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Université Gustave Eiffel — LABORATOIRE EASE ENVIRONNEMENT-AMÉNAGEMENT, SÉCURITÉ ET ÉCO-CONCEPTION

Exploring the Tire-Rail Friction: Towards a Safer 'Ferromobile' Transport Solution

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Introduction



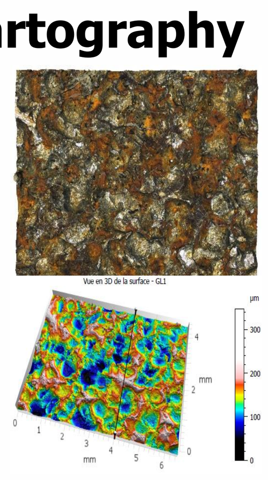
- This thesis is a component of the **FERROMOBILE** project, which endeavors to modify passenger vehicles for dual rail-road usage [1], [2], [3].

Objectives

- Understanding the mechanisms behind the tire/rail friction generation.
- Optimizing rail surface texture to optimize that friction.
- Providing recommendations for tire selection, surface maintenance and driving strategies in FERROMOBILE systems.

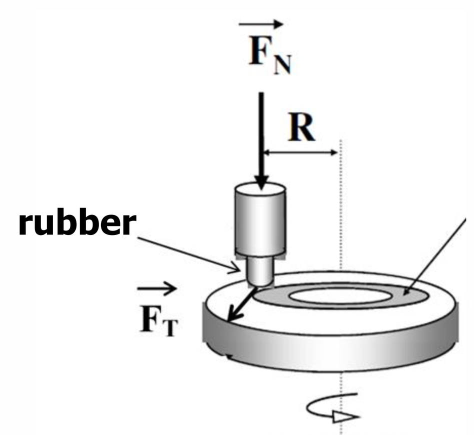
Materials and Methodology

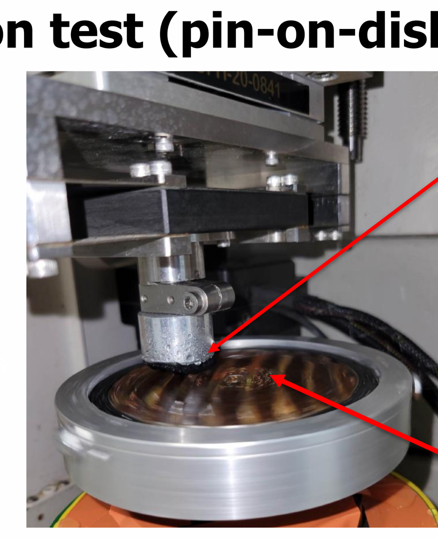
Step 1: Surface cartography

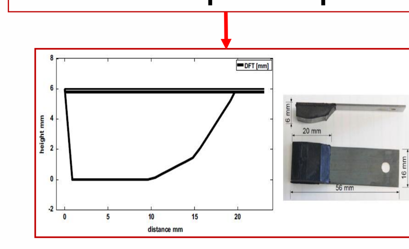



ISO 25178

Step 2: Friction test (pin-on-disk) using tribometer







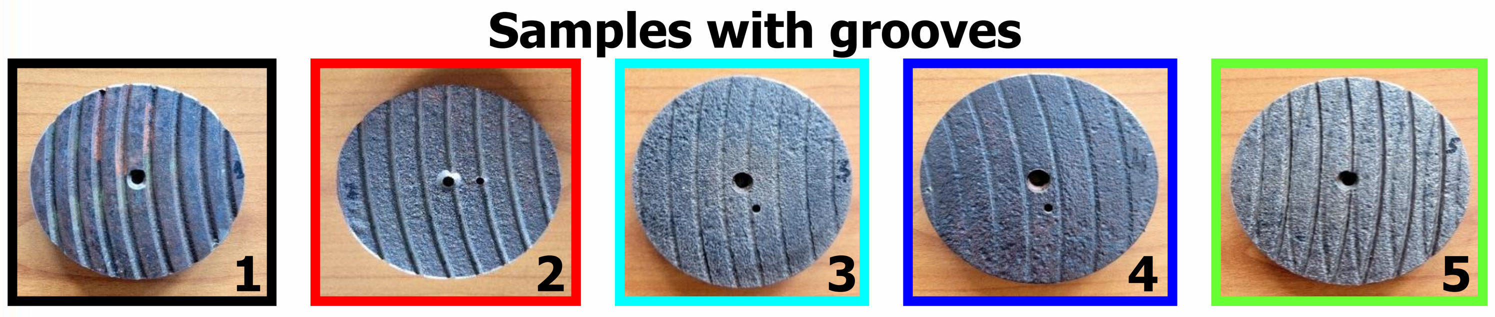
Step 3: Application of parameters correlation and Principal Component Analysis (PCA)

$\mu = f(\text{Texture parameters}, \ldots)$

With model parameters to be identified from steps 1 and 2.

