



Accelerating
the future
of aerospace

Micro-texture and its role in wet runway braking ***Summary of the EASA research project***

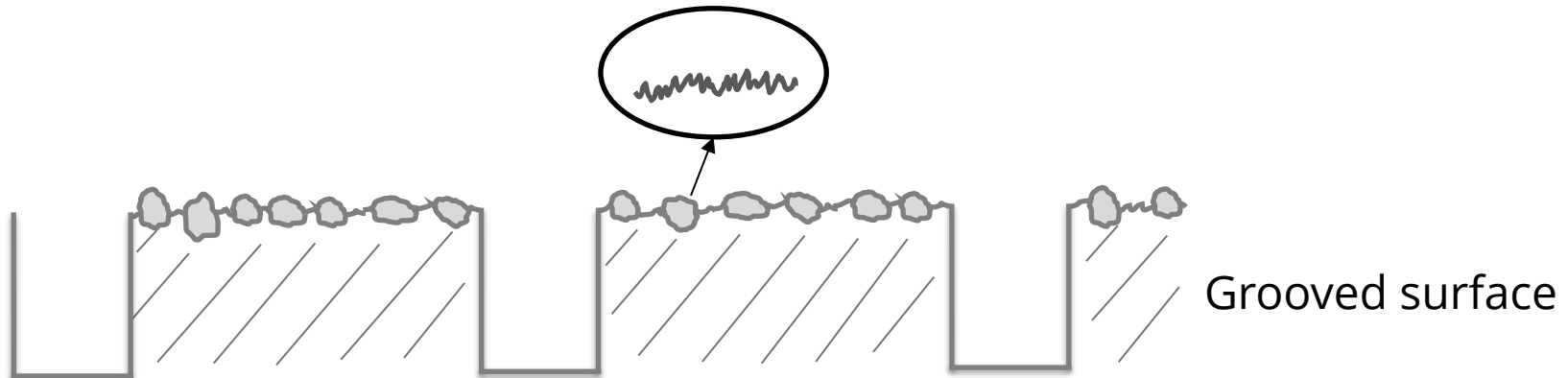
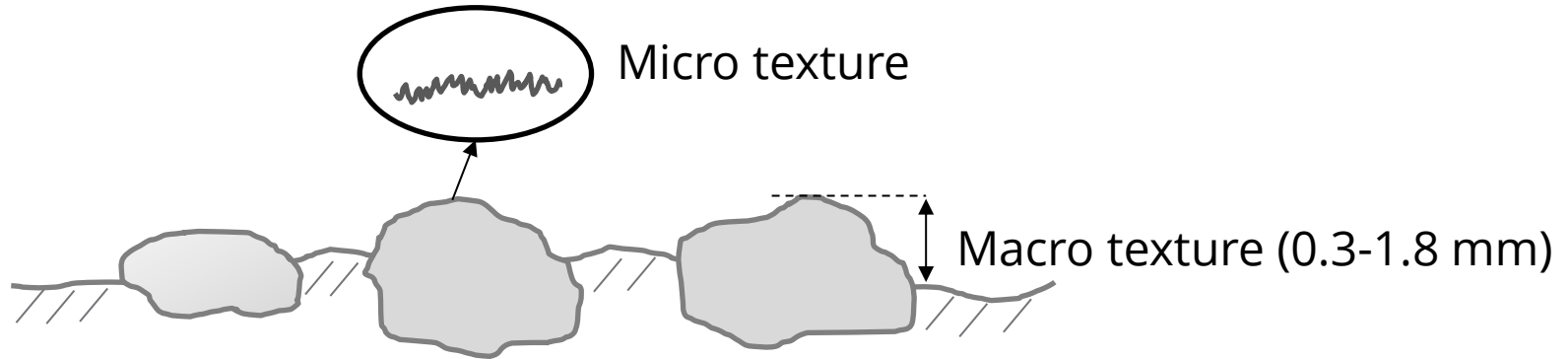
Gerard van Es
2025 SAPOE Annual Conference, 22-23 October 2025

