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THE 13th IACIP Annual Workshop: ***Adaptive Infrastructure under Climate Change***

Understanding the pavement texture evolution of RIOH Track using multi-scale and spatiotemporal analysis

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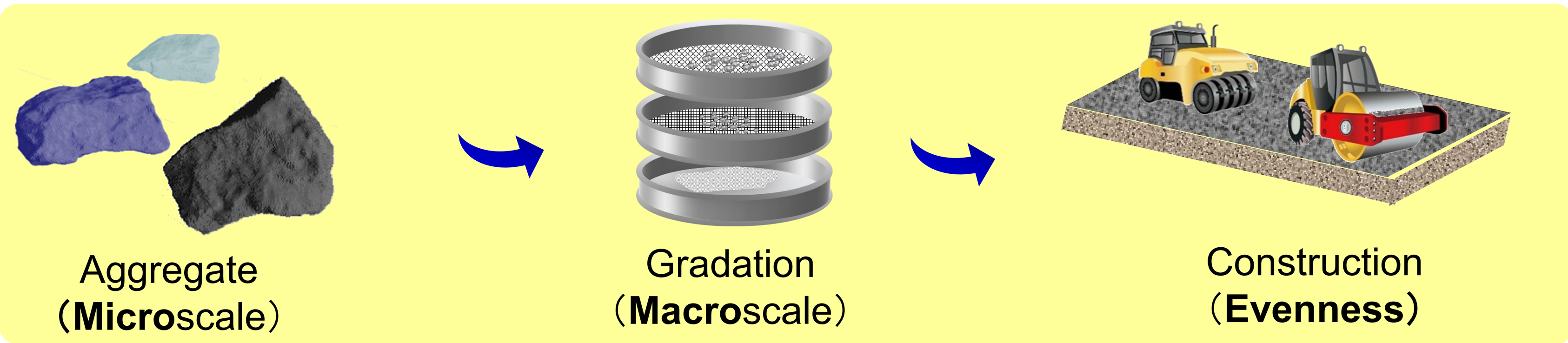
Background

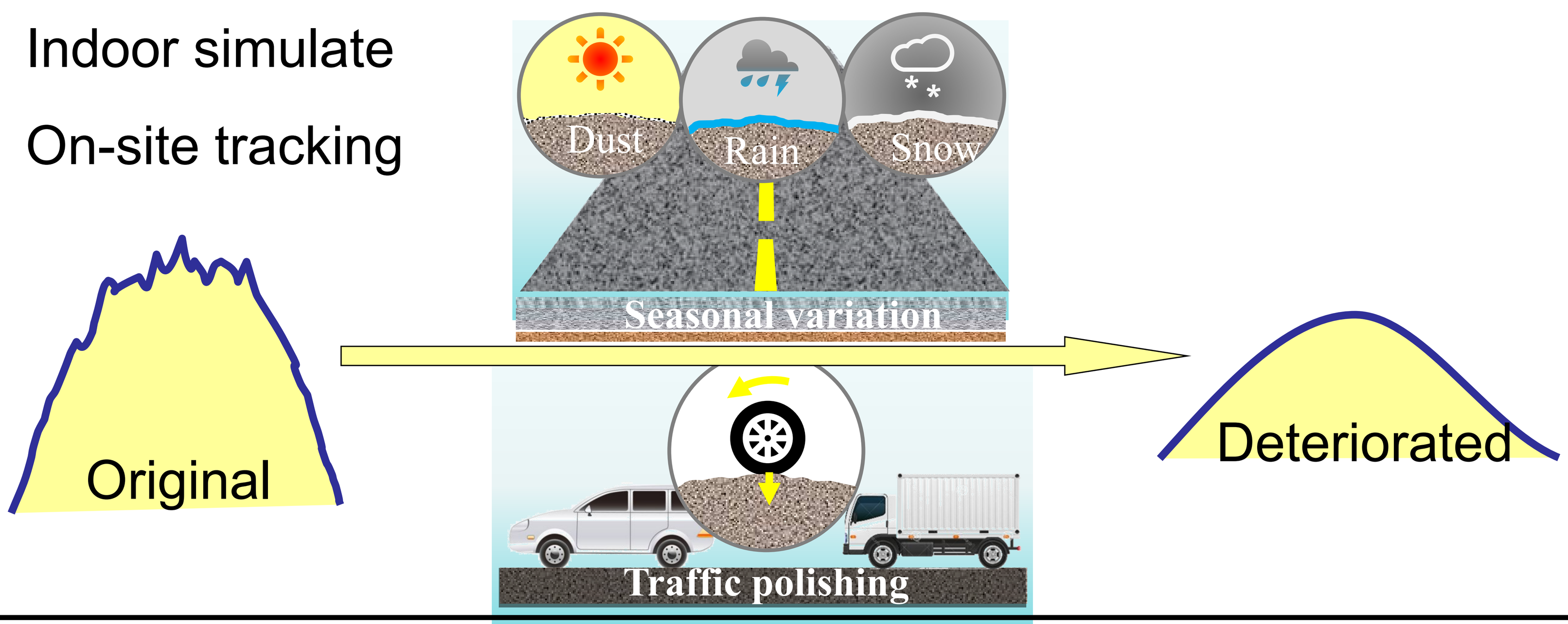
Pavement texture: the contributor to surface functions

