Abstract Submitted for the DFD19 Meeting of The American Physical Society

Modeling Turbulent Rough-Wall Flow with Pseudo Body Forces¹ GILES BRERETON, JUNLIN YUAN, MOSTAPHA AGHAEI JOUYBARI, Michigan State University — In RANS representations of turbulent flow over rough walls, it is desirable to describe flow variables as their superficial averages, so that the flow can be solved on a smooth-wall grid. The superficially averaged 'extra' terms in the x-momentum equation which describe the local effect of roughness on the flow, and which can be resolved by DNS with an immersed boundary method to enforce the precise local roughness boundary conditions, are $\langle f_p \rangle$ and $\langle f_v \rangle$. They describe averages per unit volume of the pressure dispersion and viscous stresses on account of roughness elements. As such, they are pseudo body forces distributed in the y direction, from the troughs to crests of the roughness sublayer. The distributed body force model appears to offer a more fundamental way of modeling general surface roughness than other approaches. In this talk, we present results which illustrate the applicability of the model for different kinds of roughness in fully-developed and boundary-layer flows. We also present computed distributions of $\langle f_p \rangle + \langle f_v \rangle$ for flows over surfaces with different roughness textures, and describe the practical implementation of such a model within a wall function, for high Reynolds-number flow.

¹The authors gratefully acknowledge the support of the Office of Naval Research under Grant N00014-17-1-2102.

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Date submitted: 25 Jul 2019

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