Wet runway wheel braking forces

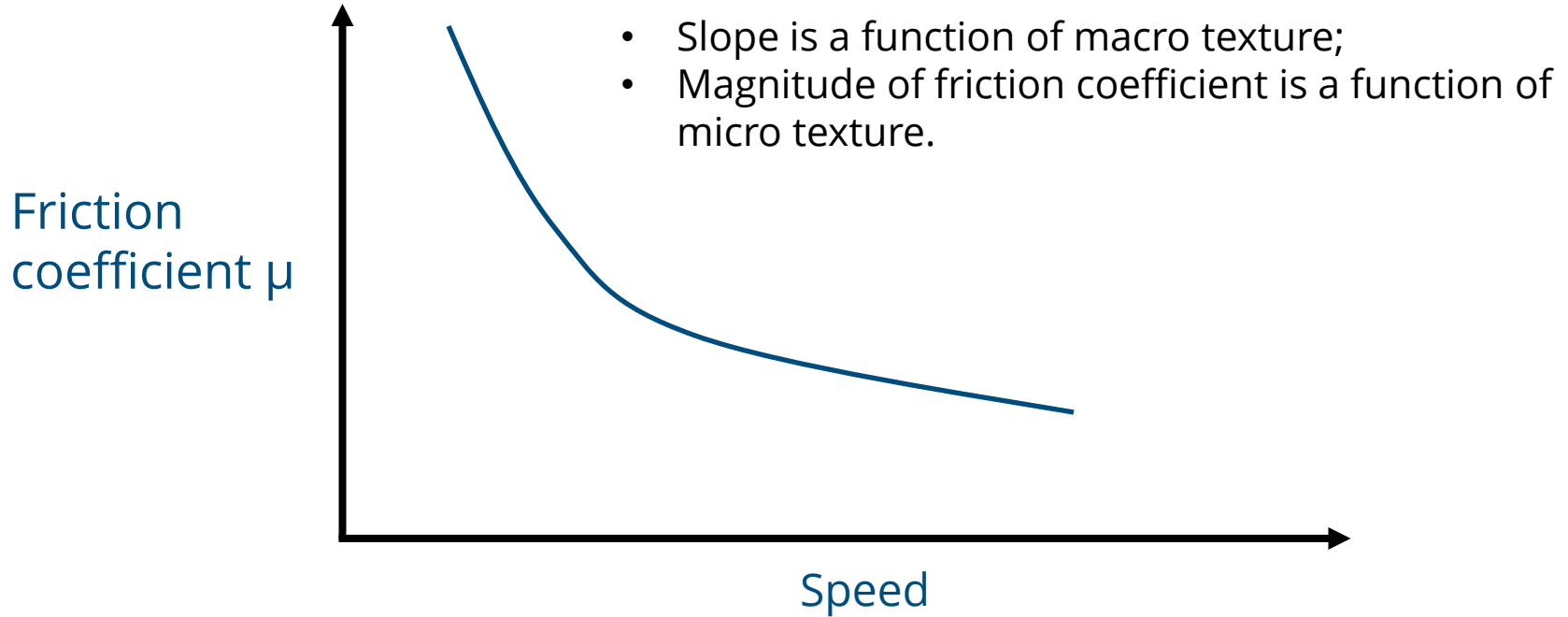
- Runway texture (macro and micro)
- Speed
- Tyre pressure
- Antiskid
- Wetness
- Loading
- Surface temperature



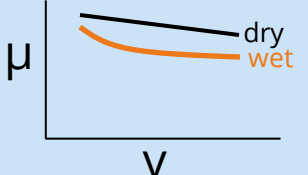
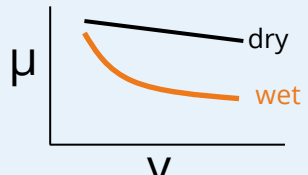
Micro texture versus macro texture

