Comment

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Comment on
SETUP OF TURBULENCE MECHANICS ACCOUNTING FOR A PREFFERED ORIENTATION OF EDDY ROTATION

T. Soomere and J. Engelbrecht
Centre for Nonlinear Studies
Institute of Cybernetics
Tallinn University of Technology
Tallinn, Estonia
e-mail: tarmo.soomere@cs.ioc.ee

The paper addresses one of the potential extensions of the mathematical description of the turbulence phenomena. The approach is applicable in cases when the motion is substantially anisotropic in the sense that it has a preferred direction of (local or global) rotation. The author has introduced term ”rotationally anisotropic turbulence” for such motions (e.g., [31]).

The central idea consists in introducing a specific equation describing temporal evolution of a sort of local angular momentum. Doing so presumes that the turbulent field can be split into two nontrivial parts: (statistically) isotropic motions and motions having a preferred direction of rotation. This partition resembles the analogous splitting of velocity into the mean and the fluctuating component.

The author has demonstrated earlier that such separation, if carried out systematically and combined with reasonable closure hypotheses, leads to a more general set of consistent equations for the parameters of such turbulent fields [8,9]. The idea itself has been discussed during many decades. It has been formulated in terms of categories used in this paper as early as in the end of the 1970s (see references in [9]). The resulting equations are reduced to the classical ones if there is no preferred orientation of eddies in the field. Usage of the approach of rotationally anisotropic turbulence has proved to be useful in several geophysical applications where a preferred direction of rotation naturally occurs in (quasi-) two-dimensional cases owing to the Earth's rotation (e.g.,[34].

The body of the paper addresses the problem of constructing of equations for description of motions with different (temporal or spatial) scales within the given turbulent flow as well as building reasonable closure assumptions for these equations. The analysis is correct and consistent.

The conclusions drawn in Section V, however, are weakly connected with the main body and are to some extent confusing. While the first conclusion is evidently true, it is still necessary to mention that there exist many descriptions of turbulent flows that account for the interaction of flow with external fields. Nothing in the body of the paper is said about negative viscosity, thus the reader has to guess in which of the references this problem is treated. It is also true that the proposed modification of the turbulence theory leads to the necessity to account for asymmetry of turbulent stress tensors, a property that usually is disallowed in the classical approaches to fluid dynamics. The third and fourth conclusions may be correct but their meaning remains vague.

The paper thus presents a nice exercise which is useful in many respects. Instead of making use of the obtained results, however, it ends with some quite general and not particularly well justified claims. Although the approach as such has a clear prospective in the theory of turbulence in specific types of media, its potential has been severely underexploited.

Since the theory contains some features that may be interpreted as contradicting with the assumptions of classical approach, it is not unexpected that it has not been become popular within three decades of its existence. It is not sufficient to demonstrate that a few selected examples can be treated in a simple or more consistent manner within the new theory. (Such exercises are of course of good use provided the relevant conclusions are rational). Instead, one has to show that the theory clearly improves the classical one in general, or is able to describe effects that have been overlooked or wrongly described by the existing approaches. We are looking forward for such a breakthrough.