Methodology:
- **Test Conditions**: $F_N = 24$ N, Rot. = 60 rpm, R = 23 mm.
- **Protocol 1 (P1):** Single wetting at the beginning of the test (application of water jets on the sample).
- **Protocol 2 (P2):** Wetting at the beginning of the test, then wetting every two minutes.
- **Protocol 3 (P3):** Greasing, wetting at the beginning of the test, then wetting every two minutes.

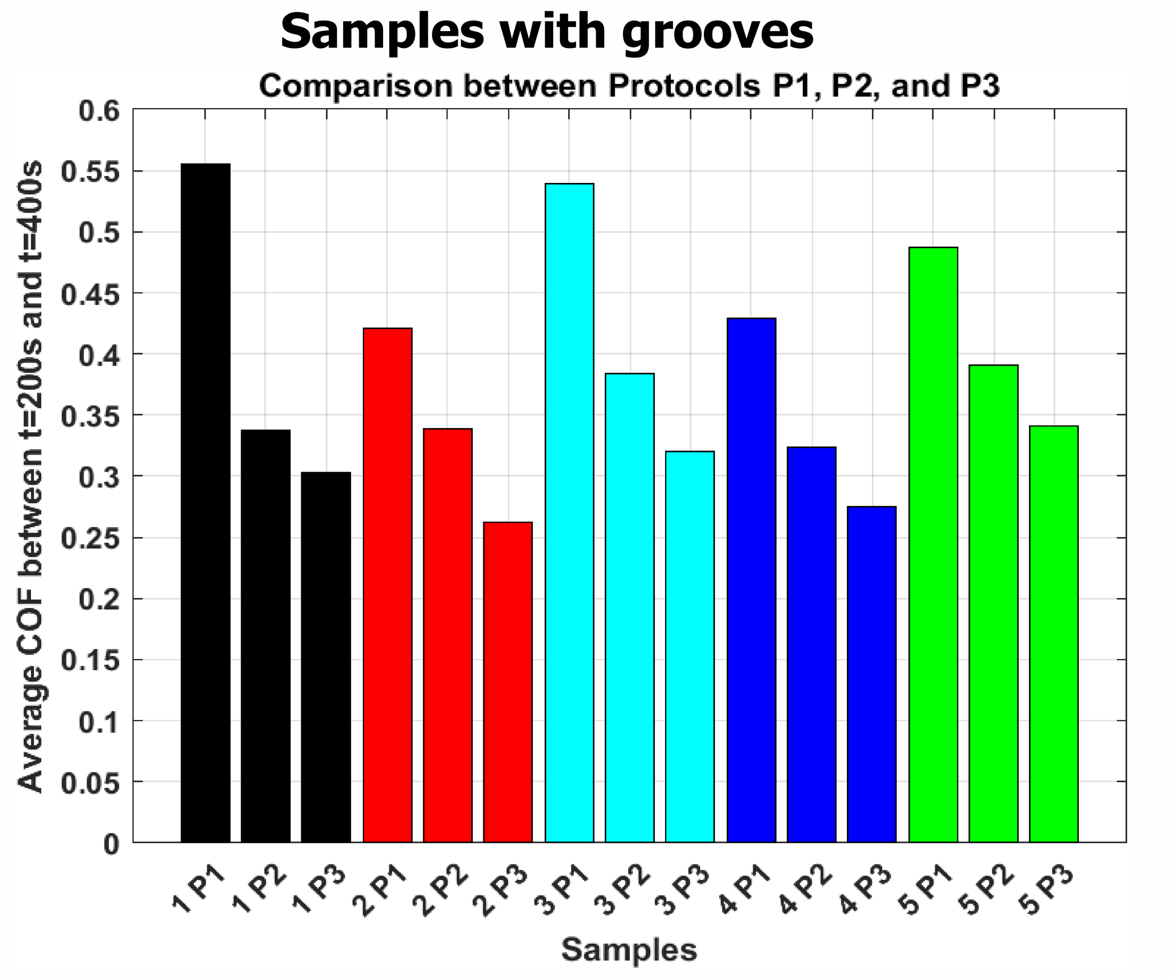
Samples with grooves

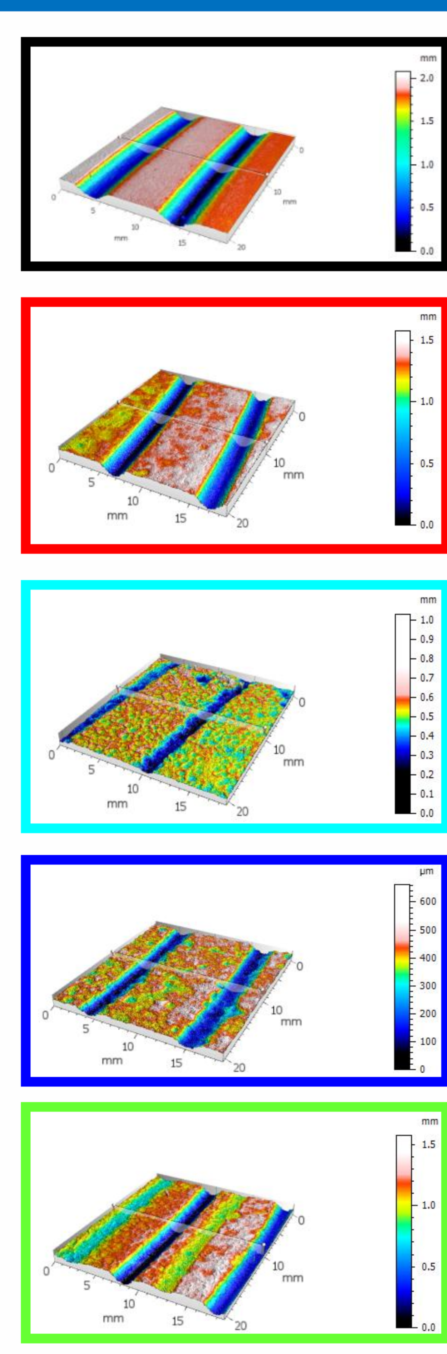


Samples without grooves

Results

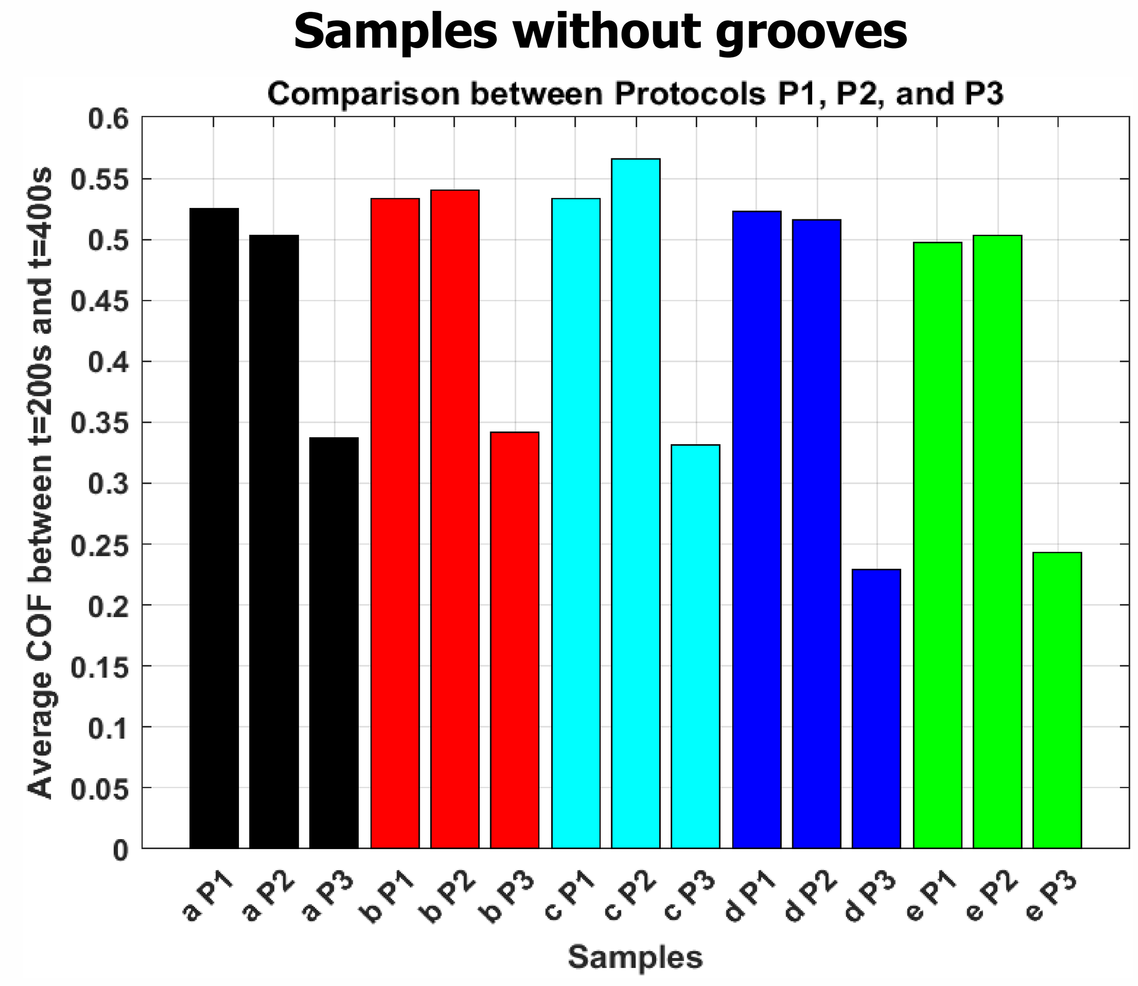
