

TOWARDS A DESIRED TRANSPORT FUTURE: SAFE, SUFFICIENT AND AFFORDABLE

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ABSTRACT

This paper briefly elaborates the evolution of global transportation and the frontier of science and technology all around the world for the sake of accurately predicting the trend of desired transport future. Furthermore, accompanied by the upcoming era of artificial intelligence (AI), the author proposed the basic vision towards a desired transport future: safe, sufficient and affordable from the perspective of global ecological stability and human sustainable development. Then three typical emerging technologies towards the desired transport future were proposed subsequently. The three technologies in the coming AI era introduced by the author are autonomous vehicle, Hyperloop and Unmanned Ship respectively. Their operational principle and extended advantages aiming at AI era are also described. Finally, some of the author's unique views and perspectives based on the new coming AI era were further discussed.

Key Words: Transport Future, AI, Autonomous Vehicle, Hyperloop, Unmanned Ship

1 INTRODUCTION

After the first, second industrial revolution and the third information revolution, artificial intelligence (AI) has slowly entered our vision. Before the industrial revolution, the traffic problem was not that serious owing to the restriction of science and technology and the slow social development. After the industrial revolution, the science and technology have made great breakthroughs, the social environment has changed dramatically, and the traffic problems are becoming more and more prominent. With the development of science, technology and economy, great changes have taken place in the desired traffic. Along with the worsening global environment and bad traffic conditions, new traffic solutions are expected to appear. At this time, artificial intelligence technology appears in people's vision, which lightens the new prospect of the future traffic, and the future of traffic can no longer be limited to the existing concept of thinking. The birth of IPAD and Avatar both demonstrated that the design can advance in technology.

Developed countries have put forward the medium and long term planning of transport future in artificial intelligence: The US clearly proposed the intelligent network and autonomous driving as the two major strategic development goals, and put forward to reach double development strategy of automobile networking and automobile automatic control intelligent; Japan takes big data as the core and proposed automatic driving and Vehicle-to-

Infrastructure cooperation system as two major strategic development goals, at the same time, the market of automatic driving system is expected to be realized in 2030.

The EU (European Union) develops intelligent transportation system from the aspects of aggregation of road environmental resources and intelligent network of automobile, mainly including collaborative ITS, highway traffic safety, vehicle network, logistics, data sharing etc. To sum up, there will be three major trends towards desired intelligent transport system future: big data+ traffic services, mobile interconnection+ integrated transportation, artificial intelligence+ system coordination. Based on these trends, what new transport tools, which new modes of transportation, new types of operation would appear? And under the new environment, what is the trend of desired transport future?

2 THE TREND OF DESIRED TRANSPORT FUTURE IN AI ERA

We need to look forward what kind of life and world are needed in the future, then consider what technology is needed to support such a big environment and consider what is the basic appealing of the future. We ought to consider the desired transport future from the perspective of global ecological development and human needs. We also ought to study the ecosystem and transportation system from the perspective of multitudinous space-time layout, then develop the corresponding technologies to implement the vision.

As is known to all, modern traffic environment is faced with two major severe problems: the shortage and deterioration of the earth energy, and traffic accidents and congestion. For the former, the main solution is searching and using green low-carbon new energy as vehicle power, the main trend of them is Vehicle Electrification; for the latter, the existing effective solution is Vehicle Intelligence, which means that many kinds of advanced digital information technologies are used to give the vehicles to the transportation system with Artificial Intelligence. The study on intelligent transportation is a frontier field of multidisciplinary and cross application, and it includes comprehensive theories of artificial intelligence, information theory, control theory and decision theory, it as well as involve the application of computer technology, microelectronics technology, network technology, communication technology and mechanical design technology etc.

