UNMANNED EKRANOMOBILE

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This paper considers the idea of high-speed transportation on the basis of small, energy-efficient wing-in-ground-effect vehicles (WIGs) in countries with high-organized land transport routes.

One of the greatest mankind achievements is development of methods and means of transportation. On this difficult path, inventors of all time strove for increasing the speed and energy efficiency and improvement the passenger comfort and safety. At the same time, every innovation in this area was met in the society by a lot of claims and objections, mostly funny, now causing only a smile of our contemporaries.

So in 1825, engineer Peter Kardel wrote in the journal "Kuogerli Review": "What could be more absurd than the assumption that locomotives could travel at speeds two times greater than the postal coaches." In 1830, Dennis Lirdner wrote in his book "The steam engine ...." that "Journey on rails at high speed is quite impossible because passengers would not be able to breathe and die of suffocation."

Comments are superfluous. Even today it is difficult to imagine, for example, a family car capable to transport five passengers and 200 kilogram of luggage, travelling faster than 400 per hour, and being not less efficient and reliable than the horse or camel used during thousands of years – the symbols of generosity and hard working.

FOTO Google+ National Geographic RU

Unfortunately, the modern vehicles are not as secure and cost-effective as would be liked, despite of the tremendous efforts to improve them.

In the twentieth century, the aviation was mastered, and now the today's bullet-trains are capable to travel over great distances at a half speed of airliners. But nevertheless, the reliability and safety of the high-speed transport does not meet the today's requirements.

Too often we are told of serious transport accidents with fatalities. What is to do? It is unrealistic to stop the ongoing development of existing vehicles, but in this situation SAFETY and ENERGY EFFICIENCY get paramount importance, because, in our hectic days, they directly affect people's lives.

What progress has already been made in this direction? Firstly, we are witnessing, a gradual shift to post-carbon, electric powered car engines aimed to reduce the fuel consumption and thereby – the environment pollution. Secondly, new high-strength lightweight materials became widely used in the car industry. These and other innovations allowed a 30-60% reduction in fuel consumption that is a good starting point, but even these modernized means of transport faced serious sale problems because some of their characteristics are inferior in comparison with those of the existing park of our iron horses. Is there a way out of this vicious circle? What is the way to move more quickly and secure?

The main condition for the transition to the use of high-speed ground transport is the ability to deliver its passengers to the long-distance goal in a number of times faster than now. The navigation of such transport should be completely automatic. During the trip the driver can have a cup of coffee, read news in the Internet and make preparations for the working day on the way to work.

But such miracle-transport already exists! And it was invented in the 20's of the last century, and later named EKRANOPLANE or Ground Effect Vehicle (GEV) or Wing-in-ground-effect vehicle (WIG). You can check this site www.NIZI.co.il and read the articles from the-19/01/2016 to learn more about the GEV "from Tel-Aviv to Haifa in 20 minutes" and "Speed ships of the desert and the sea".

A big part of energy consumed by the road-, rail- and water-transport is used to overcome the rolling friction or water resistance. In the early years of WIG's designing (see Wikipedia, WIG), it was found that for large ships, owing to their large reflecting area, the screen-effect is present not only close to the terrain (or water) surface but continues up to the height of several tens of meters that is very important from the point of view of the navigation problem.

At the same time, a great future also awaits the widespread uptake of small WIGs. And, despite the fact that their movement should be adjusted in the limits of a relatively small screen effect "corridor", I came to the conclusion that owing to the latest achievements in robotic traffic navigation, favorable conditions can be created for effective implementation of small WIG vehicles when driving on highways with parameters close to today's motor ones.

The idea of using this wonderful transportation for movement on prepared tracks visited me, a young scientist in the early seventies of the last century, when I was lucky enough to take part in the preparation of special equipment for sea trials of the world's first heavy-duty, full-scale EKRANOPLANE ship named KM (abbreviation of Russian "Ship-Model") - the offspring of the
Central Design Bureau for Hydrofoil Vessels (CDBHV), which now bears the name of the legendary scientist and designer, Doctor of Technical Sciences. R.E. Alekseev.

