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AN ATTEMPT TO USE MECHANICAL ENERGY CONSERVATION PRINCIPLE IN CASE OF CHANNEL DEVELOPED TURBULENT FLOW

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Abstract. In this work a hypothesis about the fluid flow character is proposed which consists in the splitting of a flow in two parts. The first one is treated dynamically, and the second statistically. The instability generating energy coming from the dynamical flow being distributed by the statistical flow results in an influence on the first one and forms the observed flow. The connection between the two flows is obtained by the requirement of the mechanical energy conservation. A corresponding model is analyzed in some details and applied to the case of developed turbulence in a channel Poiseuille flow. The mean velocity profiles for values of $Re = 13800$, 23200, 32800 are computed and compared with the existing experimental data. Numerically derived velocity profiles with Re from 100 to 143000 are given.

1. Introduction

Nowadays the Hamiltonian formalism is well developed and has found many applications in hydrodynamics in case of ideal fluid (for comprehensive reviews see for example [1] and [2]). In the present work we start from different basic considerations aiming to obtain equations of motion which would provide the possibility of description of dissipative behavior of the fluid. As it is usual for the Hamiltonian formalism for fluid, we will work with fluid particles in order to pass to finite degree of freedom. Later on in this paper we will obtain the typical size of these elements for the chosen example. We assume also that fluid elements keep their integrity. In other words we consider flow as non-mixing but interacting trajectories having size of the fluid elements. It is this part of the fluid motion for which we will attempt to write a Lagrangian. Some terms of it are connected with the interaction between neighboring trajectories that accumulate an internal friction energy during the movement. This energy is, of course, non-conservative. We will