



# Linearized no-slip boundary conditions at a rough surface

**Thursday,  
November 21, 2013,  
3:30P.M.**

**Engineering  
Boardroom,**

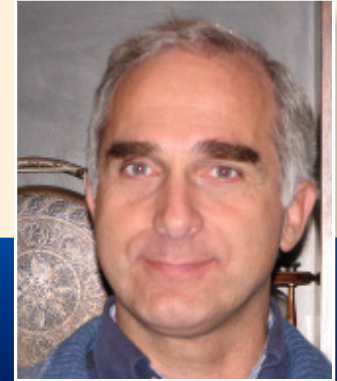
**257 Fitzpatrick Hall**

Refreshments served  
at 3:00 p.m. in  
257 Fitzpatrick Hall

Linearized boundary conditions are a common numerical tool in any flow problems where the solid wall is nominally flat but the effects of small roughness of height  $\epsilon$  are being investigated. Typical are receptivity problems in aerodynamic transition prediction or turbulent flow control.

However, two distinguished mathematical limits have to be considered: a “shallow-roughness” limit, where the linearized boundary condition properly applies, involving a family of surfaces that become smoother and smoother as  $\epsilon$  tends to 0, and a “small-roughness” limit, more closely representative of usually encountered roughness, whose family of surfaces remain geometrically similar to themselves (in particular, retain their slope) as  $\epsilon$  tends to 0.

A connection between the two limits can be established through an analysis of their asymptotic behaviour. As a result, the correct effect of the surface in the small-roughness limit, obtained through a numerical solution of the Stokes equation, can be recast as an equivalent linearized boundary condition modified by a suitable “protrusion coefficient” (related to the “protrusion height” used years ago in the study of riblets). Quantitative numerical examples of such protrusion coefficients will be provided.



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