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Design and Application of Timing Model for Tank Driving Shift

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Abstract. Aiming at the status quo of subjective factors in driving training assessment, it is difficult to quantify the wrong actions and proficiency. This paper analyzes the timing changes of the various operating parts in gear shift, designs the shift action timing model based on the change of operating state, puts forward three criteria of motion evaluation and achieves automatic evaluation of a shift through the program.

Introduction

Driving training is to give full play to the maneuverability of equipment and is the key link of training students, but because of the tank structure in the current external conditions can only rely on manual observation of the vehicle operating conditions to subjective assessment of students driving skills for driver error. And it is difficult to distinguish the driver's proficiency and other problems in the lack of appropriate skills maturity. The driving training problem of the individual driver cannot be detected in time, and the training efficiency is low.

In order to solve these problems, different scholars have carried out different studies. Zheng Dongpeng [1]studied the environmental factors on driver driving behavior; Yan Xinping [2] analyze the current driving behavior of the main research methods and found driving behavior characteristics are main in description; Pei Yulong [3] studied the characteristics of the driver's bad driving behavior and made a risk assessment. One common feature of these studies is the lack of evaluation of the driver's own actions, and subjective evaluation of the majority, the lack of objective quantitative indicators. Peng Hu [4], Liu Yile [5] and others studied the driver's specific actions, but no further application to the driver's driving evaluation. Jing Qiang [6] established quantitative driving evaluation index, and started the analysis of driving action, but the evaluation process has yet to be further optimized. On this basis, this paper starts from the driver action, establishes the standard shift action matrix of the skilled driving, compares the matrix after the other driving actions, evaluates the scoring by matlab programming, and obtains the good or bad driving action.

Analysis of Timing State of Shift Action

Shift Timing Requirements

For the 96-type medium-sized synchronizer tank, medium-sized 88-type tanks, medium-sized tank 59, the teachings of low-block for high gear action essentials are:

(1) Refueling car;
(2) Depress the main clutch pedal and release the pedal;
(3) Will shift to neutral gear and put up a high-level gear;
(4) Quickly and smoothly loosen the main clutch pedal and refuel.

Timing Feature Point of the Clutch Operation

In the shift process, the clutch action should have six feature points need to pay attention to, namely, step on the clutch point, clutch step in the end, start loose clutch, clutch semi-linkage control point, clutch half-state end point, the clutch fully integrated point. Each clutch operation process is composed of such 6 points and 5 stages. Using the collected data, we need to automatically calculate the timing of each feature point, the time interval between the different feature points, as well as the existence of the clutch does not step in the end, loose clutch too fast, the clutch is not

fully return error. The solution is expressed in terms of its first derivative, and the second derivative, the principle of acceleration.

Shift Lever Operating Characteristics

Gear change and engine speed diagram shown in figure 1.

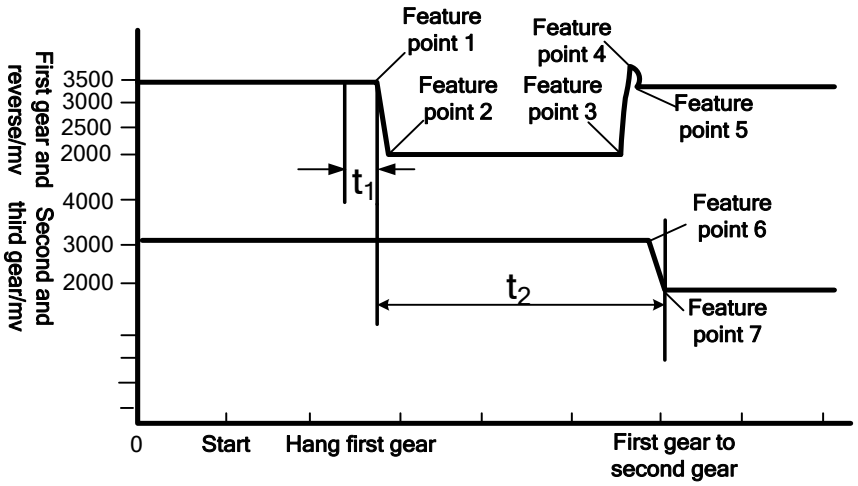

Figure 1. Gear changes and engine speed

The operation of the shift lever is completed in the t2 section of the clutch operation. In the acceleration, the gear change order is increasing, can not jump a gear to the next file; in deceleration according to need, high gear can skip a few gear to low gear.

Timing Characteristics of the Accelerator Pedal

The accelerator pedal need to be released before the shift, that is t1 in the clutch pedal to depress the accelerator pedal before; After completion of the shift, the clutch is fully engaged and depresses the accelerator pedal again. Other times the accelerator pedal remains unchanged.

Establish Time Series Model of the Gear Shift

In order to evaluate the driving behavior, it is necessary to establish a standard driving action matrix, and other driving actions can be used as a contrast to get the corresponding evaluation results. Combined with the analysis of driving action, the displacement and state data of the four parts of the sensor are converted. Conversion criteria: when the displacement or position of the component changes, is recorded as 1, otherwise, denoted by 0. The data thus processed contain only 1 and 0, and 1 indicates the state transition of the part, and 0 indicates that the state remains unchanged.