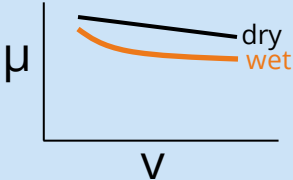
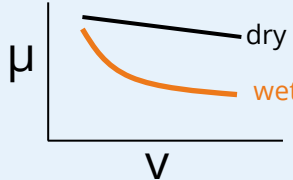
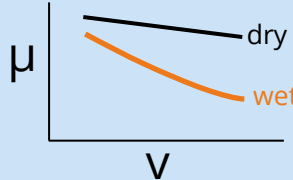


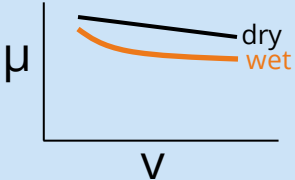
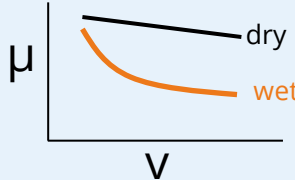
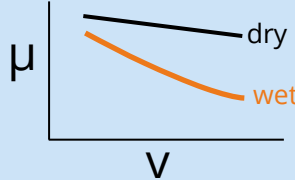
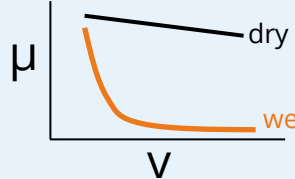
Relation texture and wet runway braking friction



Macro texture	Micro texture	μ - V relation
Open	Sharp	 <p>The graph shows the relationship between μ (y-axis) and V (x-axis). Two curves are plotted: a black line labeled 'dry' and an orange line labeled 'wet'. Both curves show a decreasing trend as V increases, with the 'dry' curve consistently higher than the 'wet' curve.</p>

Macro texture	Micro texture	μ - V relation
Open	Sharp	 <p>A graph showing the relationship between μ (y-axis) and V (x-axis) for a sharp micro texture. Two curves are shown: a black line labeled 'dry' and an orange line labeled 'wet'. Both curves show a decreasing trend as V increases, with the 'dry' curve consistently above the 'wet' curve.</p>
Open	Smooth	 <p>A graph showing the relationship between μ (y-axis) and V (x-axis) for a smooth micro texture. Two curves are shown: a black line labeled 'dry' and an orange line labeled 'wet'. Both curves show a decreasing trend as V increases, with the 'dry' curve consistently above the 'wet' curve.</p>

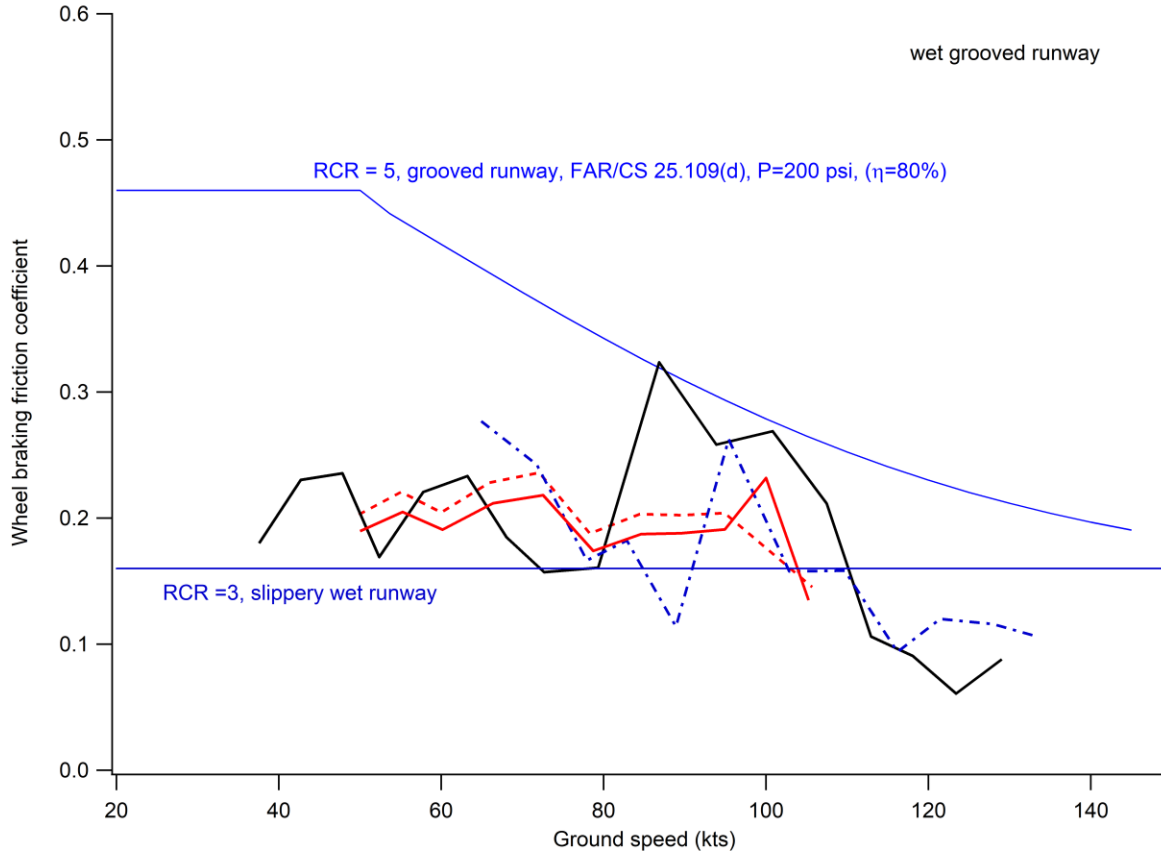
Macro texture	Micro texture	μ - V relation
Open	Sharp	
Open	Smooth	
Closed	Sharp	

