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The study on the structure crash responds of the new energy vehicle

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Abstract: Based on the structure character of the new energy vehicles, the crash responds is studied, the different structure of the traditional vehicle and the new energy vehicle is discuses, the crash model of the tow side vehicle are builds. The evaluation and optimum program are presented in this paper. The results of this study could be developed to provide a reference for the vehicle safety regulations.

Keywords: Vehicle Engineering; passive safety; new energy vehicles; safety regulation

1 Introduction

With the promotion and development of the new energy vehicle demonstration operation project in different cities, the new energy industry chain was gradually perfected. New energy vehicles were more and more involved in road traffic. With the increasing proportion of new energy vehicles in road traffic, the collision safety performance of new energy vehicles should also be not inferior to traditional fuel vehicles.

Occupant safety was not only the core of the safety performance of vehicles safety indicators, but also the requirement that must be guaranteed for passenger cars. Though there's Inheritance from traditional fuel vehicles structure, due to the addition of large high-voltage battery pack and control system, there were significantly differences between New energy vehicles and traditional ones. Considering the different structural arrangement, it's an issue to optimize the structure of new energy vehicle during the design process to its favorably occupant safety performance.

2 Structural differences analysis and model building

The majority of new energy passenger vehicles basically inherited such traditional fuel vehicles structure, which has three cabins, five doors and pre-positioned powertrain. Just when arranging the new added battery pack, there appeared front-mounted, post -mounted and under-mounted schemes, as shown below.

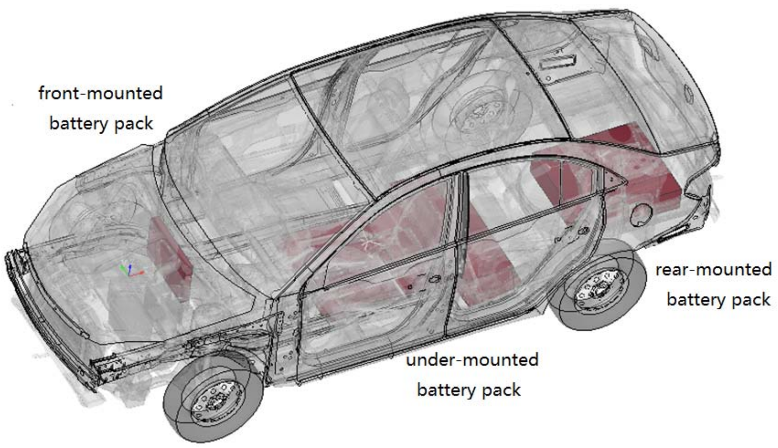

Figure 1Common battery pack arrangement for new energy vehicle

Because of the placement of powertrain in the front cabin, the battery pack was more frequently post-mounted or under-mounted, and most of the time the front-mounted battery pack only works for auxiliary use. Compared to traditional fuel vehicles , there's no heavy peer component omitted. Instead, battery pack was added, which was really a bulky part of of large mass and volume. Therefore, new energy vehicles were heavier than the traditional ones under the same circumstances.

Seen from the battery pack arrangment, the barycenter position of new energy vehicles locate lower and further rear, as shown below.

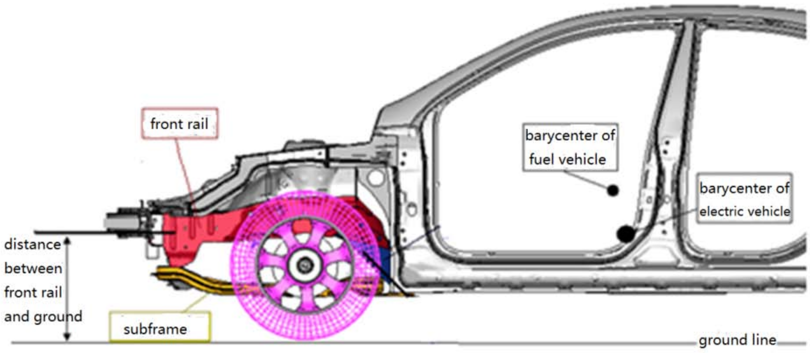

Figure 2 Changes in barycenter position between new energy vehicles and traditional fuel vehicles

To compare the structural crashworthiness of new energy vehicles and traditional ones, on the basis of a traditional fuel vehicle model, one power battery pack of 180kg was added below the floor of the passenger cabin, and also in front cabin the fuel powertrain was replaceed by motor powertrain with its control box. So the equivalent model of new energy vehicles on the same condition was got.

