

ABSTRACT

The thesis is presented in 77 pages. It contains 2 appendixes and bibliography of 32 references. 15 figures and 2 tables are given in the thesis.

Topic relevance. The idea of the impact of "space weather" (SW), or solar activity on the living and inanimate world of Earth was first expressed by A. Chizhevsky in the beginning of the XX century. Later the investigation of sunspots and flares, hard stream of solar radiation, cosmic radiation dynamics began; flow of hot plasma with high speed from the Sun was discovered, and the magnetic shell of the Earth was studied. Nowadays, the study and prediction of SW is an important branch of science because such phenomena as disturbances of the magnetic field, coronal mass ejection etc., cause problems in the spacecrafts operation and even their loss. Here we consider the phenomena that occurs in structures such as coronal loops (which arise from energy and heating of the solar corona). The transverse dimensions of the loops are small compared to their length, thus neglecting their curvature, the loops can be modelled locally by magnetic cylindrical tubes.

Thesis connection to scientific programs, plans, and topics. The thesis was prepared according to the scientific research plan of the Applied Mathematics Department of the National Technical University of Ukraine "Kyiv Polytechnic Institute."

Research goal and objectives. The aim of the thesis is to develop numerical schemes for modeling plasma oscillations in a cylindrical filament of round section with spiral magnetic field.

To achieve the above stated goal the following problems were solved:

- The review and analysis of the physical processes and the corresponding mathematical models was done.
- Numerical schemes for the solution to the chosen model were developed, and their properties were investigated.
- Appropriate mathematical support and software were developed, a series of experiments to analyze the results was accomplished.

Object of research is the process of spreading oscillations in a cylindrical plasma filament.

Subject of research is numerical methods for solving differential equations describing the appropriate physical process.

Methods of research. To solve the task numerical methods of mathematical physics were used, namely modification of Petrov-Galerkin method.

Scientific contribution of the results includes the following points:

- First computational schemes for the equation of oscillations (specialized format) in plasma filament were proposed.
- Selection of parameters in stabilizing Petrov-Galerkin method with piecewise quadratic weighting functions for convection-diffusion-reaction equations with dominant convection was proposed.
- Petrov-Galerkin method computational schemes for equations of magnetic hydrodynamics in the adiabatic approximation were improved.

Practical value of obtained results. The need for numerical simulation of described physical process originated in the Space Research Institute of NAS of Ukraine and Ukraine DKA (ISR NANU-SSAU). The developed software and mathematical support and the results are ment for use in this institution.

Approbation of the thesis results. The main points of the thesis were presented at the conference "Applied mathematics and computing - PMK'2016" as well as the International Conference SAIT 2016 «System Analysis and Information Technologies».

Publications. The results of the thesis were expounded in 3 theses publications for scientific conferences: "Computational schemes based on projection Galerkin approach for solving problems on eigenvalues for wave equations with variable density" (PMK 2016), "Correction and Fourier-analysis finite element stabilized computational schemes using mass lumping" (SAIT 2016), "Spatio-temporal MHD-structures reconstruction on example of the UFL wave disturbances in magnetosphere" (Solar physics 2015).

Keywords. MHD fluctuations, plasma, Alfven waves, Petrov-Galerkin method, finite element method.