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TSFP-9 • Book of Abstracts

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Ninth International Symposium on Turbulence and Shear Flow Phenomena

June 30th - July 3rd, 2015
Melbourne, Australia

THE UNIVERSITY OF MELBOURNE

Front cover Yarra River by night viewed from Princes Bridge

Back cover clockwise from top left: Australian Red Kangaroos, Old Quadrangle at the University of Melbourne, Australian laughing kookaburra, Royal Exhibition Building in the Carlton Gardens (UNESCO World Heritage Site)

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9th INTERNATIONAL SYMPOSIUM ON TURBULENCE AND SHEAR FLOW PHENOMENA

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PREFACE

This book contains the extended one page abstracts of the papers presented in both oral and poster form at the Ninth Symposium on Turbulence and Shear Flow Phenomena (TSFP-9), held at The University of Melbourne, Australia, from 30th June to 3rd July, 2015.

The book begins with the five invited keynote lectures, and then proceeds with the abstracts of the oral presentations, which are arranged chronologically. Papers from poster sessions come subsequently. Sessions names are included at the beginning of every concurrent session, as well as an author index at the end of the book is provided to assist in locating the abstracts.

We thank all the authors for complying with the strict formats for both the one page extended abstract as well as the full paper. The full papers are electronically available on the USB key included with the welcome package presented during registration. In line with usual practice, the full papers will also be archived at the TSFP conference website (www.tsfp-conference.org).

TSFP-9 Local Organising Committee

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John Kim

RICH FLOW PHYSICS IN CURVED ARTERIES AND THE VOCAL TRACT
Michael Plesniak

COMPRESSIBILITY EFFECTS ON TURBULENT SHEAR FLOWS
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Modelling of the decay of homogeneous magnetohydrodynamic turbulence by using compact schemes

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An examination of the homogeneous magnetohydrodynamic turbulence decay process, in spite of the large number of publications in this field, is a relevant task for researchers of several generations. The influence of magnetic field on the conducting fluid is studied in various fields of science and used in an engineering and technology. Therefore, studies of magnetohydrodynamic turbulence decay is an important task in the fields of: forming astrophysical and geophysical phenomena, MHD generators, plasma accelerators and engines.

Research problems of the magnetic field influence on the electro conductive fluid is divided into three types:

- examination of the MHD turbulence at a constant value of the magnetic field.
- examination of the self-excitation of magnetic field at a given velocity of the flow.
- examination of the self-excitation of magnetic field and the motion of a conducting fluid at the same time taking into account acting forces.

This work is devoted to study of self-excitation of magnetic field and the motion of the conducting fluid at the same time taking into account acting forces. The idea is to specify in the phase space of initial conditions for the velocity field and magnetic field, which satisfy the condition of continuity. Given initial condition with the phase space is translated into physical space using a Fourier transform. The obtained of velocity field and magnetic field are used as initial conditions for the filtered MHD equations. Further is solved the unsteady three-dimensional equation of magnetohydrodynamics to simulate homogeneous MHD turbulence decay.

The numerical modeling of a homogeneous MHD turbulence decay based on the LES method with using compact scheme depending on the conductive properties of the incompressible fluid is reviewed.

To solve the problem of homogeneous incompressible MHD turbulence, a scheme of splitting by physical parameters is used. At the first stage, the NavierStokes equation is solved with no pressure consideration. For the approximation of convective and diffusion equation members, a compact scheme of a higher order of accuracy is used by Abdibekov et al. (2013). At the second stage, the Poisson equation is solved, which is derived from the continuity equation by considering the velocity fields of the first stage. For the 3D Poisson equation, an original solution algorithm has been developed: a spectral transform in combination with the matrix run. At the third stage, the obtained pressure field is used to recalculate the final velocity field. At the fourth stage, the obtained velocity field is used to solve an equation in order to obtain the components of the magnetic field strength, which are included in the initial equation.

As a result of the simulation with different magnetic Reynolds numbers, the following turbulence characteristics were obtained: kinetic energy, magnetic energy, integral scale, Taylor scale, transverse and longitudinal correlation functions.

Based on the LES method with using compact scheme, the influence of magnetic viscosity on the decay of uniform magnetohydrodynamic turbulence has been numerically modelled. The modified LES method in combination of compact scheme is allowed to obtain a compact approximation for the convective terms of the motion equations of the third, and for the diffusion terms of the fourth, order of accuracy. The obtained results allow to sufficiently accurately calculate the variations of the characteristics of uniform MHD turbulence with time at large Reynolds and magnetic Reynolds numbers. A numerical algorithm has been developed to solve unsteady three-dimensional magnetohydrodynamic equations as well as to model the MHD turbulence decay at different magnetic Reynolds numbers. The analysis of the simulation results makes possible the following conclusion: the magnetic viscosity of the flow has a significant influence on MHD turbulence and, therefore, can be used for the process control at the production of semiconductor single crystals. Physical processes and phenomena of uniform MHD turbulence were identified in the numerical simulation. The proposed method can be used to solve MHD turbulence without significant changes.

REFERENCES

Abdibekov, U., Zhumagulov, B., Zhakebaev, D., Zhubat, K. 2013 Simulation of isotropic turbulence degeneration based on the large - eddy method. *Mathematical Models and computer simulations*, vol. 5, no. 4, pp. 360-370.

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