- **Multiscale characteristics**: Micro-,Macro, Mega-, Evenness
- **Effect aspects:** Safety /Environment /Economy /…



Texture evolution: from indoor to on-site?

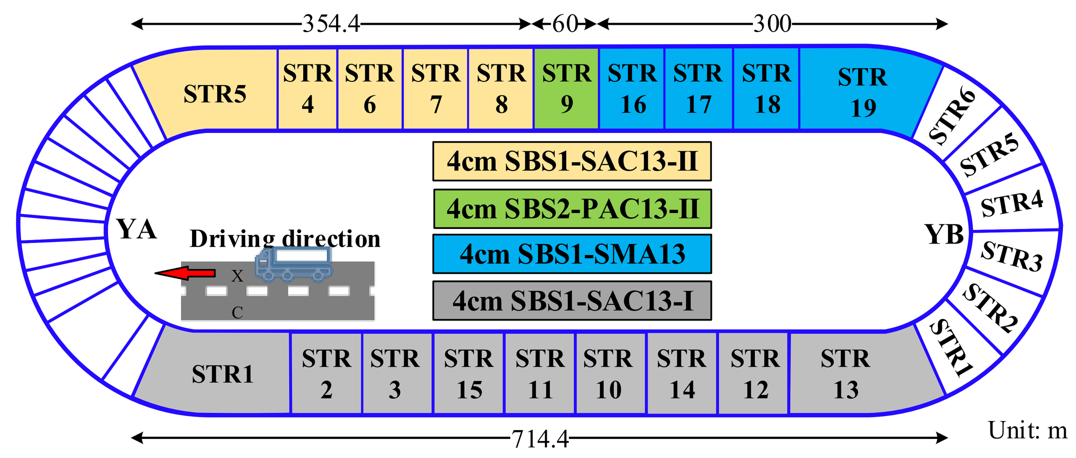
- Climate and traffic load during service period
- Indoor simulate
- On-site tracking