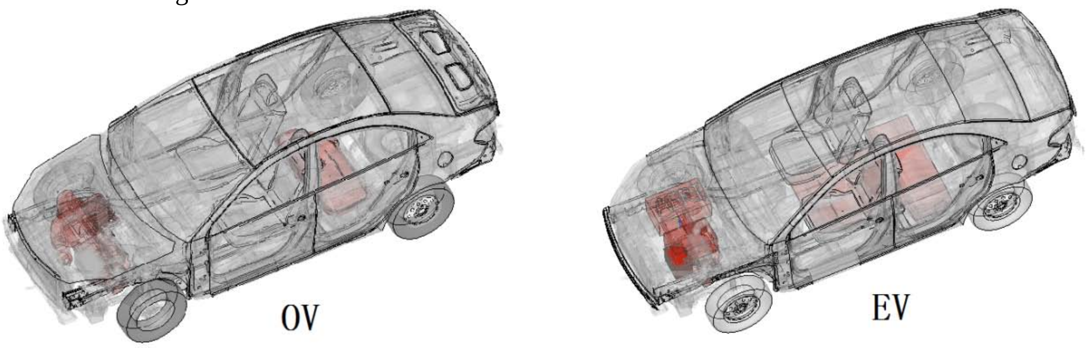

Figure 3 Fuel vehicle model and new energy vehicle model on the same condition

3 Two models of structural response analyzes frontal crash

Above the established new energy automobile collision model and traditional fuel vehicles model in accordance with the C-NCAP 50km / h frontal crash conditions and rigid walls 64km / h 40% offset frontal crash conditions loading .After simulation can get the structure of two car collision response results.

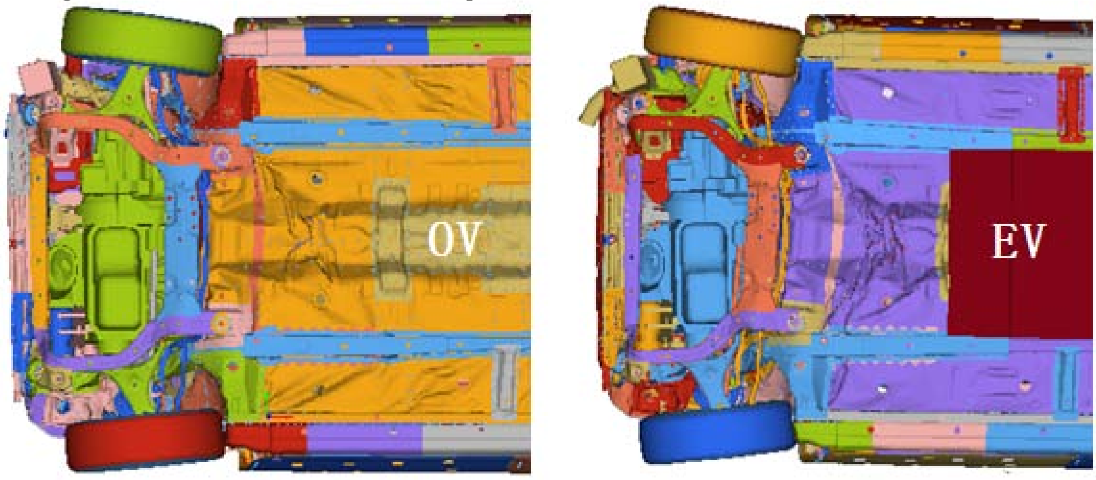

Figure 4 50km/hFrontal rigid wall structure in response to the results of front-end collision