Macro texture	Micro texture	μ - V relation
Open	Sharp	
Open	Smooth	
Closed	Sharp	
Closed	Smooth	

➔ Factor in overruns



Example narrow body jet- Open macro texture, smooth micro texture





What causes slippery wet runways?

- Smooth micro textured runway surfaces are believed to be responsible for most slippery wet runways:
 - Due to normal wear of runway surface;
 - None visible rubber build-up after touchdown zone (reduces micro texture);
 - Wrong use of e.g. fog seal to repair runway surface (reduces micro texture).



Background EASA Research Project (2022-2025)

- Explore new methods to assess slippery wet runways;
- Focus on micro texture of runway surface;
- Application of high resolution surface laser scanners;
- Funded from the European Union's Horizon Europe research and innovation programme.

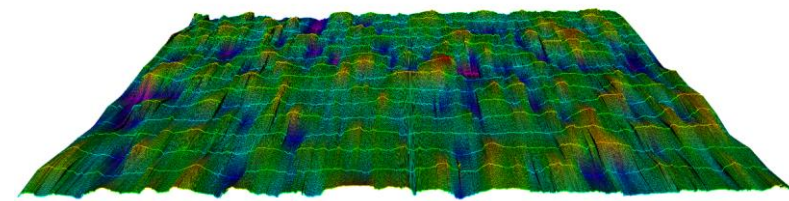


High Resolution surface laser scanner



Source: NLR

Scan 'area'