Samples with grooves

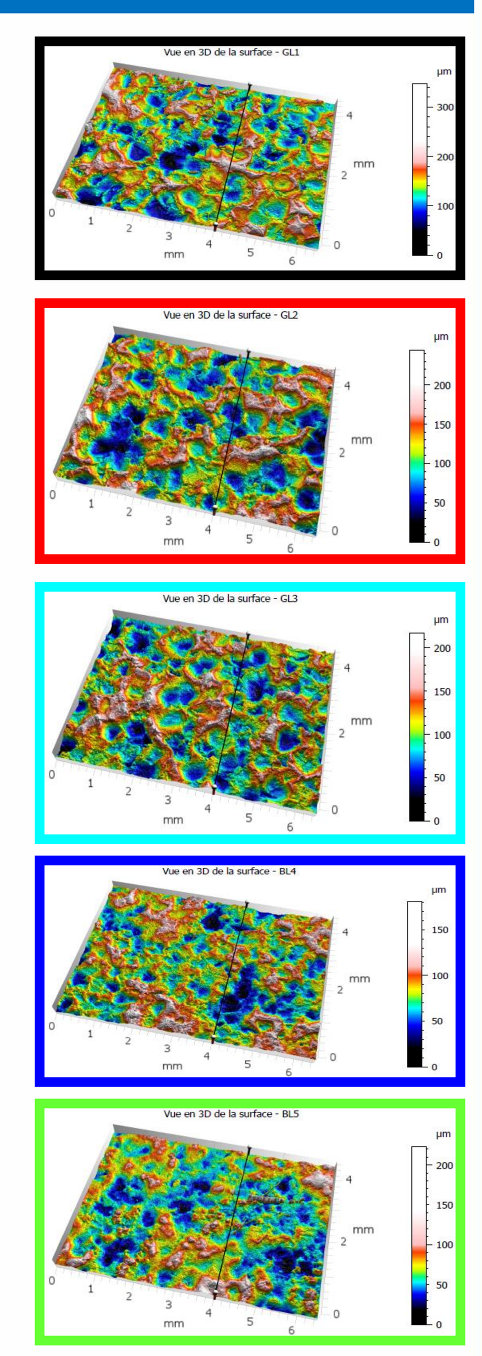




- Decrease in the coefficient of friction (COF) is observed due to the presence of a third body on the grooved samples.
- **Conclusion**: Grooves do not enhance COF in wet contact conditions.

