СИБИРСКИЙ ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ
SIBERIAN FEDERAL UNIVERSITY

ПРОСПЕКТ СВОБОДНЫЙ- 2017

МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ МОЛОДЫХ УЧЕНЫХ

ЭЛЕКТРОННЫЙ СБОРНИК МАТЕРИАЛОВ МЕЖДУНАРОДНОЙ КОНФЕРЕНЦИИ СТУДЕНТОВ, АСПИРАНТОВ И МОЛОДЫХ УЧЕНЫХ “ПРОСПЕКТ СВОБОДНЫЙ 2017” ПОСВЯЩЕННОЙ ГОДУ ЭКОЛОГИИ В РФ

КРАСНОЯРСК, СИБИРСКИЙ ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ

17-21 АПРЕЛЯ 2017 Г.

Министерство образования и науки Российской Федерации
ФГАОУ ВО «Сибирский федеральный университет»

Проспект Свободный - 2017

Материалы научной конференции
посвященной Году экологии в Российской Федерации
17-21 апреля 2017 г.

Электронное издание

Красноярск
СФУ
2017 г.

English for specific purposes

УДК 338.434

OPTIMIZATION OF THE DAIRY INDUSTRY DEVELOPMENT STRATEGY IN KRASNOYARSK TERRITORY

Anton D. Firsenko
Language Supervisor: Anna B. Alekseeva
Siberian Federal University

Development of the agricultural complex is one of the highest priorities of the current federal government political course. «Doctrine of Food Security», approved by presidential decree of February 1, 2010 sets the goal of ensuring significant growth of the agricultural production volume by 2020 in order to provide the population with the sufficient level of food supplies of domestic origin meeting the requirements of countries' food security policy [4]. For instance, according to the Doctrine, the annual volume of raw milk of all categories produced in Russia must reach 41500 thousand tons (the real figures are 30699 thousand tons in 2013 and slightly over 32 million tons in 2015). In other words, the raw material base of Russian dairy industry is supposed to grow by 35% during the 4 years left until the deadline set by the Doctrine, but it is worth mentioning that the volume of raw milk reaching the end consumer in the form of deep processed food products is far less than the overall raw milk production volume. As an example, the raw milk marketability index in Krasnoyarsk Territory does not exceed 55% according to the 2015 data.

The object of study in this article is the dairy industry of Krasnoyarsk Territory and the subject is the set of applicable instruments for stimulating dairy producers' and recyclers' profitability and efficiency growth. The analysis of several external factors restricting the potential growth of the industry is crucial for thorough understanding of the current situation.

The key method of providing government support for the agricultural complex is the implementation of «State program for the development of agriculture and regulation of markets for agricultural products, raw materials and food for 2013-2020». The Dairy Industry Development State Program was supplemented by the provisions of the Dairy Development Program until 2020, the draft of which was prepared and submitted in 2014 by the National Union of Milk Producers SOYUZMOLOKO with the participation of several related public authorities [3]. The key factor hampering the independent development of the dairy industry, according to the experts of SOYUZMOLOKO, is the low investment attractiveness of the production of raw milk [2].

In 2015 1.78 billion rubles were transferred from the federal budgets to the subjects of the agro-industrial complex of Krasnoyarsk Territory as well as 3.17 billion rubles from the regional budget. Of these, directly into the dairy industry:

- 234.59 million rubles in the form of subsidies to compensate for part of the cost of production and sale of milk and dairy products (per 1 liter of marketable milk);

- 21.16 million rubles in the form of subsidies for the reimbursement of a part of the cost of paying interest on investment loans for the development of the dairy cattle breeding sub sector for up to 15 years;

In addition to the abovementioned directions of financing, the state support of the forage production sector, dairy livestock breeding, and budgetary funds aimed at helping beginners and current farmers, and households as a whole, can have a positive impact on the development of the dairy industry.