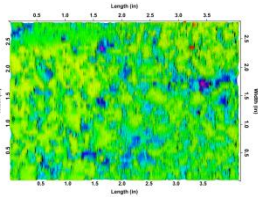


Basic approach EASA project

Runways



Surface scans



Algorithms



Micro texture parameter



Threshold for slippery wet runway



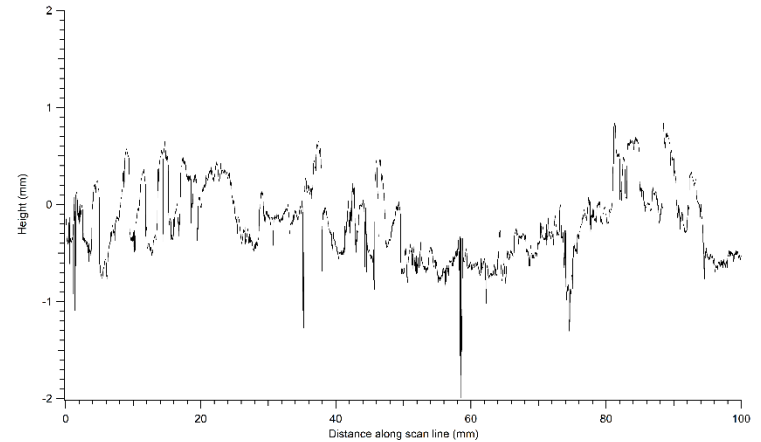
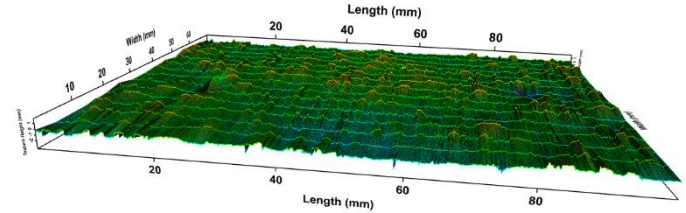
EASA project tasks

- Literature survey;
- Testing:
 - Flight tests on wet runways
 - Surface tests
- Development of algorithms to deduce micro texture parameters from surface laser scans;
- Development of slippery wet runway threshold;
- Guidance material.

Flight Testing



Surface testing- laser scans



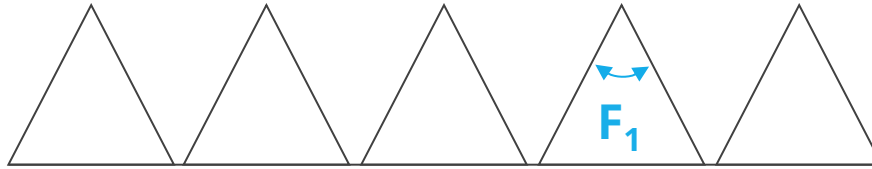
Surface testing - British Pendulum





Micro texture representation – ESDU model

Assume protrusions in micro texture are triangular with vertex upward



Assume a micro texture parameter related in some way to angle of vertex called F_1

- On a nearly complete **sharp** surface $F_1 = 0$
- On a perfectly **smooth** surface $F_1 = \pi$



ESDU models for micro texture sharpness

- Vertex angle (F_1) determines contact pressure between surface and tyre;
- High contact pressures needed to reduce viscous hydroplaning;
- ESDU developed models for deducing F_1 from BPT and aircraft wheel braking friction test data;
- Models are semi-empirical.

Sources: ESDU Data Item 10015 & 23002 and TM 201.