Dr. Rostislav Alexeyev

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At those years, the development of the concept of civil WIG transport in the USSR was out of the question because all these works were then military-aimed and therefore kept top-secret until the collapse of the Soviet Union. The status of resuscitation of the WIG vehicle development is nowadays widely covered in the special literature. So, this topic was touched upon in the Donat Moskalev's article which can be roughly translated as "Great WIG vehicles plans" published in the journal "Aviation Explorer" of July 18, 2010 (in Russian). In the paper, the author pointed out the major problems preventing widespread development of this mode of transport in today's Russia, which got a rich scientific and technological legacy of the Soviet Union. One does not still understand what basic economic and financial levers could promote the market development in this direction. The author also observed that in the rest of the world "...one also did not yet found the best way to adaptation of the WIG's".

Nevertheless, in the last twenty years the WIG transport specialists appreciated the benefits of this mode of transport when used in civil area. So, in public transport, the

employment of the dynamic air cushion technology is making it one of the most energy efficient and safe means of high-speed transportation.

I suggest to develop a compact, light-weight and economical five-seat family WIG based on the already available methods and means in this field. I would call it EKRANOMOBILE, (shortly EKM). The experimental EKM will move on highways, like the famous USA ones or Europe Auto-bans.

Unmanned EKM

As an object for comparison of energy efficiency we'll take small aircraft of similar capacity as the proposed EKM, such as the single-engine 5-seat airplane Eclipse-400 or Eclipse-500. Their characteristics are presented in the following sources:

1. http://webcache.googleusercontent.com/search?q=cache:UCcsA0rnxfgJ:video.mail.ru/mail/cevfhby/_vfavorites/86.html+&cd=1&hl=ru&ct=clnk&gl=lv

2. http://www.ato.ru/content/eclipse-500-stoit-svech

3.Eclipse-500, Fred George, Aviation week, 02.06.2011

Technical data: Speed - 611 km / h, Flight range - 2083 km; Fuel consumption - 14 litres per 100km.. According to a preliminary estimate, our EKM with the same 5 seat capacity will consume no more than 5-7 liters of liquid fuel per 100 km at a speed of 400-450 km / h and have a range of at least 2100km.

Single-engine plane Eclipse-500 (Photo by "Aviation week" 02.06.2011)

We consider as prototypes, with characteristics close to the suggested EKM, the first-born small Ekranoplanes (WIGs) - the 2-seat "Strizh" and the 8-seat "Volga-2" created by the Hydrofoil Design Bureau named after Rostislav Alekseev and the 5-seat "Aquaglide-5" designed and manufactured in cooperation with the St. Petersburg Scientific-Production Enterprise "Radar MMS.

10Eight-seat Ekranoplane “Volga-2”

ThesTwo - seat Ekranoplane "Strizh".

e WIGs, unfortunately, do not have a number of characteristics and systems which are inherent in the ultrafast WIG transport, such as, in particular, automatic stabilization system and automatic navigation system.

The main technical data of the proposed EKM should be as follows:
1. Max take-off weight – not exceeding 1800kg.;
2.Speed - 400-450km / h;
3. “Flight” range on a single fuel tank - 2100km;
4. Dimensions: length - up to 5 m and width with the wings – not exceeding 6 m.

An automatic system should be employed to stabilize the fluctuations of the vehicle in all directions, (eliminating yaw, roll and pitch) ensuring its sustainable "flight" on the highway. An automatic navigation system will, in particular, provide "in-platoon" movement controlling and setting the distance to the vehicle moving in front.

For moving in urban areas as a traditional car, the EKM will “hide” the wings, for example, under the bottom and use battery powered low power electric motors on the wheel axes. The EKM development will make full use of all the best that has been created in the previous half-century in the art, and also attract new car, aircraft and WIG design teams.

Minimizing weight using the latest technology and materials - is the prerogative of car and aircraft manufacturers. So, the designers of the Eclipse-500 managed to reduce its weight by almost 2 times compared with the previous models.

German car designers developed a full-scale robot-car prototype which passed successfully proving-ground test, then road test on the roads of Europe, Asia and Russia and now were allowed to carry out control tours at Berlin streets. (See www.membrana.ru "Car-robot master on the streets of Berlin," by Julia Rudiy, Sep 21. 2011, in Russian).

The above mentioned platoons car traffic has been proposed and successfully tried out by Sweden, UK, Spain and Germany - in accordance with the project SARTRE, which started working since 2009. The results obtained with illustrations and video materials are reflected in the materials of (www.membrana.ru "Platoons car traffic" by Konstantin Bolotov, January 19, 2011, in Russian). This work is funded under the European Commission's Seventh Framework Program (FP7) and integrated with the project " Safe Road Trains for the Environment".

