Madrid Summer Workshop Seminar

Turbulence over rough, textured and complex surfaces

Prof. Ricardo García-Mayoral
Engineering, Cambridge U. (UK)

This talk will present an overview of our current understanding of the interaction of non-smooth surfaces in general with wall-bounded turbulence, drawing from examples on riblets, super-hydrophobic surfaces, canopies, porous and rough surfaces. In most cases, the flow exhibits outer-layer similarity, such that sufficiently far above the surface the only effect is a shift in the mean velocity profile. This has been challenged in the last couple of decades for some surfaces, but mostly as a result of artefacts in data processing. Provided outer-layer similarity holds, the effect of the surface is confined to the near-wall region, results in the aforementioned velocity shift, and occurs essentially through two physical mechanisms. In the first, surface texture imposes a set of effective, homogeneous boundary conditions on the overlying, texture-incoherent background turbulence. The effect of inertia and the lack of separation of scales between the texture and the turbulent eddies are then key features. When the resulting transpiration effect is small, slip dominates, turbulence remains smooth-wall-like and the effective boundary conditions give rise to Luchini's 'protrusion-height' regime. When the transpiration effect is large, it can by itself account for the changes in the overlying turbulence - this is the case for high-permeability porous substrates. The second mechanism is the non-linear interaction of the texture-coherent flow with the overlying, texture-incoherent turbulence, which acts on the latter as a forcing term, altering the momentum equations. Including this forcing term in otherwise-texture-less simulations is sufficient to capture the effect of the texture granularity on the overlying turbulence.

Day: **11 June, Wednesday**
Time: *11:30 h.*
Place: *E.T.S. Ingenieros Aeronáuticos*
***Aula Magna**, Build. C. ground floor*