Correlation analysis



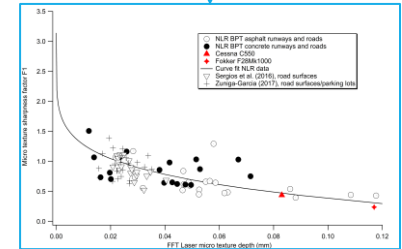
Test aircraft & BPT



Surface laser scanner

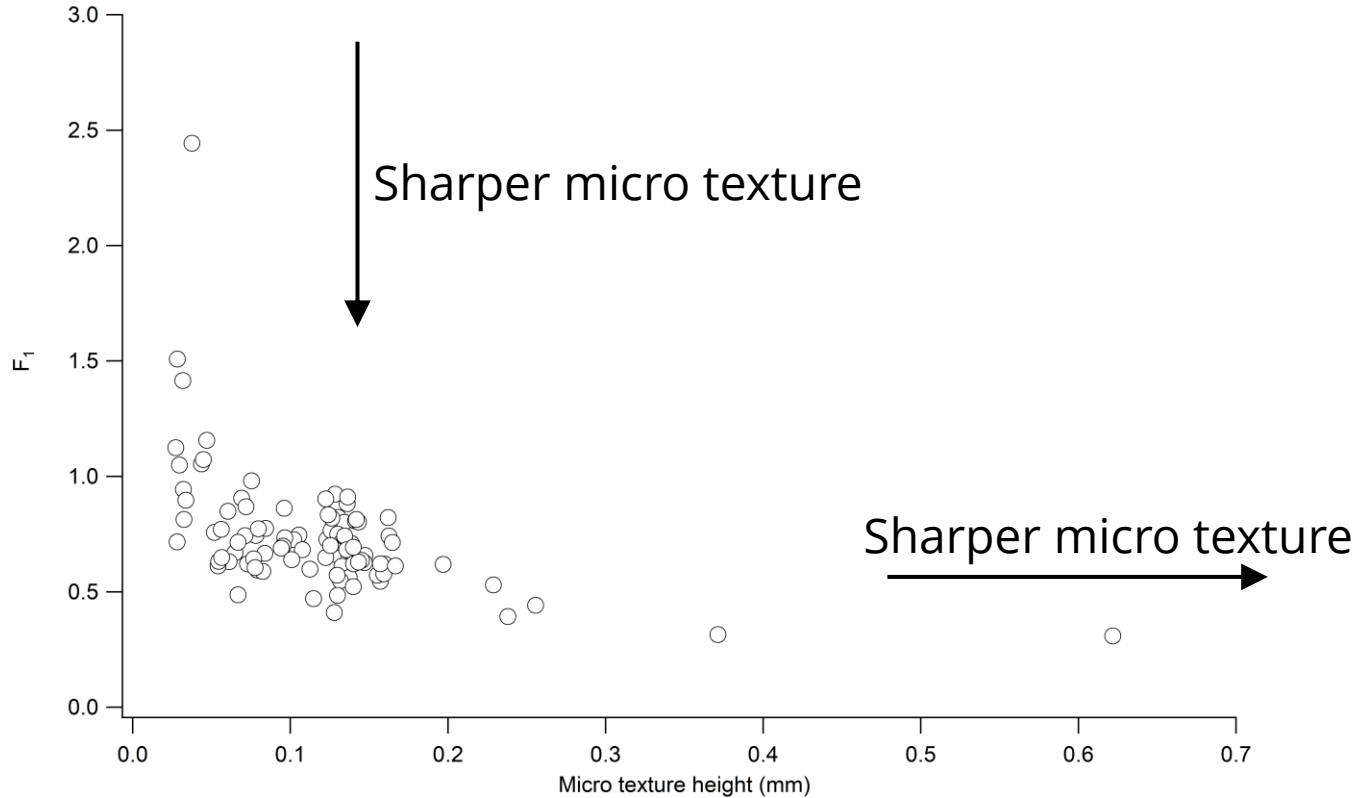
micro texture
sharpness
parameter F_1

micro texture
characteristic














Example of relation F_1 and selected micro texture parameter



Project website

- www.easa.europa.eu/en/research-projects/runway-micro-texture-rwymt
- Reports and Final dissemination event (presentation and video):

Downloads

-  RWYMT — D1 Report on the literature review
-  RWYMT — D-4.2 Thresholds for slippery wet runways related to micro texture characteristics obtained from surface scans
-  RWYMT — D-4.3 Specifications of high-resolution laser scanners
-  RWYMT — D-4.4 Manual for the use of the method
-  RWYMT — D-4.5 Pavement micro-texture characteristics, derived from laser scanner measurements
-  RWYMT — D-5.3 Final project report
-  RWYMT — Leaflet
-  RWYMT Final dissemination event — Presentation
-  RWYMT Final dissemination event — Recording



Next steps

- Choices need to be made which micro texture parameter derived from surface scans should be used;
- Proposed threshold should be evaluated in order to establish a common accepted criterium for slippery wet surface related to micro texture or macro texture (in case the macro texture is very smooth);
- Consider other devices to assess micro texture (e.g. optical);
- Approach needs further validation before full operational use by aerodrome operators and AIBs.



Open Issues

- Operational water depth measurements remains challenging;
- Consideration of surface temperature in wet runway friction;
- Macro texture depth effects (need for minimum values).





The EASA project is funded from the European Union's Horizon Europe research and innovation programme.



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