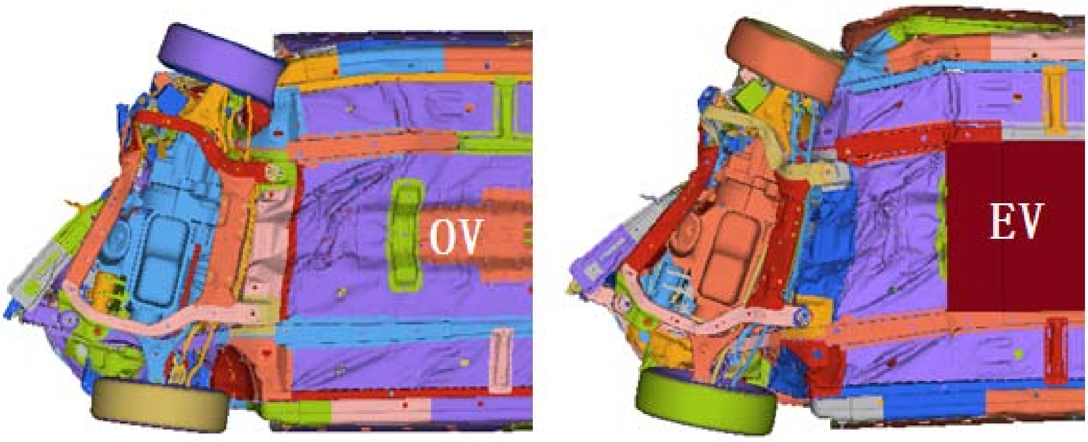

Figure 5 64km/hFront-end structure of the response offset collision

From the front rigid wall collision and offset frontal collision two kinds of conditions in response to the two vehicles contrast image shows the front-end structure, in the same conditions, the new energy vehicles structural deformation is more serious than fuel vehicles, In particular threshold front and front passenger foot area deformation of the floor amount of increase is more obvious invasion. This invasion will be pressed by the occupant legroom is increased, increasing the probability of serious injury to the occupant leg. This is mainly due to the inertia force in the new energy automobile power battery pack squeezed in front of its structure .