According to the results of 2015 (according to the data published on the official website of the Government of Krasnoyarsk Territory) in all categories of farms of the region there are 424.7 thousand heads of cattle or 99.9% of the same period in 2014, including 166.3 thousand cows (99.4%) and 54.6 thousand sheep and goats (103.4%), while milk production amounted to 674.5 thousand tons (100.6%), including agricultural enterprises' production which amounted to 342.7 thousand tons (101.3%) [1].

Thus, the author outlines the following negative features of the process of production, processing and marketing of milk in the region:

- The high cost of transport logistics of raw milk due to very low population density, as well as the remoteness of dairy farms from processing and marketing centers, combined with the need to meet short shelf-life specific to the industry;

- Low manufacturability of raw milk production, which leads to intensification of seasonality effects associated with harsh climatic conditions;

- Increased wages in comparison with neighboring regions (availability of the northern coefficient, additional paid vacation), reduce its competitiveness at the federal level;

- Introducing the products of local dairy producers into the assortment of large regional retail chains requires a separate payment (marketing fees that in some Krasnoyarsk retail chains can form up to 15-20% of the retail price of products) .

As a conclusion of studying the analysis of the investment attractiveness of raw milk production in Russia, conducted by SOYUZMOLOKO experts, the results of the implementation of the state program for the development of the agro-industrial complex for 2015, and the consideration of the regional specificity of the dairy sector, it can be stated with relative certainty that in order to ensure the profitability of the production of raw milk (at the current market price) as a separate type of economic activity and achieving the goals of the "Doctrine of Food Security" by 2020 a significant increase in annual government funding is needed.

Theoretically, with sufficient "infusion" of budgetary funds this approach can provide the industry with raw materials in the short term, granted that the existing import barriers remain, but it will not allow the development of the dairy infrastructure in the long-term period. It is noteworthy that in a number of developing countries with positive experience of state government supporting the producers of raw milk (a striking example is Brazil), measures were taken to increase and maintain prices for their products, which increased not only the profitability of producers' activities, but also the efficiency of state subsidies as well as private investments directed to the industry.

