

Influence of the Angular Momentum in Problems Continuum Mechanics

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Abstract: - For continuum mechanics a model is proposed, that is built with consideration outside the integral term when deriving conservation laws using the Ostrogradsky-Gauss theorem. Performed analysis shows discrepancy between accepted classical conservation laws and classical theoretical mechanics and mathematics. As a result, the theory developed for potential flows was extended to flows with significant gradients of physical parameters. We have proposed a model that takes into account the joint implementation of the laws for balance of forces and angular momentums. It does not follow from the Boltzmann equation that the pressure in the Euler and Navier-Stokes equations is equal to one third of the sum the pressures on the corresponding coordinate axes. The vector definition of pressure is substantiated. It is shown that the symmetry condition for the stress tensor is one of the possible conditions for closing the problem. An example of solving the problem of the theory of elasticity is given.

Keywords: angular moment, potential flow, circulation, Euler equation, Pascal's law

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1. Introduction

In aeromechanics, shipbuilding, the physics of earth and atmosphere, there are no understanding of some processes associated with the interaction of flows with body which are moving at high speeds; there are no adequate models for the formation of vortex structures, etc. The objects of study in continuum mechanics are solids, liquid, gas, and plasma. In a mathematical description, the basic laws are conservation laws. This unites them. Therefore, the work discusses general questions arising when writing conservation laws. The law of equilibrium of forces was put as basis of the classical theory, the law of conservation angular momentum was considered as consequence of the fulfillment the law of balance forces. Each of laws was considered independently. However, the gradient of the distributed moment leads to the formation of an additional force, that we need to take into account in the equations of motion. This is evidenced by the works devoted to the

calculation of stresses in the rods [1,2] and in the calculations of viscoelastic problems [3]. The probable reason for ignoring the effect in the general theory is the proof of its absence, built on the basis of the theory, taking into account the interaction of neighboring elementary volumes only along the normal to the surface [4-6]. In this case, one can only prove the consistency of the whole theory. The influence of the rotational part of the stress tensor can be traced by analyzing the Hamel solution and its generalizations [7]. Dividing the speed into divergent and rotational components about an axis passing through an arbitrary point does not right, as according to theory, only movement around the axis of inertia need to consider. A model that is ignoring the rotation of the elementary volume leads to the symmetry of the stress tensor, which violates the "continuity" of the medium [8]. When analyzing the derivation of differential conservation laws in continuum mechanics, it turned out that the transition

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