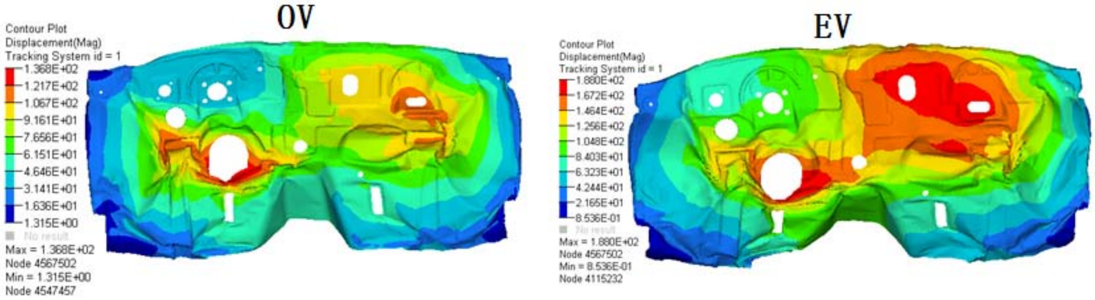

Figure 6 50km/hFrontal rigid wall collision firewall intrusion largest cloud

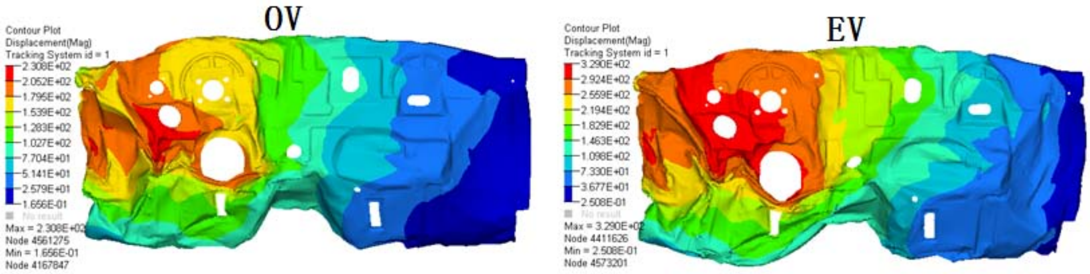

Figure 7 64km/h Offset collision firewall intrusion largest cloud

Consisting of two frontal crash conditions firewall intrusion cloud comparison shows, in the same conditions, the new energy vehicles in frontal crash conditions firewall intrusion amount greater than the fuel models .Especially the steering column and front passenger side dashboard area in front of the firewall intrusion quantity of the fuel models of new energy vehicles only two-thirds .This invasion will lead to more serious injury in the chest, head and other important parts. New energy vehicles in a frontal collision firewall intrusion is bigger .this is due to a lower center of gravity of the new energy vehicles ,the stringer in a collision bending moments more, resulting in a greater bent stringer, which led to a greater firewall intrusion deformation.