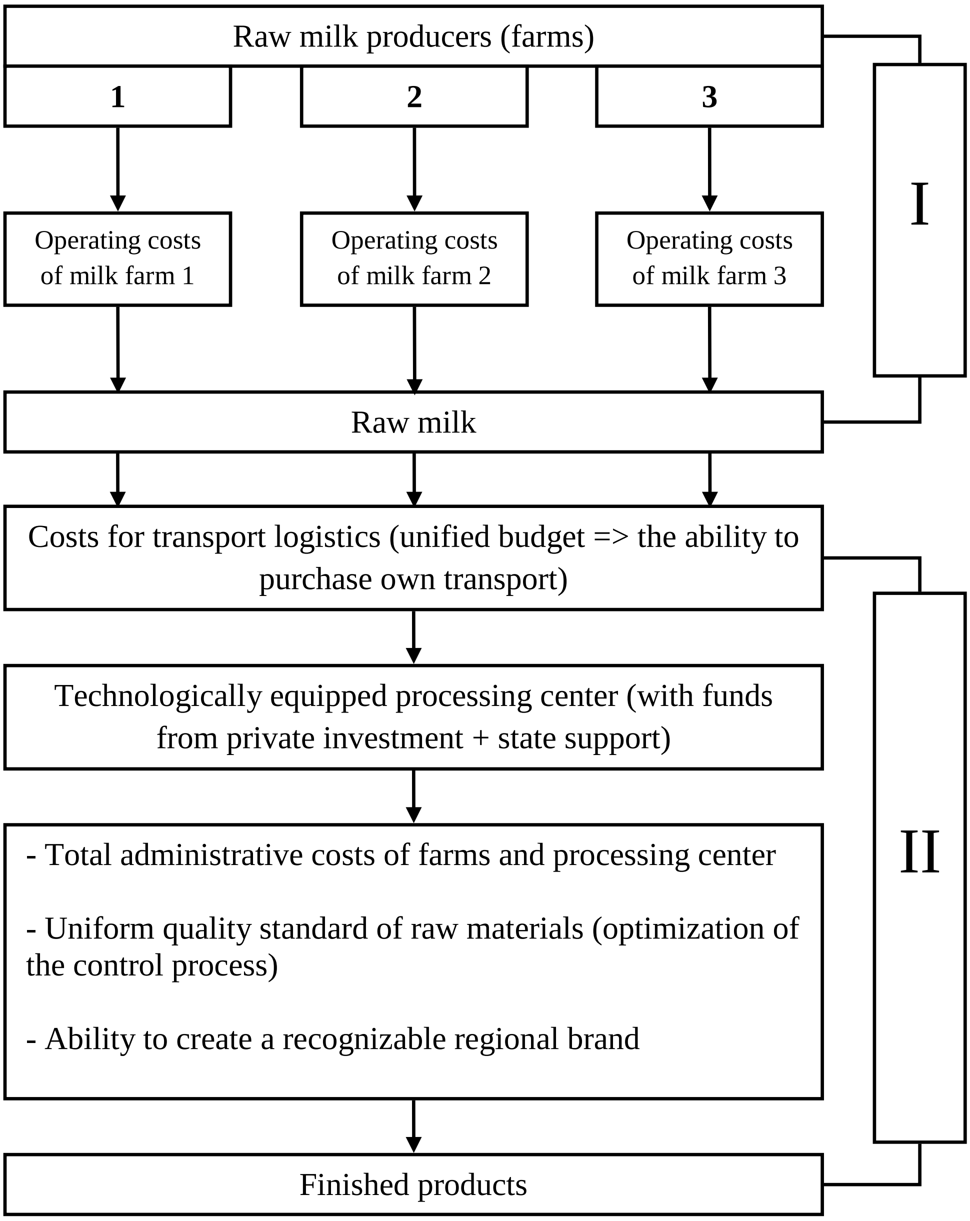
The production of raw materials by small farms can not act as a locomotive for the development of the industry, even with increased subsidies, since the difference between the market price and the cost of raw milk is most often a negative value (the aggregate expenditures are higher than the total revenues of this type of activity). Obviously, this does not allow dairy farms to accumulate free capital for long-term investments and invest it to start a much more profitable activity of processing their own raw materials into consumer products with high surplus value, such as cheese, kefir, cottage cheese, etc.

It is hypothesized that in order to stimulate the long-term development of the industry, it is necessary to consider the prospect of creating cooperatives (clusters) of raw milk producers under general management with a unified budget, centered around one technologically equipped processing center, which increases the overall profitability of the combined business unit. Let us illustrate the proposed principle of organization of such cooperatives.

Fig. 1 on the next page presents the main advantages of combining raw milk production (block I in the scheme) and its processing into finished products (block II) within the framework of one enterprise. As mentioned earlier, the production of raw milk as an independent activity has a low profitability. On the other hand, processing raw milk into ready-to-eat food products is much more profitable. Thus, the formation of a general budget of expenditures, as well as the possibility of using its own raw materials, will create an economically efficient enterprise capable of accumulating free capital which enables further growth of the dairy production volume.

Subsidizing part of the cost of production and marketing of milk, as well as channeling budget funds to help private investors wishing to launch similar projects on the basis of the existing infrastructure in obtaining borrowed funds, are by far not the only state support tools that are relevant in this situation.

Fig. 1 – Functioning scheme of a milk processing plant created through the cooperation of producers of raw milk



Firstly, it is worth to consider the possibility of providing substantial tax benefits for the period of the first 2-3 years from the commencement of business activities. Secondly, it should be taken into account that the effectiveness of agro-industrial complex is a matter of national food security, therefore it can be considered logical to use the private-state form of ownership when launching such projects.

In conclusion, it remains to be said that achieving of the goals set by the government of the state in front of Russian agro-industrial complex by 2020 is a difficult path, requiring an individual approach to solving the specific problems of each particular region, as well as the use of the most effective management tools. In addition, rational financing of agriculture will only be possible with sufficient transparency of the reports on the outcome of the implementation of the state support program, provided by maintaining the system of monitoring target spending of its participants.