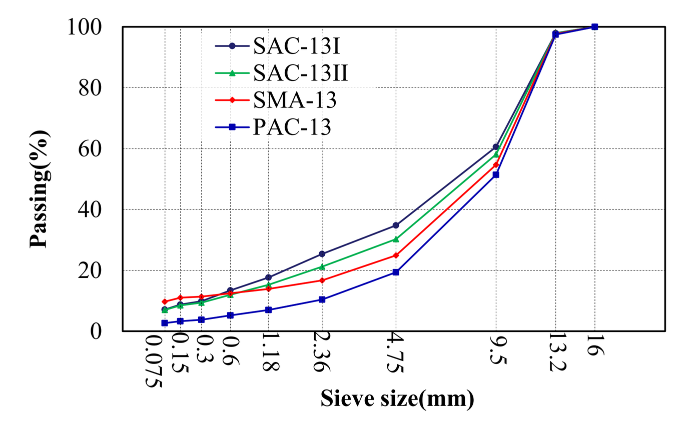


Research Methodology

RIOH track information

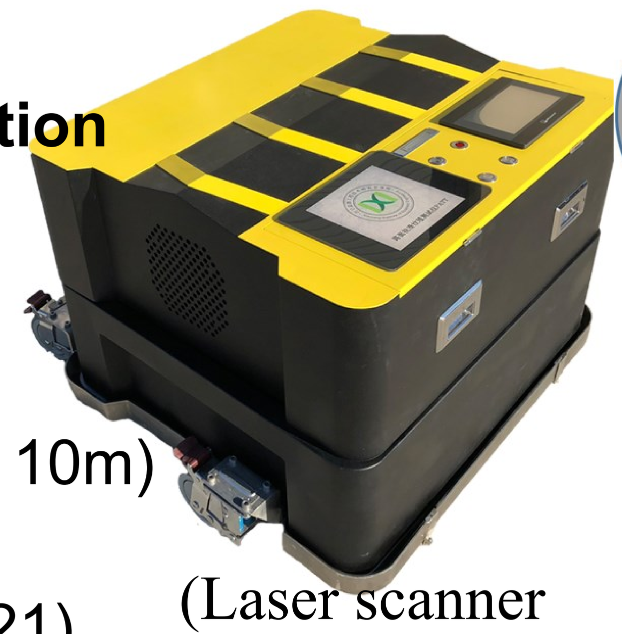
- 4 types of friction courses (4cm thick)
- Inner lane (loading and climate); outer lane (only climate)
- The ESAL is about 142,000 times each cycle (half a month).



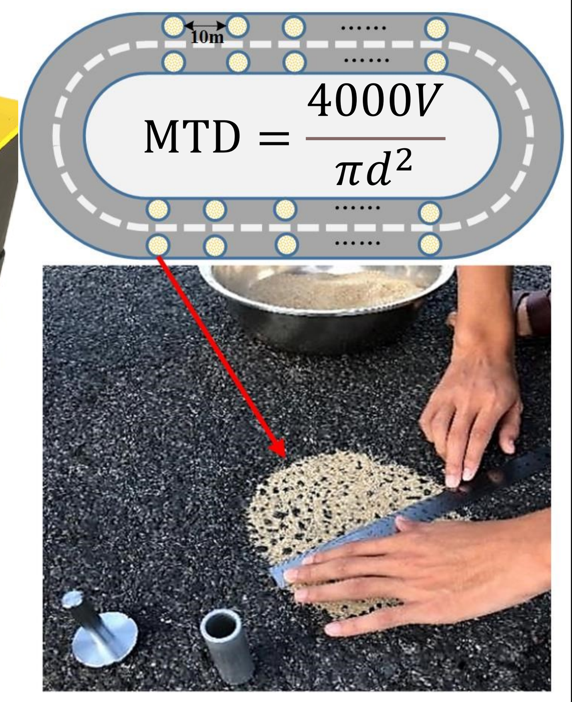


Test methods:

- **3D texture construction**
  Once (2018.11)
- **Texture depth test**
  Sand patching (every 10m)
  Periodically
  (2017.12.21~2021.1.21)



(Laser scanner PATT-I)



Results and Discussion

Multiscale analysis

Self-affine spectrum calculation

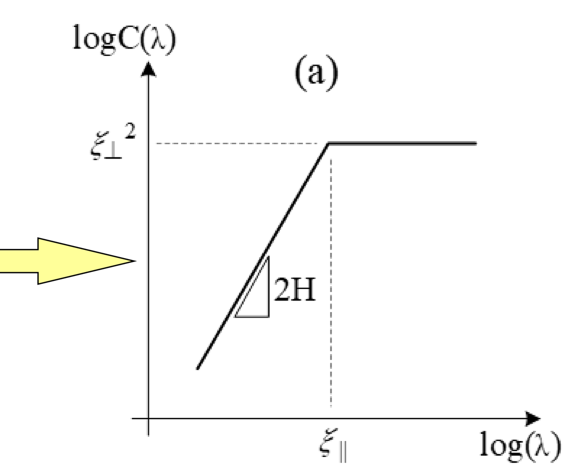
Principles: $x \to \Lambda x, y \to \Lambda y, z \to \Lambda^H z$. H is Hurst index.