The functions of traffic tools are becoming more and more comprehensive, and even gradually shake our understanding of the inherent concept of traffic tools. To reduce the damage of the earth we live on caused by the development of industrialization and informatization, transportation power has changed from steam to gasoline and diesel, even to new hybrid power, wind, solar and electric power. At the same time, strategy of transportation design from the vanity to meet the human short-term rapid commercial interests have plans to present various abolishing the system, pay attention to social responsibility, driving performance, user experience, high efficiency, economy, safety and other factors. The design strategy of transportation also changes from obtaining quick business interests by satisfying the human short term vain psychology to focus on many aspects such as social responsibility, driving performance, user experience, energy saving, high efficiency, economy and safety. The development of vehicles is closely followed by the pace of technological progress, reflecting the change of our lifestyle and of our demands. With the development of information technology, the application of AI technology in transportation will further plan and lead our future lifestyle, besides satisfying our transportation demands and solving existing problems. Three typical technologies leading safe, sufficient and affordable desired transport future will be elaborated below.

3 SOME TYPICAL EMERGING TECHNOLOGIES FOR DESIRED TRANSPORT FUTURE

3.1 Autonomous Vehicle

Automatic driving is a highly integrated product of automotive industry, artificial intelligence, Internet of things, advanced driver assistance, information communication, high-performance computing and other new generation of information technology, which could realize the automatic safety of vehicles, instead of manual driving, which is the advanced stage of intelligent vehicle development. Currently, it is also the main development direction of global automotive and intelligence transportation, and has become a high-level competition field of all nations.

In recent years, the famous automobile manufacturers in the US, Europe, Japan and other countries all attach great importance to the research of autonomous driving technology. It has been regarded as the key breakthrough of a new generation automobile revolution (Bertozzi, et al, 2010; Bishop, 2005; Brookhuis, et al, 2001; Daniel, et al, 2015; Martensson, et al, 2012; Ziegler, et al, 2014). Many major scientific research institutions and academies in many countries also attach great importance to the research of self-driving technology, such as the DARPA (Thrun, et al, 2006) in the United States, the National Natural Science Foundation Chinese Committee etc. At present, Nevada, Florida, California, Texas, Michigan and Washington, D.C. have legislated to allow self-driving vehicles to go on highway (Bishop, 2012; Lacott, 2012) , but only for testing purposes. As shown in Figure 1.

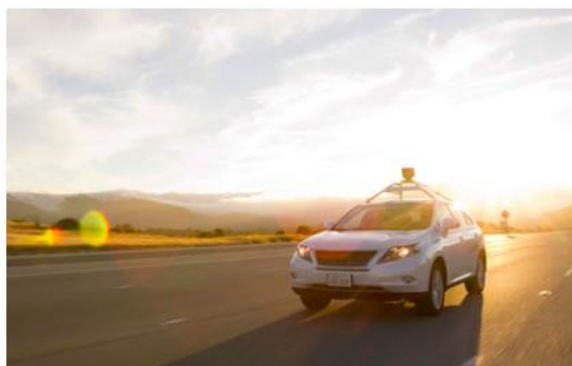


Figure1. Google autopilot test car (Lexus RX450h)

The American Society of Automotive Engineers (SAE) has a clear classification of automatic driving (SAE International, 2014) and has been identified as a standard by NHTSA. It has a clear definition from assistant driving to completely automatic driving without human intervention. In September 2016, the National Highway Traffic Security Bureau of the US Department of Transportation release the federal automatic driving vehicle policy (National Highway Traffic Safety Administration of U.S, 2016) , which is the first automated driving policy of a national government in the world, and put forward the ways of supervising automatic driving. In 2015, the United States proposed the ITS strategic plan (2015-2019) (Intelligent Transportation System (ITS) Joint Program Office (JPO) of U.S, 2014), which listed the Internet of vehicles and automatic driving as the key development areas in the next 5 years, and planned to invest 4 billion dollars in 10 years to support related research. In 2015, the Cabinet Office of Japan took the lead in releasing the world's most advanced IT national declaration of creation (Japan Cabinet Office, 2015), and promoted the development of a research program for automatic driving.

From a safety perspective, automatic driving technology can make a significant contribution. According to the data of U.S. National Highway Traffic Safety Administration, 90% of the traffic accidents were caused by carelessness, operational errors and violation of traffic regulations. Autonomous driving vehicle can comprehensively utilize its own perception, decision-making and control capabilities, and interact with intelligent transportation system to achieve more standardized driving behavior. Therefore, relatively human driving vehicles, it has the following advantages:

- The response time is shorter and the environmental measurement is more accurate.
- The blind zone can be eliminated.
- The driving behavior can be unified and standardized.
- The fatigue and flurried situations no longer exist.