List of sources used

1. Informatsiya o khode realizatsii PNP "Razvitiye agropromyshlennogo kompleksa" za dekabr 2015 goda [Electronic resource] // Krasnoyarskiy kray – official web-site – 2015. – Access mode: http://www.krskstate.ru/nacprojects/agroprom/napr/0/id/19506

2. Programma razvitiya molochnoy otrasli do 2020 goda [Electronic resource] // SOYUZMOLOKO – official web-site – 2014. – Access mode: http://www.souzmoloko.ru/news/news_2557.html

3. SOYUZMOLOKO vnes proyekt programmy razvitiya otrasli v Minselkhoz [Electronic resource] // SOYUZMOLOKO – official web-site – 2014. – Access mode: http://www.souzmoloko.ru/news/news_2594.html

4. Utverzhdena Doktrina prodovolstvennoy bezopasnosti Rossiyskoy Federatsii [Electronic resource] // Ofitsialnyye setevyye resursy prezidenta Rossii – 2010. – Access mode: http://kremlin.ru/events/president/news/6752

УДК 514.12 (075)

IDENTIFYING THE LOCATION OF AN OPEN PARKING AREA DUE TO ITS IMPACT ON THE ENVIRONMENT

E.V. Ilina, D. D. Stepanova

Научный руководитель канд. культурологии Воног В.В.

Сибирский Федеральный Университет

Nowadays freedom of citizens as well as goods and services is possible due to developed transport infrastructure of Russia. Availability and condition of a public road network provide the government territorial integrity and economic integrity. According to Russian Federal State Statistics Service the overall length of public roads has increased by 148 % from December 2000 to December 2014. However, municipal road network is behind significantly in comparison with motorization rates. Russian cities population corresponds to 73, 3 % of total population. Moreover they are clustered by the main enterprises' funds, railway junctions, bus stations and main transport bridges over large rivers. Technical parameters of streets do not often correspond to the level of traffic load, which is permanently increasing. Thus, in the period from 2000 to 2014 a number of passenger cars has increased by 113 %, a number of public transport has decreased by 31,2 %, a number of trucks has increased by 42 %. Thereby, the share of private transport in terms of traffic flow has reached 70-90 % [1].

Transport network is considered to be a road network managed by different ways of business, combines different technical levels with road transport infrastructure objects (such as petrol stations, food services area and technical services). Besides linear objects and common area for vehicle and pedestrian traffic, there are mandatory elements of municipal transport system such as areas for passenger cars for citizens to keep their vehicles.

As a result cities tackle the problem of an impact of a parking area on the environment. This important component of social and economic development has a significant negative effect on the environment, especially in large cities, where the influence increases due to population growth.

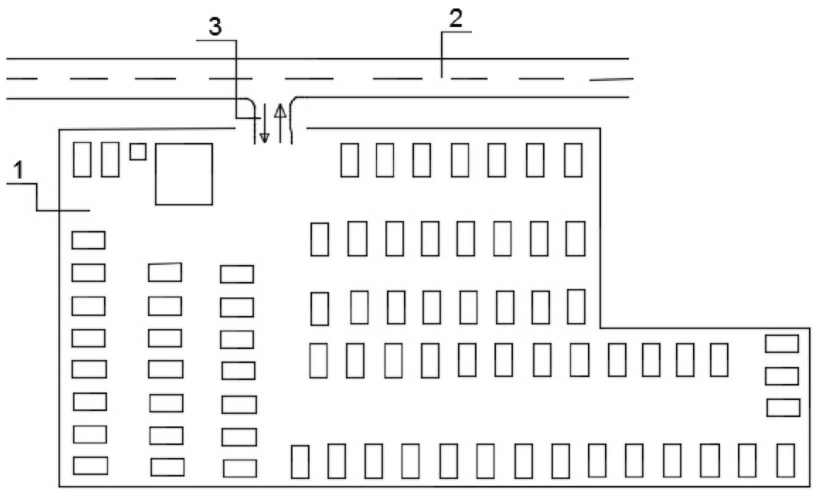
Besides the negative impact of all transport and road network (transport emissions share in air pollution is equal to 45 %, and noise pollution is equal to 85-95%) public parking areas pollute the atmosphere to a larger degree.