EKM movement on thoroughfare

Majority of developed countries today are operating motorways having from five to ten lanes of traffic in one direction.

Motorway, China.

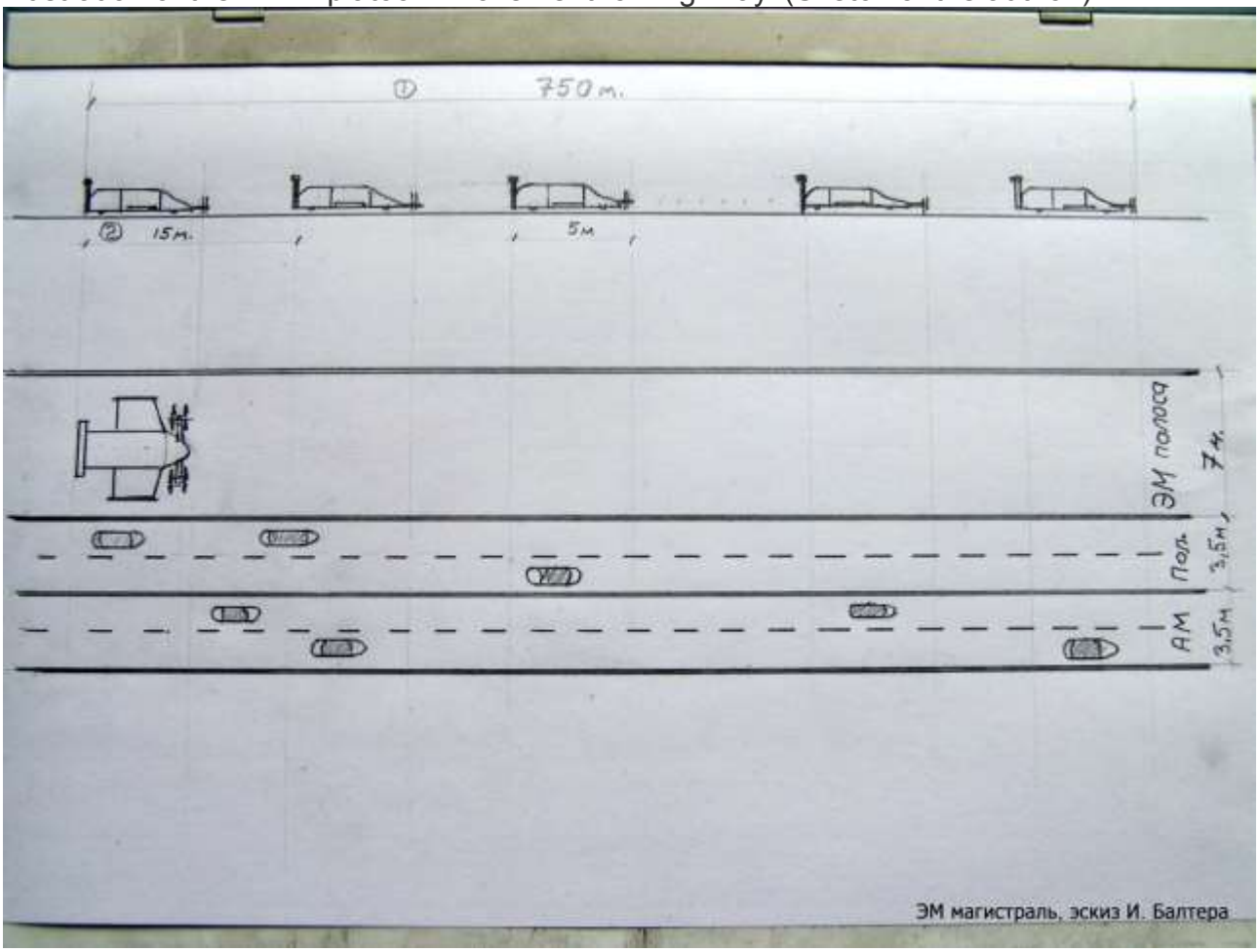
Even such multiband transport arteries no longer cope with ever increasing flows of cars. Graphic illustration proving this statement is shown in this photo.