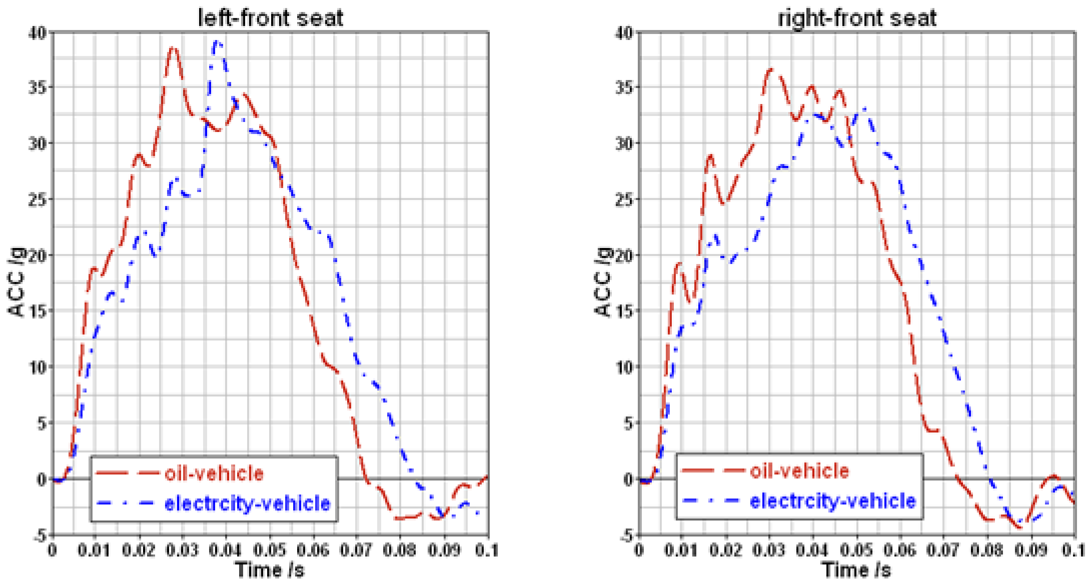

Figure 8 50km/hFrontal rigid wall collision crew cabin acceleration curve

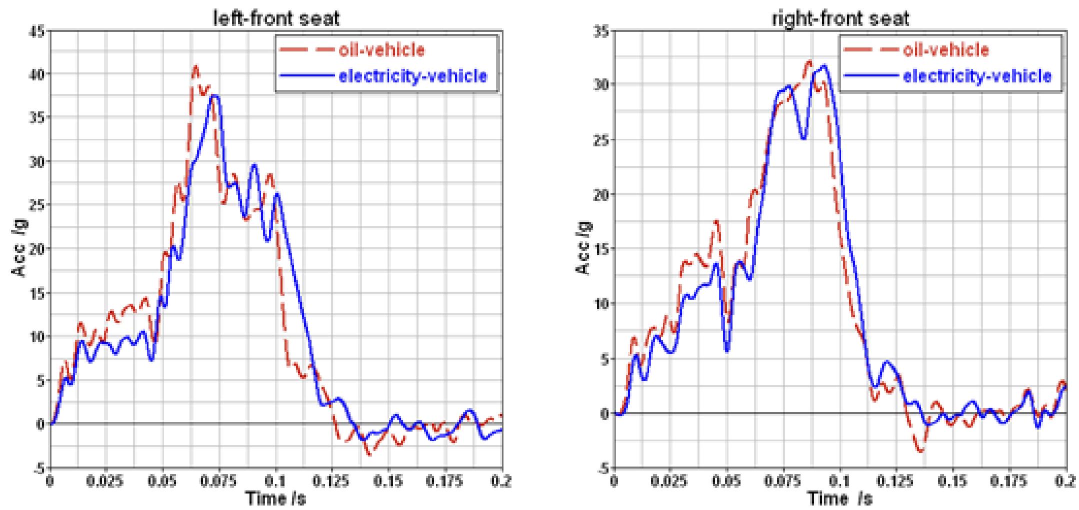

Figure9 64km/h Offset collision crew cabin acceleration curve

Two frontal collision conditions of passenger compartment overload acceleration curve comparison shows that, new energy vehicles under the same circumstances the passenger compartment acceleration overload curve slightly lower peak, overload pulse width wider than the traditional fuel vehicles rising lag, but did not cause the entire overload curve shape and a fundamental change in the trend. This trend in new energy vehicles passenger compartment overload acceleration curve will help to improve the occupant by the value of the damage, but due to an overload finite impulse range, so it would not more harm good crew. This phenomenon is due to the new energy vehicle curb weight gain and increased intrusion range interaction.

So from the above simulation and analysis of knowledge, the development of new energy vehicles on the fuel truck platform, for frontal collision conditions, on the one hand the need to enhance the ability to bend stringer bending under the original platform, and the need to enhance the passenger foot area load-bearing capacity of the structure. Only the original platforms in both optimization and enhanced the platform to get new energy vehicles with the same platform, it may have a considerable positive conventional fuel vehicle structure crashworthiness.

4 Analysis on the side-impact structural response of two cars' models

According to the regulations of 50 km/h mobile walls on ENCAP collision condition, we will set up the same situation of new energy automobile collision model and traditional fuel vehicle collision model to be loaded. We will get the response on the structure of the two cars' crashes after the simulated calculation results.

Figure10.The results of response on wall at a speed of 50km/h mobile of side structuralcollision in AE-MDB

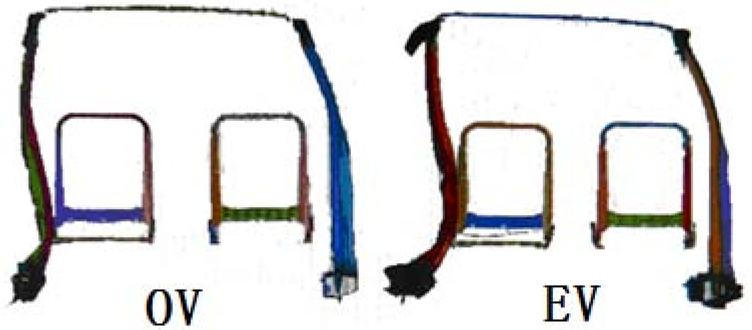

Figure11.The results of deformation on wall at a speed of 50km/h mobile collision to B pillar in AE-MDB

Compared to the traditional fuel vehicle, new energy vehicles have more deformation intrusion under the equal collision conditions at 50 km/h speed in AE-MDB by the graph. Equivalence of new energy vehicles has obvious intrusion occupant seats on space in the AE- MDB side impact on pillar B .This situation could lead to serious damage on ’ chest .