We analysed the regulatory instruments with requirements to different parking areas, including main standards [2], [3]. Analysis showed that all the requirements include mainly fire prevention measures and geometrical parameters and do not touch the impact of car parking areas on the environment. These documents do not consider the geographical location of parking and principles of its location, climate, average annual temperature and wind direction. Currently, forecasting of pollution caused by harmful substances is not provided methodically, so we need a monitoring (with appropriate statistical processing) as a foundation of necessary method development.

Due to foregoing, we suggest the first results of studying the impact of parking areas on the environment. Our research has applied in terms of Krasnoyarsk open parking areas.

For doing research, a common parking area was chosen, which is located among blockhouses, near the nursery school (approximate address: Krasnoyarsk, Micro district Severniy, Vodopjanova Street, 8a). The parking area places 90 parking lots. The plan of the parking are is illustrated on Figure 1. The calculation of car emissions has done for one among three parking areas, where two areas are located close to each other and one is separated with a road. The period of calculation lasted for one month in winter. Predominant wind direction regarding the parking is western and south-western.

Gross and ultimate one-off pollutant emissions have been determined in order to evaluate the impact of such type of parking [4].



1 – The area of parking; 2 – the public road;

3 - The entrance from public road.

Figure 1 – The scheme of an observed parking

Table 1 – The results of the i-th substance emissions calculation produced by one car applied with a petrol engine

	$m_{ПPIK}$, g/min	m_{LIK}, g/km	m_{XXIK}, g/min	M_{1IK}, g	M_{2IK}, g	G_I, g/s	M_{1X}, t/year
CO	8,8	16,5	3,5	637,375	593,375	8,321	2,40
C_nH_m	0,66	2,5	0,35	93,025	89,725	1,214	0,356
NO_x	0,04	0,24	0,03	8,81	8,61	0,115	0,034
SO_2	0,14	0,079	0,011	3,535	2,835	0,046	0,012
Pb	0,004	0,019	0,003	0,702	0,682	0,009	0,003

Table 2 – The results of the i-th substance emissions calculation produced by one car applied with a diesel engine

	$m_{ПPIK}$, g/min	m_{LIK}, g/km	m_{XXIK}, g/min	M_{1IK}, g	M_{2IK}, g	G_I, g/s	M_{1X}, t/yr	$G_{IНП}$, g/s
CO	0,75	3,7	0,4	136,425	132,675	1,781	0,04	0,364
C_nH_m	0,29	0,8	0,17	30,22	28,77	0,395	0,009	0,045
NO_x	0,35	2,4	0,21	87,76	86,01	1,146	0,026	0,054
SO_2	0,78	0,23	0,008	12,131	8,231	0,158	0,003	0,009
C	0,018	0,48	0,065	17,315	17,225	0,226	0,005	0,014

According to preliminary data based on calculations, there is air and soil saturation of substances that exceed the maximum permissible concentration (the total pollutant emission produced by parking vehicles is equal to 2,888 t/year) in an open parking area significantly [5]. Air saturation of pollutants may be explained by neglect of the wind diagram (windproof and, as a consequence, stagnation of pollutants) at the parking location and its excessive capacity (90 parking lots). Geographically, the parking is located perilously close to the nursery school that does not meet the requirements of Sanitary Rules and Regulations [6].

