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News & Comments

The Double-Decomposition Concept Revisited for Modeling Turbulence in Permeable Media

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The volume-average method can be used to model macroscopic transport for laminar flows in permeable mediums. Two different approaches can be used to generate macroscopic equations when the fluid's properties exhibit both spatial and temporal variations. The debate over which order to apply mathematical operators to governing equations while double averaging the equation set is clarified by this novel idea. The concept of double-decomposition was first created for the flow variables in porous media and then expanded to include a variety of flows and instances. The scope of the current study does not provide a comprehensive analysis of all these scenarios, but the reader who is interested can find the foundations of the double-decomposition idea as well as its application to moving media.

More applications for the study of turbulence via porous media can be found in engineering and environmental studies, among other fields. The former includes research on impinging jets for cooling or heating, porous combustors, moving bed reactors, thermal energy systems, volumetric solar collectors, and others. Environmental research can benefit from using applications of the study of turbulence in porous media, such as flows through vegetation and the simulation of forest fires.

The methodology for analysing turbulent flow in permeable media that was first published in the early 2000s has been revisited by the authors in this study. The double-decomposition idea, an unique theory that demonstrates how a variable can be decomposed in both time and volume to simultaneously account for fluctuations (in time) and deviations (in space) around mean values, is explored in this paper. The mean and turbulent flow transport equations have been presented. Since the double-decomposition concept was introduced, numerous authors have worked on similar treatments for turbulence in porous media at various levels of complexity, sometimes combining what was already understood and detailed, other times dividing the turbulence spectrum into bands, each of which was dealt with by its own transport equation.

However, in most of the research, the volume-time or time-volume sequence of integration has always been important in establishing the overall modeling method.

The numerical and experimental evaluations of individual terms in the double-averaged equations above could be additional research topics for young scientists. A general tool for the study of various important engineering and environmental flows would be improved with the help of the evaluation of specific terms and comparison with tests.

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KEYWORDS
Turbulent flow, modeling, double decomposition, permeable structures, porous media