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Current situation and trend of ADAS in medium and large new energy SUV market

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Abstract: With the rise of new energy vehicles, the technical level, application scope and user requirements of Advanced Driving Assistance System (ADAS) are developing rapidly. Based on consumers' concern, demand, preference and evaluation of ADAS, this paper analyzes the current situation of the main contents of ADAS in the large and medium-sized new energy SUV market and explores the development trend of the industry.

Keywords: ADAS; Medium and large new energy SUV; User attention; User evaluation.

1. Introduction

At present, China's new energy vehicles have entered a new stage of market-oriented development, with the penetration rate of new energy constantly increasing from 6.2% in 2020 to 25.7% in the first three quarters of 2022. New energy vehicles for consumers to bring more diverse "play" and a higher level of "care", the car is no longer just as a travel tool, and gradually become a "large toys" even "partners & friends", to bring more rich functions and emotional value for users. Users are also more and more attention to the intelligent car, auxiliary driving safety and other related functions. At the same time, the development of artificial intelligence, 5G, smart sensors and other technologies provides more possibilities for ADAS.

1.1. ASDS

ADAS refers to sensing changes in the external environment at any time, collecting data through the camera, laser, millimeter-wave radar and satellite navigation data installed on the vehicle during the driving process, and conducting scene classification and calculation through various algorithms to identify, detect and track static and dynamic objects, and discover behaviors or hidden dangers affecting driving safety. It informs the driver in time or even intervene actively in the driving process by means of icon flashing or buzzing, so as to gain more reaction time for the driver to take countermeasures and improve driving safety [1]. In general, ADAS includes a perception layer (radar, cameras, sensors, etc., collect data), a decision layer (make decisions based on the analysis and judgment of the collected data), and a control/execution layer (translate decisions into driving actions).

At present, countries around the world have the same understanding and classification of intelligent assisted driving. According to the national standard "Classification of Vehicle Driving Automation" implemented on March 1, 2022, driving automation is divided into 0 to 5 levels according to the role allocation in the execution of dynamic driving tasks and whether there is a design operation range limit. L0-L2 is the primary stage of autonomous driving, mainly focusing on active safety. At present, L2 and L2+ are the main levels in the market. It is in a period of rapid popularity, and shows the characteristics of continuous penetration from high-end models to low-end models. From January to October 2022, the penetration rate of L2 level driver assistance in China's passenger cars has reached 33.9%.

1.2. ADAS classification

The ADAS system is complex and constantly evolving. At present, there are different standards for the classification of ADAS. According to the National Internet of Vehicles Industry Standard System Construction Guide (Intelligent Connected Vehicles), ADAS are divided into four categories of functions: information perception, decision warning, driving assistance and partial automatic driving.

The functions of information perception include adaptive lighting system, panoramic image monitoring, night vision system, head up digital display HUD, vehicle distance monitoring system, reversing visual field assistance. The decision warning category includes blind area monitoring assistance, pedestrian warning system, front collision warning system FCW, lane departure assistance system LDW, driver attention monitoring system, low speed control assistance, rear crossing warning system, curve speed warning, alcohol locking monitoring system, and intelligent speed limit control system. Driver assistance includes automatic emergency braking, lane keeping, lane merging assistance, adaptive cruise, forward collision warning, and emergency steering assistance. Some autonomous driving includes parking assist control system, remote control, intersection collision avoidance assist system and so on.

This paper focuses on cruise, collision prevention, lane assistance, blind spot monitoring, parking and so on.

1.3. Development of ADAS in China

With the continuous growth of car ownership in China and the continuous improvement of the penetration rate of new energy vehicles, all levels of the country, industry and enterprises are making efforts in the field of intelligent assisted driving.