In accordance with this study, and as a result, identifying the negative effect of an open type parking on the environment, we have proposed measures to improve the environmental situation:

1. Technical measures. There is a multi-storey parking garage construction for 500 – 1000 parking lots. If single-stage storage method (open parking) of 1 car occupies about 25 – 30 m^2 of land, with storage in multilevel garages it takes not more than 15 m^2 (together with driveways, entrances, accumulative areas and protective green spaces).
2. Administrative activities that are aimed at streamlining existing regulatory framework of parking accommodation standards, limiting the number of cars in parking areas in accordance with ecological aspects, restricting parking placement or construction near playgrounds and pre-school institutions and schools.
3. Development of estimation methods concerning parking ecological safety.
4. Qualitative activities aimed at calculating parking capacity in order to limit emissions to maximum permissible concentrations (MPC).
5. The development of an abstract model for determining the capacity of car parks taking into account the influence on the environment.
6. The development of practical recommendations for the parking design area.

The above mentioned facts require further research

Список использованных источников

1. Росстат: Федеральная служба государственной статистики [Электронный ресурс]: Транспорт URL: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/enterprise/transport/ (дата обращения: 27.02.2016). [*Rosstat: Russian Federal state statistics service* [Electronic resource]: Transport (in Russian)]

2. СП 42.13330.2011 (СНиП 2.07.01-89*) Градостроительство. Планировка и застройка городских и сельских поселений. [SP 42.13330.2011 (SNiP 2.07.01-89*)]. *The planning and construction of urban and rural settlements*. (in Russian)]

3. СП 113.13330.2012 (СНиП 21-02-99*) Стоянки автомобилей. [SP 113.13330.2012 (SNiP 21-02-99*) *Parking*. (in Russian)]

4. В.И. Жуков, Л.Н. Горбунова, С. В. Севастьянов. *Оценка воздействия транспортно-дорожного комплекса на окружающую среду*. Красноярск, Сибирский Федеральный Университет, 2012. 784 с. [V. I. Zhukov, L. N. Gorbunov, S. V. Sevast'yanov. Assessment of the impact of the transport system on the environment. Krasnoyarsk, Siberian Federal University, 2012. 784 p. (in Russian)]

5. ГН 2.1.6.695-98 Предельно допустимые концентрации (ПДК) загрязняющих веществ в атмосферном воздухе населенных мест. [GN 2.1.6.695-98 *Maximum allowable concentrations (MAC) of pollutants in atmospheric air of populated areas*. (in Russian)]

6. СанПиН 2.2.1./2.1.1.1200-03 Санитарно-защитные зоны и санитарная классификация предприятий, сооружений и иных объектов (3-я редакция). [SanPiN 2.2.1./2.1.1.1200-03 *Sanitary protection zones and sanitary classification of enterprises, constructions and other objects (3rd edition)*. (in Russian)]

УДК 62-519

EFFICIENT PATH PLANNING FOR DYNAMIC ENVIRONMENT

K.A. Safarov, N.A. Zaitceva

Scientific supervisor: PhD (MIT) Dr Arthur Richards

Language supervisor: senior lecturer of the department of foreign languages for engineering T.V. Zhavner

University of Bristol

Siberian Federal University

I. INTRODUCTION

Thank to recent advances in electronics and sensing driverless vehicles became a near future reality. The autonomous driving is potentially more efficient that human driver. The energy efficiency can reduce traffic congestions and save enormous amount of money spent due to traffic accidents. One of the main problems of the technology is robust motion planning. More specifically, motion planning problem involves multiple moving and static agents around the vehicle. Thus, this project focuses mainly on solving that particular problem. Although this problem is highly studied area by now, most of the studies are based on single car planners, whereas the aim of this project to simulate a network of those vehicles interacting with each other within various urban scenarios. Within this network, some of the vehicles will be modeled as driverless vehicles, and others will be modelled as a manually driven. We will try to illustrate examples of difficulties an autonomous vehicle could get into in certain interaction scenarios and also to find out ways that the system could be modified to avoid those difficulties. Examples might be getting stuck at junctions or breaking some rules we had made up about passenger 'satisfaction' (e.g. it ends up accelerating and decelerating too much, or similar).