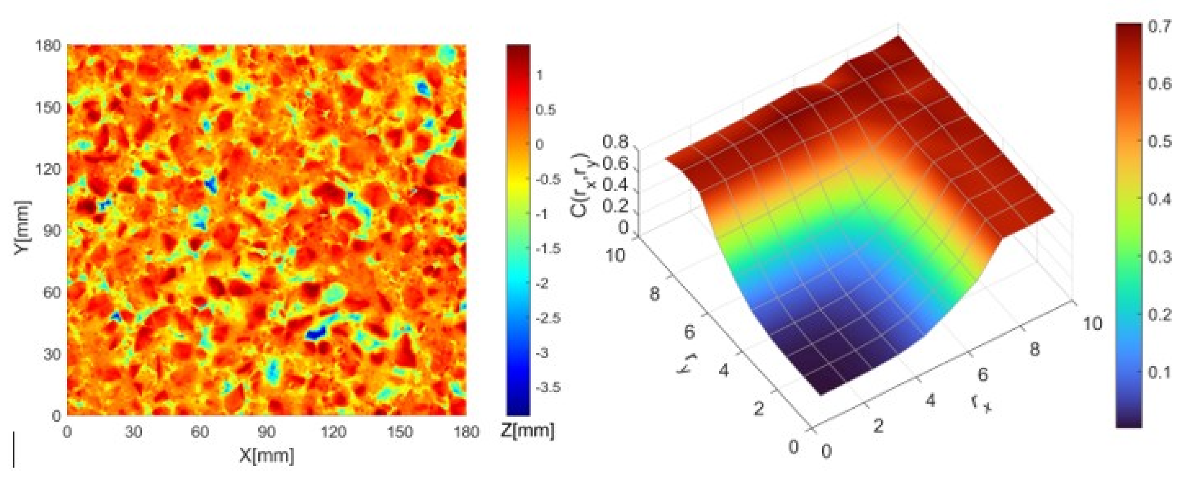
For 2D profile, $C(\lambda) = \langle (z(x+\lambda) - z(x))^2 \rangle$

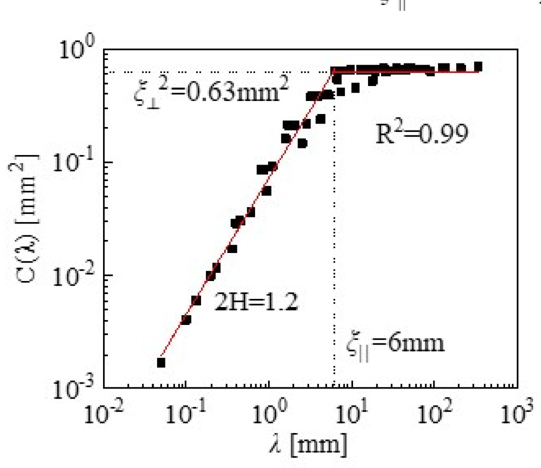
Characteristic parameter: $C(\lambda) = \xi_\perp^2 \left(\frac{\lambda}{\xi_\parallel}\right)^{2H}, \lambda \le \xi_\parallel$;

$C(\lambda) = \xi_\perp^2, \lambda > \xi_\parallel$

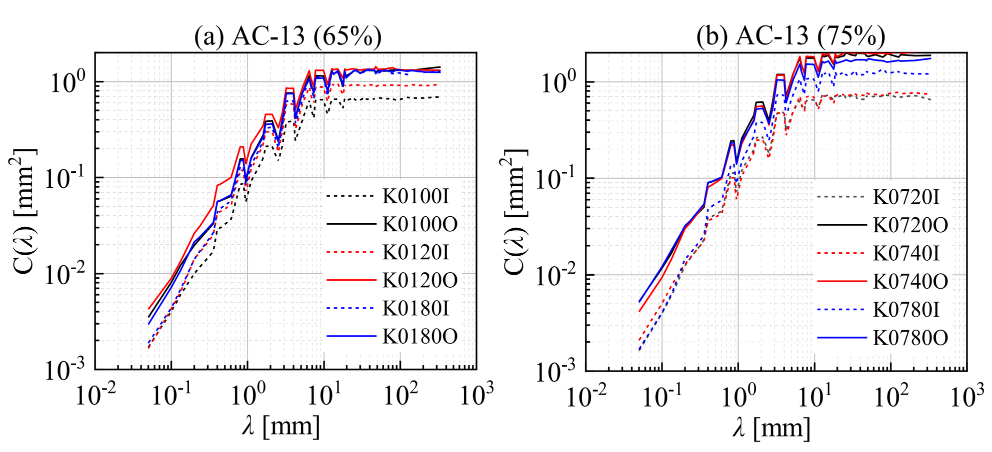
For 3D image, $C(\lambda_x, \lambda_y) = \langle z(\lambda_x, \lambda_y)^2 \rangle$







