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| Numerical simulation of the Kolmogorov flow in the inviscid case |
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| **Abstract –** In this paper, the Kolmogorov flow is investigated by direct numerical solution of equations describing the flow of an inviscid medium with an ideal equation of state under the action of an external force. The method of the simplest Godunov linearization [2] developed by the authors is used to solve the problem numerically. Various flow modes (vortex parquet) and parameters that influence the emergence and development of these modes are studied. |

# 1. Introduction

The Kolmogorov flow is a two-dimensional flow that occurs under the action of a periodic force along one of the coordinate axes [1]. This problem was set by A. N. Kolmogorov, using it as a model for studying the development of flow instabilities and the transition to turbulence. Несмотря на

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# References

1. E.M. Cherry, C.J. Elkins and J.K. Eaton. Geometric sensitivity of three-dimensional separated flows. *Int. J. of Heat and Fluid Flow*, 29: 803-811, 2008
2. Y. Hattori, T. Tsuji, Y. Nagano and N. Tanaka. Effects of freestream on turbulent combined-convection boundary layer along a vertical heated plate. *Int. J. Heat and Fluid Flow*, 22: 315-322, 2001.
3. H. Pascal, S. Jakirlic and K. Hanjalic. DNS and RANS-Modelling of in-cylinder turbulence subjected to axial compression. In *Third International Symposium on Turbulence, Heat and Mass Transfer (Edited by Y. Nagano, K. Hanjalic and T. Tsuji)*, pp. 479- 486, 2000.
4. K. Hanjalic and S. Jakirlic. Second-moment turbulence closure modelling. In *Closure Strategies for Turbulent and Transitional Flows (Edited by B.E. Launder and N. Sandham)*, pp. 47-101, Cambridge University Press, 2002.