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Toward Simple Boundary Condition Representations of Zero-Net Mass-Flux Actuators in Grazing Flow

Ehsan Aram,[1] Rajat Mittal[2]
Department of Mechanical and Aerospace Engineering,
The George Washington University, Washington, DC – 20052

and

Louis Cattafesta[3]
Interdisciplinary Microsystems Group
Department of Mechanical and Aerospace Engineering,
University of Florida, Gainesville, FL - 32611

The paper explores a set of simple boundary conditions that can represent the flow emanating from zero-net mass-flux (ZNMF) jets in grazing flow. Results from numerical simulations of ZNMF jets in grazing flows are used to determine the key characteristics of the jet profile, and these are used to construct a series of boundary condition models. These various boundary conditions are then tested for a jet exhausting in an attached boundary layer as well as a boundary layer with an induced separation bubble.

Nomenclature

C_{uv}^2	=	u momentum flux in y-direction
$\overline{C_{uv}^2}$	=	Time average of C_{uv}^2
C_{vv}^2	=	v momentum flux in y-direction
$\overline{C_{vv}^2}$	=	Time average of C_{vv}^2
d	=	Slot width
F^+	=	Dimensionless forcing frequency, f_J / f_{Sep}
f_J	=	Forcing frequency of ZNMF actuator
f_{Sep}	=	Separation bubble frequency
H	=	Cavity height
h	=	Slot height
Q_1	=	Volume flow rate amplitude of ZNMF actuator
Re_δ	=	Boundary layer Reynolds number, $U_\infty \delta / \nu$
Re_J	=	Jet Reynolds number, $V_J d / \nu$
St	=	Strouhal number, $2\pi fd / V_J$
U_J	=	u-velocity amplitude at the jet exit
U_∞	=	Free stream velocity
u	=	Streamwise velocity (in x-direction)

[1] Graduate Student, Department of Mechanical & Aerospace Engineering, Student Member AIAA.
[2] Professor, Department of Mechanical & Aerospace Engineering, Associate Fellow AIAA, mittal@gwu.edu
[3] Professor, Department of Mechanical & Aerospace Engineering, Associate Fellow AIAA, cattafes@ufl.edu.