In terms of government policies, in 2015, The State Council issued Made in China 2025, which regarded autonomous driving as one of the important directions of Nio's transformation and upgrading of the automobile industry. In 2018, the National Development and Reform Commission pointed out that by 2020, China's standard intelligent vehicle technology innovation, industrial ecology, regulations and standards, product monitoring and

information security system framework basic form, to be fully formed by 2025. In 2020, the New Energy Automobile Industry Development Plan (2021-2035) of The State Council proposed to implement the intelligent networking technology innovation project, take new energy vehicles as the carrier for the first application of intelligent networking technology, and develop technologies and products such as integrated perception of complex environment, intelligent networking decision-making and control. In 2021, the Outline of the National Comprehensive Three-dimensional Transportation Network Plan issued by The State Council proposed that the technology of intelligent connected vehicles (intelligent vehicles, autonomous driving and vehicle-road collaboration) should reach the world's advanced level by 2035. In March 2021, the Ministry of Public Security issued the Road Traffic Safety Valve (Revised Draft), adding new laws and regulations related to automatic driving.

In addition to the formulation and release of relevant policies and regulations, the standardization of intelligent driving has also been continuously improved, such as the Performance Requirements and Detection Methods of Lane Change decision assistance System of Intelligent Transportation System, Overall Technical Requirements of Autonomous Valet Parking System, Terms and Definitions of Road Vehicle Advanced Driver Assistance System (ADAS), etc. The industry as a whole is gradually moving towards large-scale and high-quality development.

Major automobile enterprises are facing challenges in the industry. In order to adapt to the development trend, they have adjusted their strategies and made plans. In 2025, FAW Group will realize the penetration rate of intelligent connected vehicles above L3 level to reach 20%, and the penetration rate above L4 level to reach 5%. Great Wall Motor released the 311 strategy of coffee smart driving, planning to achieve the penetration rate of high-level autonomous driving above 40% by 2025. Gac Group and Huawei plan to mass-produce L4 intelligent driving cars in 2024. The Volkswagen Group plans to have systems capability for fully autonomous vehicles by 2030. Dongfeng Motor plans to adopt progressive and leapfrog technology routes in parallel in terms of intelligent driving technology. By 2025, the penetration rate of new cars at L2-L3 will increase to more than 50%, and L4 intelligent driving vehicles will realize large-scale demonstration operation.

2. Development status and trend of ADAS of medium and large new energy SUVs

In this paper, the development status and trend analysis of ADAS will focus on the market of medium and large new energy SUVs for the following reasons. First, China's new energy market is rising and its market share is expanding. The second is the rapid development of China's economy. China has entered the third or even the fourth consumer society, and personalized and diversified consumption has gradually become the mainstream. The trend of high-end, intelligent and platform-based commodity consumption is obvious, the pace of consumption upgrading is further accelerated, and the trend of high-end consumption is obvious. The third is that various automobile enterprises have laid out the market of medium and large new energy SUV. Such as Nio ES8, LEADING IDEAL one/ LEADING IDEAL L9, VOYAH Free, BYD Tang and so on. This paper will analyze the satisfaction of some indicators of ADAS of owners of Model Y, AION LX, Tang EV, LEADING IDEAL ONE, NexteV ES8 and Volkswagen ID.6 CROZZ, and explore the current situation and development trend of the industry.

2.1. Cruise

Overall, the LEADING IDEAL ONE and Model Y have above-average customer satisfaction, with Tang EV and ID.6 CROZZ having the lowest. Users have a high utilization rate of cruise function and are satisfied with the adjustable following distance function. They expect effective cruise at full speed.

