**Unveiling the Ties Between Nikuradse and Kolmogorov: How
to Derive the Diagram From the Spectrum** GUSTAVO GIOIA, PINAKI
CHAKRABORTY, University of Illinois at Urbana-Champaign — We model the
relation, first evinced by Nikuradse, among the Reynolds number, the relative rough-
ness, and the friction coefficient (f) of turbulent flows in rough pipes. To that end,
we identify the eddies that effect most of the momentum transfer between the vis-
cous layer and the turbulent flow, and derive an expression for f in terms of the
characteristic velocity of those eddies, u_s. Then we use Kolmogórov's spectrum for
the inertial range to determine u_s, and show that the resulting expression for f
gives a gradual transition between the scalings of Blasius and Strickler, but fails to
give the hump or the bellies of Nikuradse's diagram. To obtain an expression for f
that also gives the bellies, we include an exponential spectrum for the dissipation
range. Last, to obtain an expression for f that also gives the hump, we include von
Kármán's spectrum for the energy-containing range. This final expression for f is
in minute qualitative agreement with Nikuradse's diagram; it affords a way of inter-
preting successive portions of the diagram as manifestations of the varying habits of
momentum transfer; and it reveals the existence of close ties between two milestones
of experimental and theoretical turbulence.

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