Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

On the lower bound of net driving power in controlled duct flows KOJI FUKAGATA, Keio University, KAZUYASU SUGIYAMA, NOBUHIDE KASAGI, The University of Tokyo — We examine mathematically the lower bound of the net driving power of a controlled flow under a constant flow rate. The net power in a duct with arbitrary cross-section in the presence of the inertial term, blowing/suction from the wall, and arbitrary body forces can be decomposed into four terms: (1) dissipation due to the velocity profile of Stokes flow; (2) dissipation due to deviation of mean velocity from the Stokes flow profile; (3) dissipation due to velocity fluctuations; and (4) correlation between the wall-pressure of Stokes flow and the time-averaged blowing/suction velocity. Among these, the first three terms are shown to be non-negative, while the sign of the fourth term is indefinite. The fourth term vanishes in the cases where the duct has a constant-shape cross-section, such as cylindrical pipes and plane channels. Namely, in such cases, the lower bound of net power is exactly given by the dissipation rate of the Stokes flow at the same flow rate.

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Date submitted: 16 Jul 2010 Electronic form version 1.4