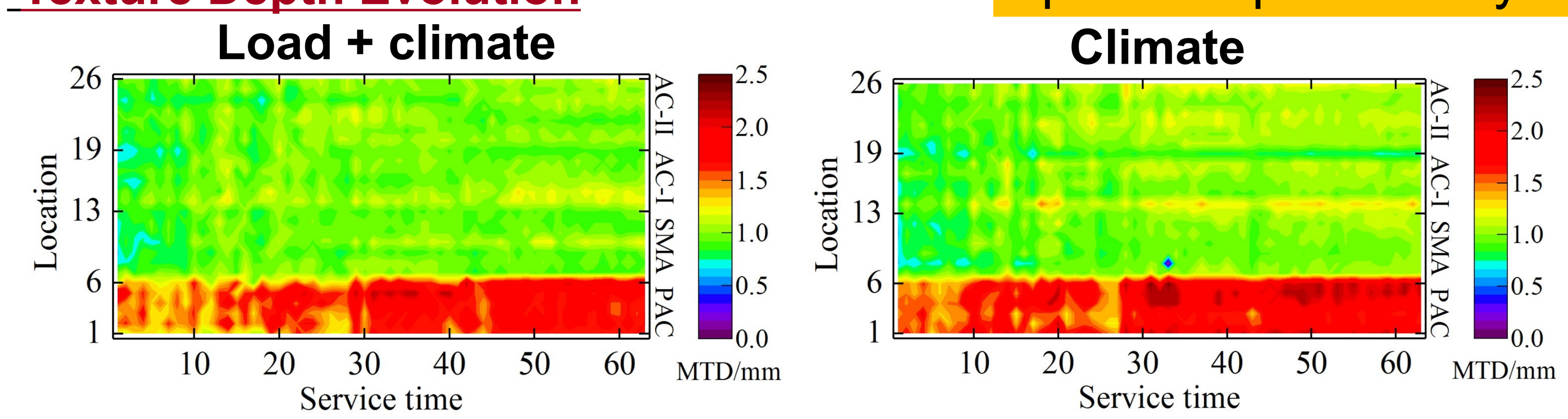
Results analysis



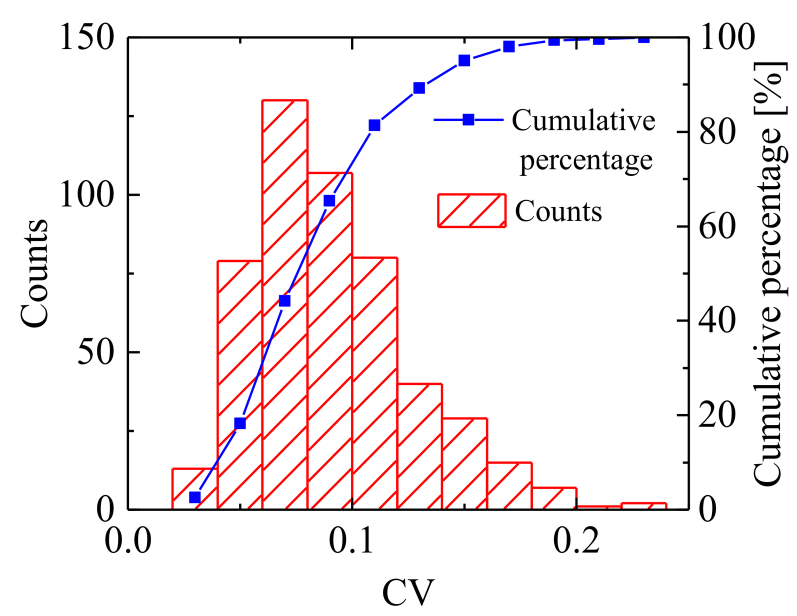
- The self-affine spectrum of same pavements **almost coincident** especially within a small wavelength (e.g., below 10mm).
- Traffic load (**I**nner lane) reduces the texture roughness throughout the whole scales.