From an energy conservation (affordable) perspective, the automatic driving can also make an important contribution. In fact, people's driving habits and driving abilities exert a tremendous influence on the fuel consumption of vehicles. Therefore, the autonomous driving system can use the driving habits and operation methods of excellent drivers, to achieve the purpose of fuel-efficient.

From an efficient perspective, in the future intelligent transportation system, all the autonomous driving vehicles are overall planned by the ground control center to achieve the most optimal driving path. Relatively to human driving vehicles, autonomous driving vehicles have the following advantages:

- The utilization rate of road attains the optimal condition and the vehicle will not pile up a traffic jam.
- Standardize driving and avoid the increase of energy consumption.
- The running efficiency can be greatly improved by the constant speed of the autonomous driving vehicle.

3.2 Hyperloop

Hyperloop is a kind of transportation tool with "Vacuum Steel Pipe Transportation" as the core. It has many characteristics, such as hypervelocity, high safety, low energy consumption, and little noise and low pollution. Because of its capsule appearance, it is called the capsule high-speed rail. It adopts the mode of "magnetic suspension+ coarse vacuum". Its maximum speed can reach 1200 kilometers per hour. As shown in Figure 2. The concept of Hyperloop was first proposed by American Mechanical Engineer Daryl Oster in the 90s of last century, whose earliest English name is Evacuated Tube Transport, referred to as ETT.

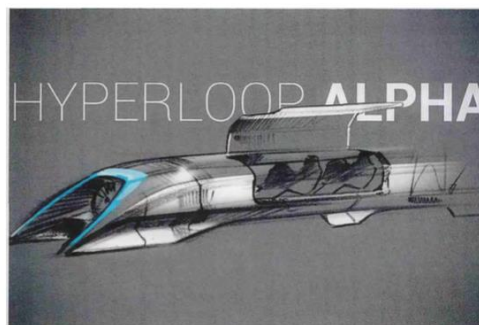


Figure2. The prototype of Hyperloop

“Science Maniac” Elon Musk, the founder of the U.S. electric car company Tesla, has further enriched the concept and put forward the idea of "Hyperloop". He contributed more design details of the concept of transportation. In August 2013, Elon Musk's SpaceX Company issued a "Hyperloop" white paper, which made a rough plan for a link from Los Angeles to San Francisco, including the related concept design map, cost and speed parameters etc. An important point is that the white paper clearly shows that Hyperloop technology will be open source, Elon Musk and SpaceX hope more people to participate to accelerate development of "Hyperloop ". Elon Musk said that this system would not collapse and can be safe, immune to a variety of complex weather. It is 34 times faster than a bullet train and can reach two times the speed of the plane.

The advantages of Hyperloop:

- Hypervelocity. In the dense surface of the earth's atmosphere, high-speed traffic vehicles are affected by contact friction and air friction when running. At present, the highest speed can reach 500 kilometers per hour (Lee, 2006; Najafi, 1996). T3 Company claims that their target speed is 6500 kilometers per hour, and the SpaceX Company of Musk set the speed goal at 1200 kilometers. It can be assured that the passengers on Hyperloop will not feel the acceleration, because the acceleration is progressive.
- High safety. The choice of this “Passive Magnetic Suspension” technology (UIC, 2010) is not only because its cost is lower than the traditional magnetic levitation technology, but also because it is much safer.
- Less pollution. In terms of energy, the Hyperloop will use a self - powered design, by laying a solar panel on the top of the pipe to generate enough electricity to keep it running. In the system installed with solar panels, the acquired energy will exceed the energy consumption of the whole system.
- Low cost. For example, California high-speed rail proposed by Elon Musk, is expected to total investment of \$68 billion, and is nearly 10 times more than the Hyperloop.
- Low energy consumption. Because the Hyperloop is running in a vacuum environment, the energy consumption is very low in the case of a great increase in speed.
- Much cheaper. In accordance with the Musk' idea, for any two metropolises whose distance not exceeding 1500 km, Hyperloop is a very economical mode of transportation.