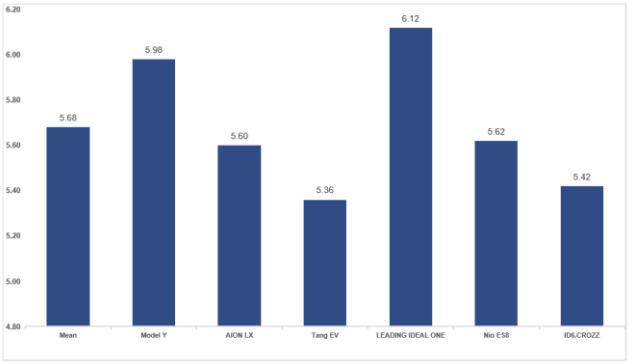

Figure 1. Cruise Usage satisfaction (Full score: 7)

Table 1. Cruise' VOC

User VOC	
Cruise is the use of more, especially in high speed and traffic jams, the use of cruise is much easier than not to use, and does play an auxiliary role, in the steering wheel shift lever can be adjusted. You can adjust the cruise speed on the wheel roller, in addition to the automatic auxiliary driving Settings on the car set speed.	Tesla owner
Use the cruise function when you need to be able to adjust the distance, otherwise easy to be cut in line. Especially in Guangzhou, if you follow a car a little too far, you will be cut in line.	Nio owner
It says no speed limit, but it doesn't seem to work when the speed is slow. Hopefully, whatever speed will work, and it will be more accurate.	AION owner

At present, the main models in the new energy medium and large SUV market are full speed cruise.

Table 2. Cruise system loading

Vehicle Type	Cruise system	Vehicle Type	Cruise system
Model Y	Active full speed domain adaptive	LEADING IDEAL ONE	Full speed domain adaptive
Tang EV	ACC-S&G stop-and-go full speed adaptive cruise system	Nio ES8	Full speed domain adaptive
AION LX	Full speed adaptive cruise system ACC; Integrated cruise Assistance ICA	ID6.CROZZ	ACC 3.0 Advanced Adaptive Cruise System (with follow stop function)

There are three main trends in the future of cruising. First, in the future, with the maturity and integration of laser radar, millimeter wave radar and camera sensor technologies, the functionality and applicability will be richer. Second, the combination of hardware and software technology will enrich the cruise operating conditions. Third, through road engineering and auxiliary facilities, intelligent perception facilities, roadside communication facilities, computing control facilities, high-precision map and other intelligent road construction (road end equipment) and vehicle cloud coordination to achieve advanced cruise.

2.2. Collision Prevention

Overall, the LEADING IDEAL ONE, Model Y, and AION LX have above-average customer satisfaction, with ID.6 CROZZ having the lowest. Users believe that the anti-collision accuracy is in urgent need of improvement, the anti-collision mode can be innovative, and the reminding mode needs to be adjusted to avoid the impact of emergency braking on user experience.

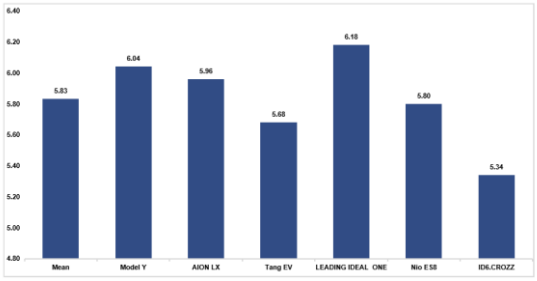

Figure 2. Satisfaction with anti-collision use (Full score: 7)

Table 3. Collision Prevention' VOC

User VOC	
This function itself can improve the security. If there is a car nearby, the alarm will be reported. However, sometimes the distance recognition is not good, and the alarm is still far away, which may not be smart enough.	Nio owner
The LEADING IDEAL millimeter-wave radar is not accurate enough, and there are situations when no one is there, which is scary.	LEADING IDEAL owner
Emergency braking is sometimes very scary, especially when there are people in the car, manufacturers should adjust the strategy through data accumulation, constantly learn, not only through the way of emergency stop to prevent collision, but also actively change lanes and so on.	Nio owner

At present, the main models in the new energy medium and large SUV market carry anti-collision mainly including front anti-collision, side anti-collision, rear anti-collision, and equipped with automatic emergency braking function. AION LX and LEADING IDEAL ONE can choose different anti-collision distances.