Spatiotemporal analysis

Texture Depth Evolution



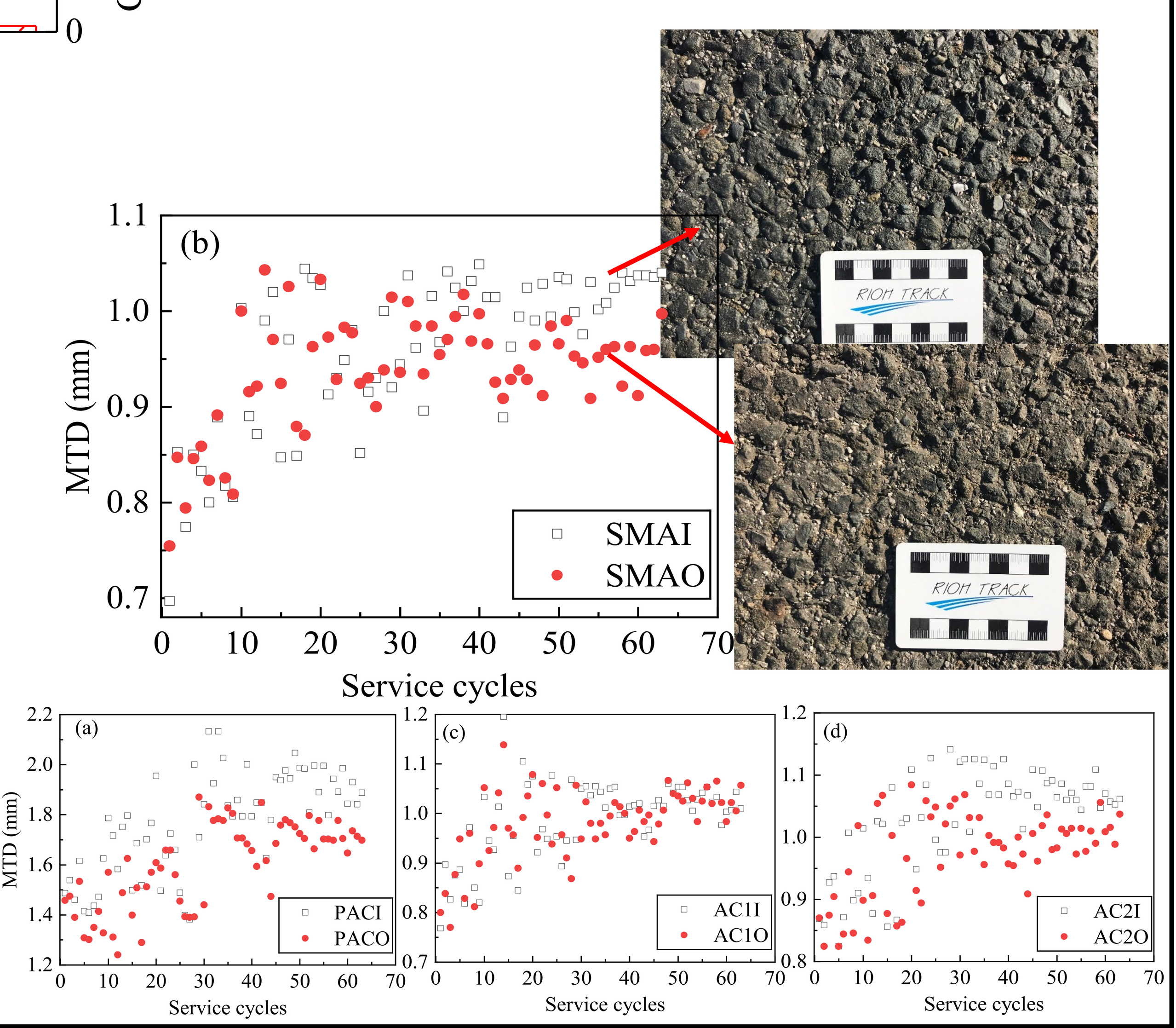
Spatial variability



- **504** variation coefficients (63 cycles * 4 types * 2 lanes) .
- Spatial variation coefficient of texture depth is below 0.2.

Temporal evolution

- During the long-term period, the texture depth will increase.
- Under the **load/climate** condition, the depth is **higher** due to increased particle gaps.
- The convex surface becomes **smoother**, resulting in the friction reduction at a low speed.



Conclusion

- The surface textures of same pavement have almost the **same self-affine spectrum**, especially in the small-scale range.
- The **spatial variability** of on-site pavement texture depth is found within 20%.
- From the long-term service, pavement texture depth shows an increasing trend especially under the climate/load conditions. Locally, the convex surface becomes smooth.

Acknowledgement

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