WALL TURBULENCE AND ROUGHNESS

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PARAMETRIZATION OF ROUGHNESS
WE ARE NOT YET CAPABLE OF DESCRIBING A ROUGH SURFACE!

- Scaling of sand-roughness in the whole Re range

- Today: scaling of many roughness types via $k_{s,\infty}$
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DESIGN OF BETTER-THAN-SMOOTH SURFACES

- Riblets
- V-shapes
- Others?
- Selection of one longitudinal length scale

\( \Delta U^+ \) vs. \( k_\infty^+ \)

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Wall turbulence and roughness
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TBL on rough surfaces

How does roughness affect the whole boundary layer?

Several open questions

- Difference between $k$-type and $d$-type roughness?
- How far does roughness influence the various statistical quantities?
- How does roughness affect the anomalous scaling of Re stresses?

Answer

Very accurate data in the fully-rough regime with $k \ll \delta$: CICLoPE
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ANOMALOUS SCALING OF SPECTRAL QUANTITIES
WITH A VIEW TO CHANNEL VS. PIPE COMPARISON

Models of fluctuation spectra need assessment
Region B is particularly complicated


V-shapes by Sirovich & Karlsson
Nature, 1997

Random pattern

Aligned pattern