Samples without grooves



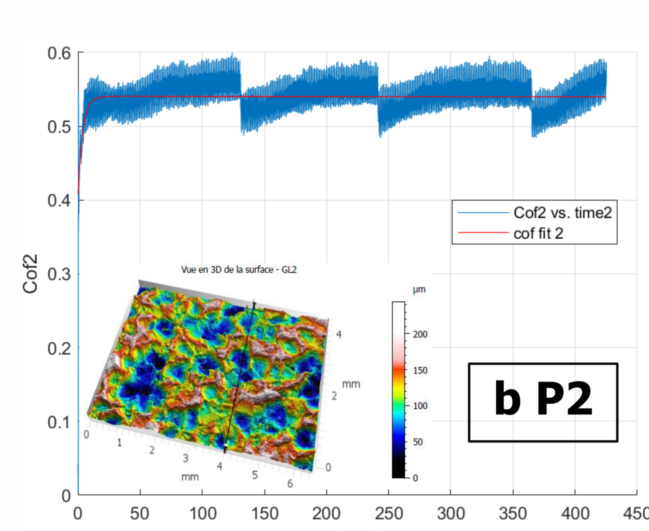


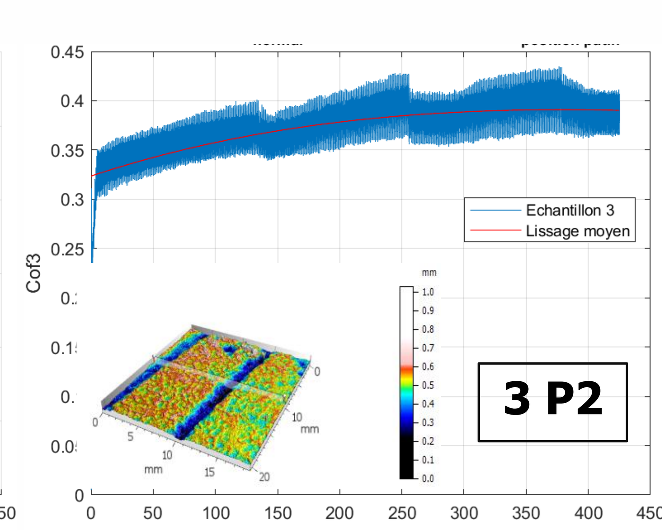
- For a specific shot peening process, water does not affect the COF during pure sliding.
- **Conclusion:** COF can be controlled by choosing specific texture parameters in wet contact conditions.

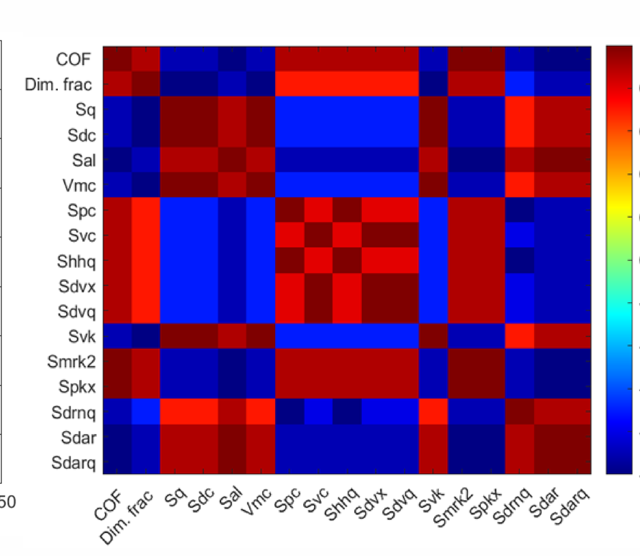
Conclusions and Perspectives

- The COF of the rails can be optimized by modifying the surface texture in specific areas, such as level crossings or stopping stations, by applying a shot peening process.
- This optimization will significantly improve braking distances, thereby ensuring the safety of individuals.

- Introducing a fourth protocol **(P4)** with a continuous water flow over the sample surface throughout the test to enhance water film control.
- Correlating surface texture parameters with the COF in the perspective of underlining the most influential parameters.







Bibiliography

[1] https://ferromobile.fr/la-ferromobile/
[2] Khelifi, C., Do, M. T., Kane, M., & Meyer, M. A. (2017). Wear and wet friction of steel tracks for rubber-tired metros. *Wear*, *376*, 1912-1918.
[3] Gómez, M. C., Gallardo-Hernandez, E. A., Torres, M. V., & Bautista, A. P. (2013). Rubber steel friction in contaminated contacts. *Wear*, *302*(1-2), 1421-1425.

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