II. LITERATURE REVIEW

According to Blincoe et al. [3], there were 32,999 fatal cases in car accidents and 3.9 million injuries in 2010 in Unite States only. The data from WHOs Global Status Report on Road Safety indicates that there are about 1.2 million car accident related deaths each year[6]. It is increasingly hard to reduce that number because the number of cars increases each year. As an example, there were over 1.015 billion cars on the road around the globe [8]. Surprisingly, over 90 per cent of all the car accidents are caused by human factors [1]. That number indicates that human as a part of the control loop in the car is least robust. More than the third of the fatal cases involved drunk drivers [3].

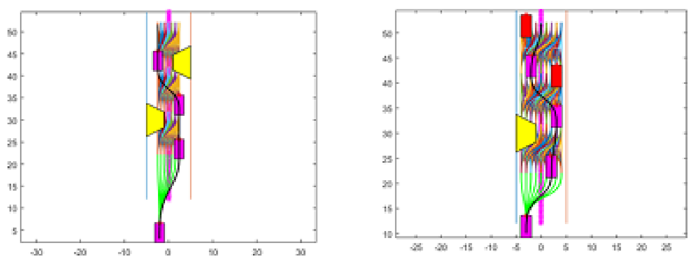
The road infrastructure capacity limitations cause traffic jams in many cities, especially, in megapolises. According to Azmat and Schuhmayer [2] drivers spend 40 per cent of the fuel on finding the parking slot. At that time only 5 per cent of the capacity of highways is used efficiently and 95 per cent of the life-time cars remain parked.

In summary, all the issues named above created a perfect environment for researches in driverless technology. In this paper we will try to present our contribution towards solving those issues. There are many different approaches developed for motion planning of mobile robots. However, for our case we have to look at the algorithms that take into consideration non-holonomic vehicles. Non-holonomic vehicles are described by 2 Cartesian coordinates x and y, orientation and heading [7]. This reduces the search space for best route due to the nature of the vehicles movement.

Lattice planner seems promising, as it is computationally fast to generate off-line unless it has to take a shape of the road line it follows [4].

III. RESEARCH METHODS

In this project the robust motion planner was developed for driverless vehicle in simulation environment. The motion planner is based on state lattices. The state lattice reduces the search space for the vehicle to a few connected polynomial spirals. Dynamic programming was used to choose the best route from generated lattices. An obstacle avoidance algorithm was implemented based on occupancy grids. Before the motion planner were able to generate an optimal path, the costs and weights of the dynamic programming optimiser had to be established. To improve the performance of the planner when dealing with obstacles, the lattice parameters tuning was conducted. Within the tuned range of parameters the performance of the optimizer was improved without loss of runtime.



(a) Dense spatial lattice (b) Sparse spatial lattice

Fig. 1: Two configurations of spatial lattice planner.

Figure 1a shows the performance of dense spatial lattice when there are multiple static obstacles. Another configuration is illustrated in the Figure 1b, where less cluttered environment causes the algorithm to use more sparse lattice.

The next chapter in the project is about developing more advanced motion planner that can deal with dynamic obsta-
cles. This task was even more complex than static obstacle avoidance as an extra dimension was introduced - time. An intelligent controller had to be developed to manage motion planning to avoid collision with dynamic obstacles.

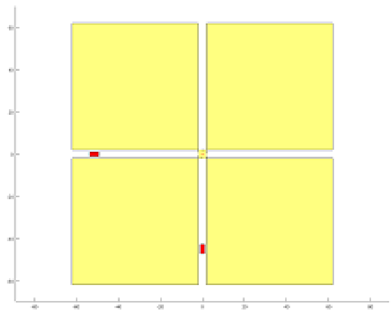


Fig. 2: Perpendicular crossroad scenario.

In order to create such a controller, we have to visualize the dynamic obstacle environment. Once we have acquired an optimal trajectory in space, we need to choose right trajectory in time dimension [5]. As we can see from the Figure 2 in the Euclidean space two vehicles cross a perpendicular crossroad.