One way to relieve the roads is to build new ones. But this direction leads eventually to a shortage of agricultural land and the deterioration of the overall environmental situation in the

region.

The second way - is to increase several times the speed of traffic and here the EKM can present the solution of the problem. Now, we have to take into account that the EKM lane should be twice wider than the standard lane designated for cars. Therefore, as an experiment, during the development stage two straight standard lanes can be combined into one. Despite the "annexation" of two bands by the EKM, we get almost double the gain in capacity of passage owing to its high speed, and in addition, the passengers arrive much faster at the destination of their journey. And high comfort and safety is insured owing to the completely automatic navigation.

Illustration of the EKM ”platoon” movement on highway. (Sketch of the author.)



In one “platoon” up to 50 vehicles can move with a 15 m step and 10 m gap between them. So, while driving, a fully complete “platoon” is 750 m long. The “platoon” step is 1,000 m and the distance between them is 250 m.

In the EKM track, as in the standard highway should be both acceleration sites and exit ones. In addition, near residential blocks the sound insulation is to be improved, as the noise from the engines may exceed the health standards. The problem becomes irrelevant in places where instead of the main engines, the low-noise electric ones are used.

Economic performance of the project

It is impossible to determine the market price of the EKM before its appearance in public sale. We can only very approximately compare the cost of an analog – the ”Eclipse-500” small aircraft – with rough estimate of the EKM. Firstly, the WIG vehicle is significantly simpler and consequently, cheaper in production than the aircraft. Secondly, the aircraft navigation equipment and control systems are complex and extremely expensive. It is also known that WIG vehicles are considerably cheaper than the universal ones combining the features of both the WIG and winged aircraft. Hence, for economic calculations it can be assumed that the WIG vehicles are cheaper than their aircraft analogs.

Below, a brief look at the economical aspects of fuel consumption is presented.
Our adopted analog, the «Eclipse-500" aircraft consumes 14 litres fuel per 100 km flight with a speed of 35% higher than that of the EKM. The latter, employing the dynamic air cushion, consumes in the cruise regime about 4 times less. But taking into account the increased starting power and the need of battery charging for off-highway driving, the real fuel consumption will be only three times less that is about 5 litres per 100 km. Fuel consumption comparison of the EKM with a simple car is incorrect because it is unable to move at a speed even close to that of the EKM.

Assuming that the EKM “flies” 60,000 km per year, it will save at least 5000 litres fuel or about $8000 as compared with the analog. It should be emphasized that In addition to fuel economy, the EKM uses twice as efficiently the transport infrastructure than a car, because of the inherent 4-fold higher speeds.

According to my estimate, at the first years of implementation of the CME on experimental highways of the EU, U.S., China and South America, not less than 30 000 km of total straight highway fragments can be mastered. If we estimate the peak load of one EKM lane as 90%, and the rest as 50%, the fuel economy in terms of money for all of the vehicles, operated for one year, will be a substantial amount.

Reconstruction of 30,000 km of highways by replacing four car lanes by two EKM ones in both directions requires about 25 billion EUR (according to the road building prices of USA and EU.). Considering that 30% of the reconstructed road is planned in China, where road construction is almost four times cheaper than in the U.S. and EU, this amount would be substantially less.

Finally, I would like to say, "I believe that implementation of high-speed ground transport - safe, reliable and affordable – is the “call of the times” of our life, and this is the Ekranomobile”.

Almost in two human generations, the means of conveyance on our planet has been radically changed. Our great-grandparents and even grandparents still used for this purpose a camel or a horse, and their children and grandchildren, only for a century, exchanged seats to high-speed trains, modern and comfortable cars and airplanes. And now the turn came to introduce vehicles, based on the use of the principle of dynamic air cushion.
The development of this fantastic miracle-transport will radically improve the life level and

quality of many millions on all continents of our planet.

They will be able to afford to go back for a permanent residence from large cities to places closer to pristine wildlife, where peace and quiet reigns, with clean air and clear water, against the background of wonderful natural landscapes. Besides, everyone knows that buying a home or renting it away from big cities is much cheaper than within them.
Finally, it is worth noting that the acquisition of an EKM will allow the holders to take advantage of all the benefits of rural life at a lower cost than permanent residence in urban areas, without leaving a job in their profession.

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