Modeling OF TRANSport PROCESSES USING NEURAL NETWORKS IN REAL TIME [[1]](#footnote-1)\*)

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Kapralov V.G., Krivosheev A.N., Bogdanov A.M., Novokhadskaya E.O., Solovyev K.V.

SPbPU, Saint-Petersburg, RF, [v.kapralov@spbstu.ru](mailto:v.kapralov@spbstu.ru)

Modern plasma machines place ever higher demands on plasma control systems [1]. It should be noted that additional difficulties in the management of large reactor facilities are associated with a smaller number of available diagnostics, both due to the more applied nature of systems like FNS and high neutron loads, which do not withstand all diagnostics used at research facilities. Another problem is a decrease in the ratio of the power of active control systems, for example, additional heating of the plasma, to the stored energy in the plasma, which requires an earlier response of the control system if there is a threat of deviation of the discharge parameters from the specified mode.

There are discusses options for calculating transport coefficients in real time. The solution of the inverse problem for the transport equations is replaced by its approximation using a neural network. In the general case, this leads to a decrease in the accuracy of the solution, but significantly reduces the calculation time, making its application available in real time and including its results in the control loop of the machine. In addition to the directly measured parameters, it becomes possible to use calculated values ​​in the control of the machine, for example, transport coefficients.

Another area of application of neural networks in the study of transport processes is their use in modeling [2]. Modeling using fine-mesh grids and implicit methods for solving equations requires significantly more processor time than solving using a neural network. Therefore, neural networks can provide a preliminary search and search for complete modeling options, which significantly speed up the receipt of results.

Neural networks do not exhaust the possibilities of using machine learning in the study of transport processes. There also discusses the application of symbolic regression based on evolutionary algorithms. Symbolic regression allows you to select a functional form of scaling for modeling, both on the basis of experimental data and the results of solving the inverse problem for the transport equations.

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References

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Mu/ru/CH-Kapralov.docx) [↑](#footnote-ref-1)