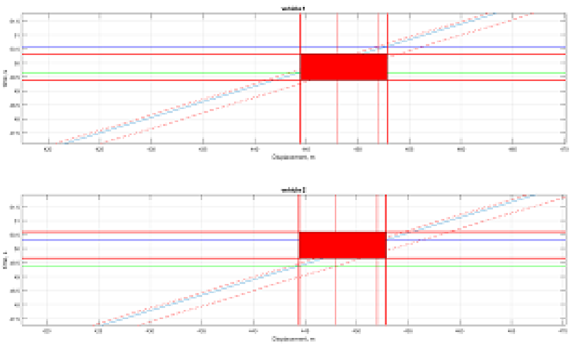


Fig. 3: Collision box in 2-dimensional space.

The same two vehicles' movement in time/displacement space is shown in the Figure 3, where red box is collision area and blue diagonal lines are the velocities of both vehicles.

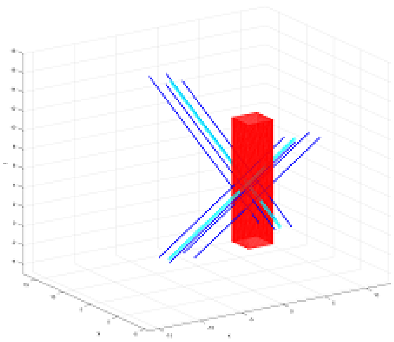
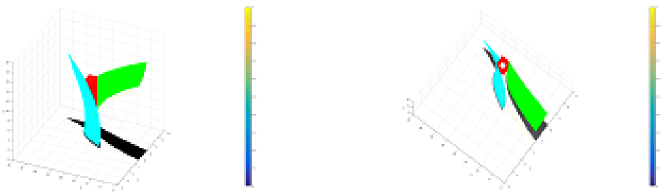


Fig. 4: Collision box in 3-dimensional space.

In the Figure 4 we can clearly see that both vehicles will inevitably collide if none of them will slow down or speed up to avoid the collision.



(a) (b)

Fig. 5: Two perspectives on the 3-dimensional plot of the 'near-miss' case.

Finally, we plot in the Figure 5 all the possible velocities that represent 'near miss' situations to get an idea of the shape of the safe zones. Once we acquire those shapes, we can model them and implement in a controller to avoid collisions.

IV. CONCLUSION

In this work we have described motion planning problem for driverless vehicles as highly complex problem. Also, we investigated lattice based two-level motion planner. It can be robust to static obstacles as well as dynamic ones. The research is currently in its initial stages to suggest any strong conclusions.

Future work will include non-centralised multiple vehicle control to improve the traffic flow and comfort of passengers. Also, sensor uncertainty will be modelled to improve the robustness of the controller and planner.

References

[1] N. H. T. S. Administration et al. National motor vehicle crash causation survey: Report to congress. National Highway Traffic Safety Administration Technical Report DOT HS, 811:059, 2008.

[2] M. M. Azmat and C. Schuhmayer. Self driving cars. 2015.

[3] L. Blincoe, T. R. Miller, E. Zaloshnja, and B. A. Lawrence. The economic and societal impact of motor vehicle crashes, 2010. Technical report, 2014.

[4] T. M. Howard et al. Adaptive model-predictive motion planning for navigation in complex environments. 2009.

[5] J. Johnson and K. Hauser. Optimal longitudinal control planning with moving obstacles. In Intelligent Vehicles Symposium (IV), 2013 IEEE, pages 605–611. IEEE, 2013.

[6] W. H. Organization et al. WHO global status report on road safety 2013: supporting a decade of action. World Health Organization, 2013.

[7] J. D. Schwartz and M. Milam. On-line path planning for an autonomous vehicle in an obstacle filled environment. In Decision and Control, 2008. CDC 2008. 47th IEEE Conference on, pages 2806–2813. IEEE, 2008.

[8] J. Sousanis. World vehicte popuiation tops 1 billion units.2011.