3.3 Unmanned Ship

Intelligent ship develops based on advanced sensing technology, processing analysis and controlling technology, and with auxiliary decision-making, remote controlling, intelligent controlling functions. The Unmanned ship is a kind of full-automatic water surface robot that can navigate on the surface according to the preinstalled task without any remote control, precise satellite positioning and self-sensing. The abbreviation is USV (Campbell, 2012.) at present, to grab the decisive occasion, Japan, South Korea, and many European countries have attached great importance to research and development of intelligent ship including unmanned ship as shown in Figure 3.

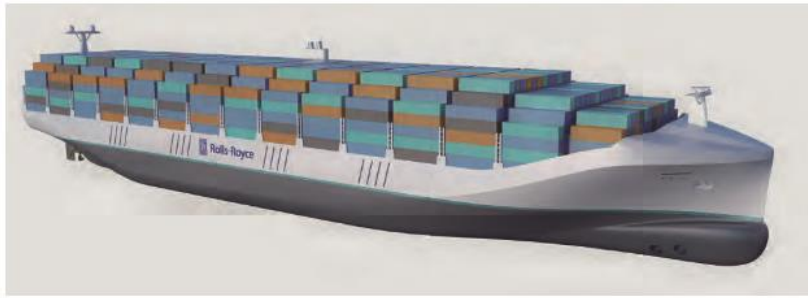


Figure3. Rolls, Royce unmanned ship

The development direction of ships is more economical, safer and more environmentally friendly. Intelligent ship is a fundamental change that breaks Information Island to promote the ship - shore – people information circulation and integration, and has the advantage of non-intelligent ships that cannot be compared with (Gao, 2017). The benefits of unmanned ships are numerous:

- It can reduce the wrong operation of the personnel, avoid the casualties of the crew and reduce the risk of the ship. According to the Allianz insurance report in Munich, Germany, 75%~96% of the maritime accidents are often caused by personnel decision-making and operational errors, improper emergency response and fatigue driving. The unmanned ship can fundamentally reduce the influence of human factors on ship navigation safety.
- It has a larger volume of cargo and a substantial reduction in operating costs. Because there is no need for crews and deck facilities, dormitories, lifesaving, firefighting and ventilation, heating, sewage disposal facilities and other facilities for them, it makes the ship more portable and smooth, which achieving the purpose of full loading, thereby reducing fuel consumption and carbon emissions.
- Further reducing the threat of piracy. The design of the type of unmanned ship is such that it would be difficult for pirates to board.
- The problem of solving the shortage of professionals at sea is effectively solved. When the work is transferred to the land operation center, the remote control and pilotless technology of the unmanned ship will attract more high-quality personnel into the shipping industry.
- Unmanned ships integrate real-time data of ships and ports, which helps to optimize the global logistics and supply chain, and promote the synergy of multi field enterprises, to maximize the conveying efficiency of fleet transportation.

4 CONCLUSION AND PERSPECTIVES

This paper elaborated the frontier of science and transport technology accompanied by the upcoming era of AI, and concretely introduced three emerging transport technologies, autonomous vehicle, Hyperloop and unmanned ship. By analyzing the new typical transport tools adapting for AI era, the author concluded that the trend of a desired transport future ought to be Safe, Sufficient and Affordable.

The discussion in this paper was mainly focused on the typical emerging transport tools towards the desired transport future. However, many other significant aspects such as Vehicle-to-Infrastructure cooperation system, intelligent transportation system and solar pavement etc. we're not listed limited to length of paper. However, we all can further imagine what the better transport future is. Is the interstellar travelling tool with solar energy zero

emissions, or exciting “black technology”? Is the new hardware, new software, new technologies, new processes and new materials applying to the field of vehicle, ships, roads and port? Or the comprehensive transportation ecosystem meeting the common needs of the earth and mankind in the framework of big data, open mobile cloud, artificial intelligence and smart city? The desired transport future ought not to confine to our imagination.

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