In the future, collision prevention will gradually become a mandatory standard for vehicle models, and the integration of active and passive safety development and the humanization of control strategy will improve the accuracy and adaptability of collision prevention. Among them, humanization of control strategy includes reasonable braking speed reduction, coordinated control of braking and steering under complex and dangerous conditions, and collision avoidance system will better reflect the differences of driving behaviors. In addition, strengthening cooperation between enterprises to create a new generation of intelligent anti-collision is also one of the future development trends. For example, Soorian and Mobileye cooperated to create intelligent anti-collision solutions with night recognition, 3D detection and identification of vehicles of the opposite sex.

Table4. Collision Prevention loading

Vehicle Type	Anti-collision system	Vehicle Type	Anti-collision system
Model Y	Forward collision warning, obstacle sensing speed limit	LEADING IDEAL ONE	Forward collision warning system
Tang EV	FCW forward collision warning system, RCW rear collision warning system	Nio ES8	Forward collision warning, automatic Emergency braking (AEB), enhanced automatic emergency braking
AION LX	Forward collision warning, side collision warning, backward collision warning	ID6.CROZZ	Front Assist front anti-collision automatic braking system, RTA rear lateral approach warning function

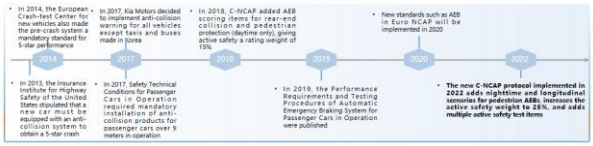

Figure 3. Collision Prevention' developing

2.3. Lane Assistance

In general, the LEADING IDEAL ONE and Model Y have higher user satisfaction than the average, while ID.6 CROZZ has the lowest user satisfaction and has a big gap with other models. The lane assistance function of major models can adapt to a variety of road conditions and weather, and the accuracy of recognition and the comfort of reminding mode need to be improved.

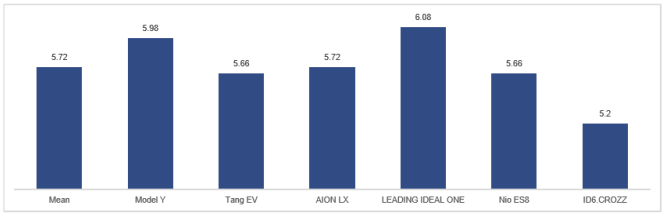

Figure 4. Satisfaction with Lane Assistance use (Full score: 7)

At present, lane assistance mainly includes lane keeping, lane departure warning and lane change assistance for major models in the new energy medium and large SUV market.

Model Y and Tang EV have more abundant functional configurations.

Table 5. Lane Assistance' VOC

User VOC	
At present, the lane of my car can be used normally under various road conditions. In bad weather, the utilization rate is relatively high, which improves the safety to a certain extent. In bad weather, such as rain and fog, the judgment will be more advanced and conservative.	AION owner
If there is a slight deviation in the lane, there will always be an alarm. Sometimes when you change lanes, if you don't use the turn signal in advance, it will keep barking. It feels very rigid.	Nio owner

Table 6. Lane Assistance loading

Vehicle Type	lane assistance	Vehicle Type	lane assistance
Model Y	Steering intervention, lane departure prevention, emergency lane departure prevention	LEADING IDEAL ONE	Lane departure warning system, lane keeping assistance
Tang EV	LDWS Lane departure warning system, LKS active Lane keeping system, DiPilot steering wheel Lane Departure Assist warning, ELKA Emergency Lane Keeping Assist, ILCA Interactive Lane Change Assist system	Nio ES8	Lane Departure warning LDW, Lane Change Assistance (LCA)
AION LX	Lane departure warning LDW, lane keeping assist LKA	ID6.CROZZ	Lane Assist lane keeping system, Side Assist lane change assistance

At present, the most representative lane departure systems in the industry include AutoVue system jointly developed by Daimler and Iteris, ALVINN system and SCARF system jointly developed by NavLab Lab of School of Robotics and Vision and Automation System Research Center of Carnegie Mellon University, AWST developed by Mobileye M system, DSS system developed by Mitsubishi in Japan.

