

# MULTI-AGENT SYSTEMS FOR THE ANALYSIS OF TRANSPORT DISCRIMINATION OF THE POPULATION OF THE FAR EAST

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**Abstract:** *transport problems of the Far East are analyzed from the position of transport discrimination of the population*

**Keywords:** *transport discrimination, analysis, population, Far East, inaccessible regions*

# МУЛЬТИАГЕНТНЫЕ СИСТЕМЫ АНАЛИЗА ТРАНСПОРТНОЙ ДИСКРИМИНАЦИИ НАСЕЛЕНИЯ ДАЛЬНЕГО ВОСТОКА

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**Аннотация:** *анализируются транспортные проблемы Дальнего Востока с позиции транспортной дискриминации населения.*

**Ключевые слова:** *транспортная дискриминация, анализ, население, Дальний Восток, труднодоступные регионы.*

Currently, there is an active reformatting of the world economic system, which is manifested through the weakening of the economic influence and potential of the old European states, the growth of economic power and political influence of China, the reorientation of a number of OPEC countries to other centers of power, the formation of new intercountry and interregional associations, etc.

This is especially important in our time, when the latest economic development forecasts indicate a slowdown in the global economy, due to the slowdown in the advanced economies.

The emergence of crisis phenomena in various parts of the world economic system cannot but affect Russia, because not only are the tasks of restoring the economic complex of our country becoming more complicated, but the geography of potential points of growth is also changing.

One of these niches can be the Russian transport system itself, the role and importance of which is only growing. Our country also has a rich scientific and technological potential, which has transport technologies oriented to the conditions of the northern regions. This technological and scientific potential can be useful for overcoming the transport inaccessibility of the regions and reducing the level of transport discrimination of their population.

The strengthening and development of this transport segment can create good prerequisites for the development of the country in the post-crisis period, which is now intensifying. The transport technologies and vehicles available in the country that can be useful in many mega- and macro-regions: a) to ensure the fastest possible restoration of the transport potential that the regions of the European territory of the country previously had and which have not yet completely lost labor personnel and technologies; b) to expand its participation and strengthen its position in the countries of Asia and Africa. Our country can offer transport technologies that will allow them to provide a fundamentally different level of connectivity of their economic spaces, taking into account its specifics.

In order to reduce the acuteness of transport problems, it is necessary to have tools for comparing different options for analyzing possible options for transport networks. Classical software tools are not suitable for our purposes [1-9], as well as well-known specialized software systems: CUBE from the UK, PT Vissim / PT Visum (Germany) and AIMSUN (Spain), PARAMICS from the UK and TransCAD from the USA, as well as Russian software complexes Road Manager and PKM MADI, because I am considering a narrower group of issues.

At the same time, it is the possibilities of multi-agent modeling [9-19] that are of the greatest interest for the competent formalization of the problems of transport discrimination of the population.

In the developed multi-agent system for modeling different options for solving the problem of transport discrimination, two classes of agents (orders and resources) and two options for movement were provided: by public or transport (on fixed routes) and by individual transport. It seems to us that it is this approach to the

formation of a list of agents that made it possible to obtain more accurate and realistic results, both at the stage of setting the problem and at the stage of analysis in the process of model experiments.

The regions of the Far East were chosen as the object of study, for which, on the one hand, the problem of transport accessibility and discrimination of the population is most relevant, and on the other hand, it is possible to use a fairly wide range of vehicles and technologies that are poorly used in the rest of the country.

At this stage of the study, it was considered appropriate to limit ourselves to only two main classes of agents - "orders" (for receiving transport services) and two types of "resources" to support transport processes (individual and public transport).

Note that "order-agents" is a fairly representative group, the goal of each member of which is to reach the destination by finding some route and searching for agents capable of providing them with the necessary service.

In this class, two subclasses were provided:

1) agents responsible for route transport. These agents need to know the nodes of the route and the schedule of movement along them;

2) agents in charge of individual transportation.

These agents need to know both all nodes through which they can move and the distance between them. The resource agent class was introduced to model the function (process) of acquiring transport services by agents. The target function of this group of agents is to provide the "order-agents" with the transport they need to reach a certain point on the route.

Experimental calculations and approbation of the model were carried out in relation to the conditions of the regions of the Far East. The population of these regions is more familiar with the problems of transport discrimination. At the same time, there is a fairly wide range of off-road vehicles that can radically change the situation in the region.

When developing a toolkit for the implementation of the task, a decision was made to use IntelliJ Idea as a development environment, as well as a relational database (MySQL DBMS). The choice of this toolkit made it possible to obtain a) gain in the formation of queries to the database using the SQL language; b) ensure a high level of data reliability and integrity; maintain the necessary level of scalability for processing large amounts of data and supporting multi-user applications; guarantee a high level of data security.

### References

1. *Amelin K.* [и др.]. Development of applications for mobile intelligent systems on the platform Intel Atom/– St. Petersburg: publishing house BBM, 2012. – 2018 p.
2. *Vince D.* Application of a multi-agent model of an operational control system for high-performance computing systems to study the effectiveness of various control algorithms/ Vins D.V., Glinsky B.M. // Problems of optimization of complex systems: Proceedings of the 12th International Asian School-Seminar, Novosibirsk, December 12–16, 2016, – p. 109-117.
3. *Gamma E.* Methods of object-oriented design. Design patterns / E. Gamma, R. Helm, R. Johnson, D. Vlissides - St. Petersburg: Peter, 2016. - 366 p.
4. *Zaitsev I.* Multi-agent systems in modeling socio-economic relations (research of behavior and verification of properties using Markov chains): specialty 05.13.10 "Management in social and economic systems" : abstract of the dissertation for the degree of candidate of technical sciences / Zaitsev Ivan Dmitrievich. - Novosibirsk, 2014. - 16 p.
5. *Yesikova T.* Analysis of transport discrimination of the population of regions in assessing the options for the backbone transport network of Asian Russia // Economics of Siberia in the context of global challenges of the XXI century. - 2018. - pp. 117-128.
6. *Konyavsky V.* Application of multi-agent systems and evolutionary-simulation methodology for managing large-scale systems / Konyavsky V.A., Ross G.V. // Management of the development of large-scale systems mlsd'2016: Proceedings of the Ninth International Conference: in 2- x volumes, Moscow, October 03–05, 2016 / Under the general editorship of S.N. Vasilyeva, A.D. Tsvirkun. - Moscow: Trapez, 2016. - pp. 199-200.
7. *Kopeliovich D.* Principles of constructing automated monitoring systems for socio-economic objects / D. I. Kopeliovich, O. N. Yurkova // Bulletin of the Astrakhan State Technical University. Series: Management, Computer Engineering and Informatics. - 2015. - No. 1. - pp. 98-104.
8. *Parondzharov S.* Multi-agent systems. Interaction. / S. Parondzharov - St. Petersburg: LAP Lambert Academic Publishing, 2012. - 200 c.
9. *Yurasov V.* Multi-agent systems of the regional logistics system / V. A. Yurasov // Scientific notes of the Russian State Social University. - 2010. - No. 8 (84). - pp. 143-153.
10. *Piatkowski B.* Comparison of traffic assignment in VISUM and transport simulation in MATSIM / B. Piatkowski, M. Maciejewski // Transport Problems. – 2013. – Vol. 8, No. 2. – pp. 113-120.

11. *Sandita A.* Developing A Multi-Agent System in JADE for Information Management in Educational Competence Domains. / A.V. Sandita, C.I. Popirlan //Procedia Economics and Finance, 2015. Vol. 23. pp. 478-486. doi:10.1016/S2212-5671(15)00404-9.