estimate the friction and the other one for the rolling resistance will be applied on the texture profiles extracted from the 3D cartographies. These models will first be tested separately to identify the relevant scales for each property, and then they will be combined to identify scales where a compromise between friction and rolling resistance could be found. Multicriteria optimization methods will also be tested. Recommendations for the scales to be promoted and / or suppressed could thus be provided.