With the continuous development of vehicle networking and communication technology, lane departure warning will be combined with V2X communication technology for lane detection and environmental detection in the future to increase the effectiveness and reliability of the system. Meanwhile, artificial intelligence, machine learning and other algorithms will be widely used in LDW to improve the accuracy and reliability of lane recognition.

2.4. Blind area monitoring

In general, the LEADING IDEAL ONE and Model Y have higher satisfaction than average, while ID.6 CROZZ and Tang EV have the lowest satisfaction, and the overall satisfaction is high, but the accuracy, response speed and reminding mode need to be improved.

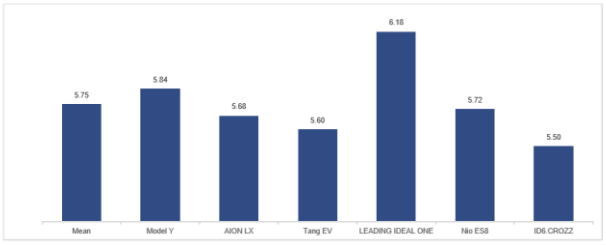

Figure 5. Satisfaction with Blind area monitoring use

(Full score: 7)

Table 7. Blind area monitorin VOC

User VOC	
Blind spot monitoring works for me, because I tend to get distracted while driving, so this alarm works.	Byd Tang owner
Practicability is very high, when it is good to use, but there is also failure situation. One night when reversing because the speed is relatively fast, there is a big branch cannot be detected, the result of the car scratched, and is scratched after the reminder.	AION owner
Tang's blind spot detection alerts don't show up on the dashboard, just like the ones on the Eanteslas that do, hopefully, show up on the dashboard.	Byd Tang owner

Except for Model Y, which displays the road and surrounding environment digitally in real time on the center control screen, the blind area monitoring of other models mainly sends alarms through the indicator light and prompt sound.

Table 8. Blind area monitorin loading

Vehicle Type	Blind spot monitoring	Vehicle Type	Blind spot monitoring
Model Y	Automatic blind spot camera, blind spot collision warning buzzer	LEADING IDEAL ONE	Lateral blind area assistance; External rearview mirror integrated vehicle blind spot monitoring
Tang EV	BSD blind spot monitoring system	Nio ES8	Vehicle Blind Spot Monitoring (BSD)
AION LX	BSD Blind area monitoring and warning BSD	ID6.CROZZ	Blind area monitoring system

In 2021, the national standard "Road Vehicles -- Blind Area

Monitoring (BSD) System Performance Requirements and Test Methods" was implemented, which officially stipulated the requirements for blind area monitoring from the perspective of the standard. The blind area monitoring function will also be continuously upgraded with the improvement of the degree of driving automation. With the continuous development of autonomous driving technology, the blind spot monitoring function will be upgraded to provide necessary peripheral information through the combination of images and radar, so as to realize autonomous driving without the control of safety officers.

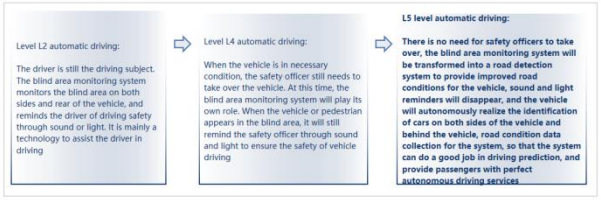

Figure 6. Blind area monitoring' developing

3. Conclusion

This paper introduces the concept and development of ADAS, as well as the user experience and development level of cruise system, anti-collision, lane assistance and blind area monitoring of major models in the medium and large new energy SUV market, and analyzes the industry trend. With the continuous growth of the penetration rate of new energy vehicles and the increasing demand of users for safety, convenience and intelligence, the technical level and update and iteration speed of ADAS will be further accelerated.

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