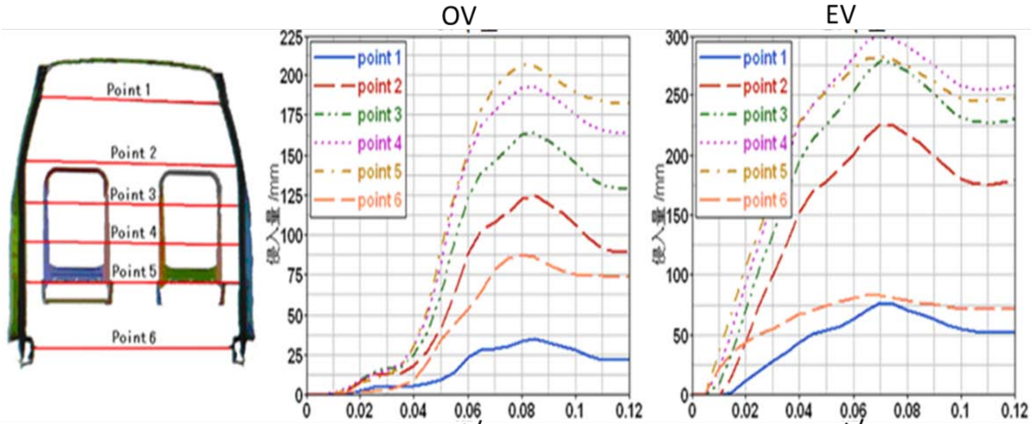

Figure 12. 50km/h AE-MDB Mobile walls collision on B pillar invading curve

Compared to the traditional fuel vehicle, new energy vehicles have more deformation intrusion and faster speeds invasion under the equal collision conditions at 50 km/h speed in AE-MDB by the graph. It will possibly lead to serious harm for occupants because of the fierce collision on occupants with side panel.

On the one hand, because the equivalent of new energy car has bigger curb weight on the inertia force, the cars need to take more impact energy in the side impact on side collision. On the other hand, because the equivalent new energy vehicles have a low center of gravity position, the side panel and upper car body have more torsion deformation in the side collision. In order to make the same platform and development of new energy vehicles have the lateral movement of traditional fuel vehicle on equal safety performance of wall collision, we need effectively enhance the threshold, B pillar on lateral bending strength and the structural stiffness of car body.

According to the working condition of 29 km/h side column rigid collision, we will set up the same situation of new energy automobile collision model , this could obtain the new energy automobile collision deformation results.

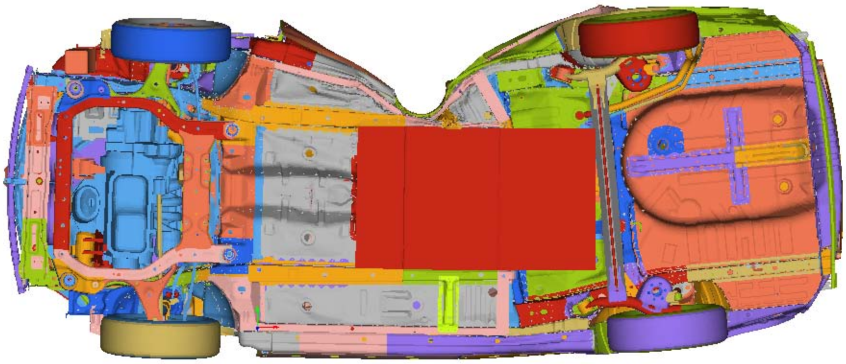

Figure13.Same effect of new energy automobile column structure deformation

New energy vehicles have bigger side surround structure deformation and the power battery pack has a direct impact force to the rigid column under rigid column side collision by the graph. In this kind of deformation mode, the internal batteries have a higher risk of fire, explosion due to extrusion . So in the development of new energy vehicles based on the traditional fuel vehicle platform, we should focus on the optimization design especially on the threshold and battery pack edge beams.

5Conclusion

This article has analyzed the structural performance of collision in the development of new energy vehicles which based on the traditional fuel vehicles.In order to make the new energy vehicles have not less than traditional fuel vehicle on performance of occupant protection, this paper argues that we need to focus on the strengthening and optimization of the structure, such as recurved stringers,floor beams in front, side panels B-pillar, the threshold and the upper body stiffness.

References

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