MACHINE LEARNING BASED
VEHICLE PERFORMANCE ANALYZER
Literature Survey

1. An approach of modelling on dynamic performance evaluation for off-road vehicle:

Automobile dynamic is one of the most important performance indexes, the key is whether the simulation accords with the real status, whether the vehicle performance under real driving conditions can be reflected more validly, and it will be used to estimate automobile dynamic accurately, or to provide theory reference for vehicle design. On the point of view of using vehicle, considering the effects of external factors as air velocity, tyre slip, adhesion coefficient on vehicle dynamic performance, a novel method on dynamic performance evaluation is established, and the effectiveness of the dynamic performance model is verified.

2. Steering performance simulation of three-axle vehicle with multi-axle dynamic steering:

Because three-axle heavy-vehicle with front-wheel steering has big radius at low speed and bad stability at high speed, in order to improve heavy vehicle steering performance at different speed, the multi-axle dynamic steering technology is put forward. Selecting zero side-slip angle of mass centre and proportional control strategy to control vehicle, Using MATLAB, the steering performance of the three-axle vehicle with different steering modes are simulated. The result shows that multi-axle dynamic steering can decrease the steering radius at low speed and improve vehicle stability at high speed.

3. Simulation study on synthetical performance of electric vehicles:

This paper presents the software development on the performance simulation of electric vehicles. Software verification is carried out via the comparison of simulation results with on-road test. Applications of the software in prototype design are also presented in terms of theoretical inference, modelling, software development and simulation of synthetical performance for EVs such as dynamic performance, economy performance as well as analysis of parameters' influences on EV performance. The commonly used European drive cycle is adopted for simulation in the paper. Simulation with the software proves an efficient and money-saving means for prototyping of EV or HEV systems with control units.

4. Simulation and Analysis of Performance of a Pure Electric Vehicle with a Super-capacitor:

Energy storage and power boost are major problems in the development of electric vehicles (EV). Installing a super-capacitor as an auxiliary power source to improve the performance of electric vehicles is a feasible and realistic solution. In this paper, the structure of a multi-energy system and the principles of flow of the multi energy of electric vehicles were introduced first, explaining how different sources of energy work in different situations. A model of electric vehicle with a battery and a super capacitor, based on MATLAB/Simulink was built up. The model was validated by comparing the simulation results and the actual data from later field tests. The drive cycle used in the simulation was the CYC_CONST_45. Comparisons were made between the model of the vehicle with a super capacitor and the model of a vehicle without a super-capacitor. Field tests of an electric vehicle were conduct and analyses were made. The analysis includes vehicle dynamic performance and economic performance in urban environments where the vehicle accelerated and decelerated frequently. The results showed that installing a super-capacitor improves the working conditions of the battery. The variation of the current drawn by the vehicle was smoothed due to the working of the super-capacitor, which provided better working conditions for the battery and increased the operating life of the battery.

5. **Steering feel study on the performance of EPS:**

The steering feel study is very important in the development of electric power steering system (EPS). This paper describes a method about how to evaluate and get the suitable steering feel when driving a vehicle

equipped with EPS. The EPS steering feel subjective tests were performed to obtain objective quality parameters that correlate with subjective evaluation. After this, the paper briefly describes the statistical technique used to identify which parameters best correlate with vehicle steering qualities. As there was no correlation between a single partial rating and a single objective indicator, the principal component analysis (PCA) method was chosen and obtained objective indices. The objective evaluation parameters have been validated by drivers' subjective evaluation. In the third part, the analytical method was applied to vehicle dynamic analysis to analyse vehicle steering feel characteristics, we established a closed-loop steering feel simulation model to analyse steering torque characteristics, vehicle dynamic response and assess steering feel performance for different settings of a EPS system. The design of EPS was optimized and achieved more suitable driving feel by using the dynamic analysis model without plenty of real vehicle tests. This method makes it possible to easily and accurately benchmark steering dynamic characteristics, set design targets, and is helpful to achieve good steering feel.

6. Study on the performance and control of SR machine for vehicle regenerative braking:

A regenerative braking system with simple structure, high efficiency, good performance and easy control is crucial for electric vehicle (EV), hybrid electric vehicle (HEV) and fuel cell vehicle (FCV). SR machine is one of the promising candidates. In this paper, the current and torque performance of a SR machine for application to vehicle regenerative balding has been studied. The relationship between the torque, speed, turn-on and turn-off angles has been established. The data obtained through simulation is very useful for vehicle control design.

7. A method to analyse driver influence on the energy consumption and power needs of electric vehicles:

The energy consumption and power needs of electric vehicles are evaluated on roller test benches according to test procedures defined by legal standards and by vehicle manufacturers. These test procedures are mainly defined by driving cycles and include tolerances to compensate for the human error during these tests. These tolerances may seem to make the tests easier but they can have a big effect on the appropriate dimensioning of the components, and also on the performance of the vehicle. Within this paper, a method is presented, which enables the quantification of these effects depending on the type of the test procedure, and the way the driving cycle is driven. The developed method has been tested in a simulation environment and several standard test procedures were analysed.

8. Autonomous underwater vehicle minimum-time navigation in a current field:

The problem of navigation in a spatially variable current is reviewed, and for a certain class of mathematically-describable functions, solved for minimum time in closed form.

9. Transmission system performance analysis of traditional power vehicle:

Based on simulation software GT-drive, the author analysed the transmission system performance of a passenger car with diesel engine and provided the appropriate research methods. Firstly, the numerical simulation model of a vehicle was built based on vehicle weight, frontal area, rolling, air-drag coefficient, etc. The different matching schemes were simulated and compared. The results show that, for a given engine, using different transmission systems, the matching efficiency is significantly different. In view of power and economy of the vehicle, it is important that selected suitable power transmission device. This method has provided a theoretical basis for studying traditional power vehicle, also giving some information to study the new type vehicle power train system.

10. Real-time performance of control allocation for actuator coordination in heavy vehicles:

This paper shows how real-time optimisation for actuator coordination, known as control allocation, can be a viable choice for heavy vehicle motion control systems. For this purpose, a basic stability control system implementing the method is presented. The real-time performance of two different control allocation solvers is evaluated and the use of dynamic weighting is analysed. Results show that sufficient vehicle stability can be achieved when using control allocation for actuator coordination in heavy vehicle stability control.

Furthermore, real-time simulations indicate that the optimisation can be performed with the computational capacity of today's standard electronic control units.

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