The Standard Matrix for Acceleration

In the acceleration process, first release the accelerator pedal, and then depress the clutch pedal to keep the clutch pedal status, operating the shift lever. Shift lever operation is divided into pick file, short stay, linked file. Then, quickly release the clutch pedal to the semi-combined state, and maintain a period of time. Finally, completely release the clutch pedal, and depress the accelerator pedal to complete the acceleration of the vehicle shift. This process does not use the brake pedal, the results shown in figure 2. The coordinates of each operator displacement change characteristic point 0, 1 are converted into a standard matrix.

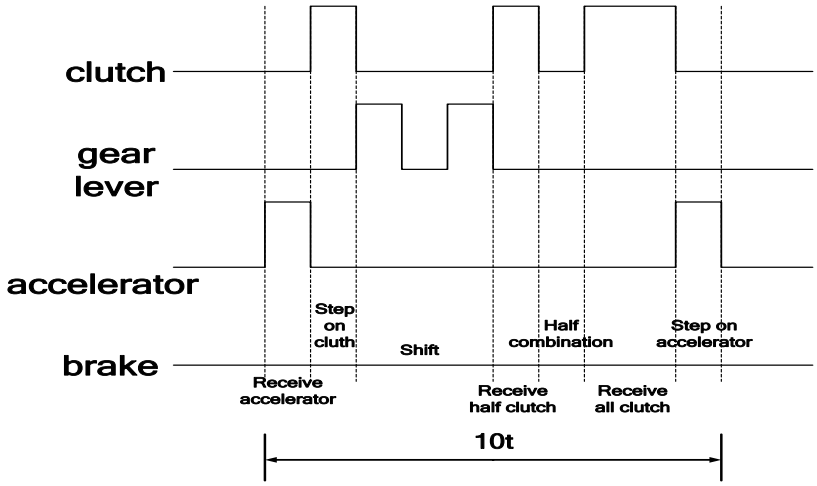

Figure 2. Timing diagram of component state change during acceleration

For the ideal driving condition, it is assumed that each state change time is t and the state hold time is t, and the clutch is set to 2t from the half-engaged state to the fully engaged state, thereby obtaining an ideal component state change timing chart The driving action shown in the figure is the standard time series model, the time length is 10t, the matrix form is:

$$A=\begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

The standard matrix has a dimension of 4×10.

The Standard Matrix for Deceleration

As with acceleration, during deceleration, first release the accelerator pedal, and then depress the clutch pedal while depressing the brake pedal and keep the state unchanged, and according to the speed to determine the appropriate time to release the brake pedal. At this time, a shift operation is performed. The subsequent operations are the same as those for the acceleration operation, and the results shown in figure 3 are obtained.

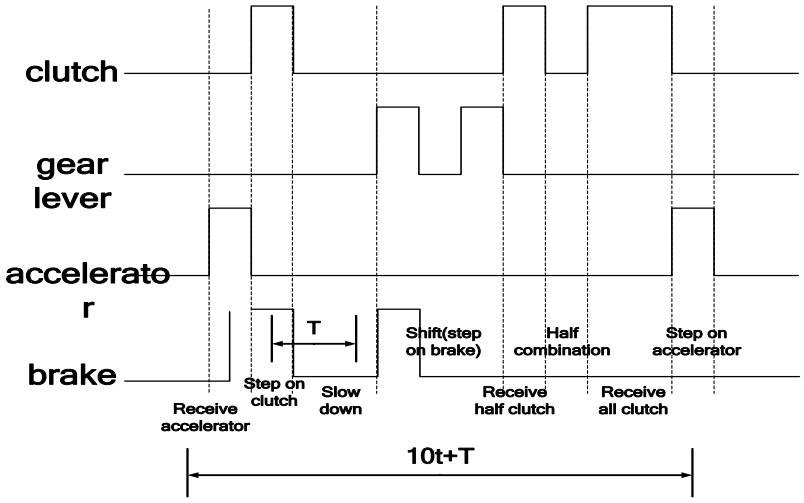

Figure 3. Timing diagram of component state change during deceleration

Similar to the acceleration standard matrix, the deceleration shift process is only the deceleration waiting time T, so the total length is 10t + T, T is determined according to the speed and

deceleration speed before and after deceleration, the bigger the difference is, the smaller the acceleration is T is bigger, on the contrary, T is smaller. Written in matrix form is:

$$B=\begin{bmatrix} 0 & 1 & 0 & \cdots & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & \cdots & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & \cdots & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & \cdots & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

The dimension of the deceleration standard matrix is $4\times n$, n is determined according to the vehicle speed.

Timing Evaluation of Shift Action

Driving action evaluation criteria are:

(1)Each component action increases or decreases, then determine the group driving action error, score 0, the performance of the matrix is the number of each column 1 compared to the standard matrix increase or decrease; In the driving process shown in figure 4, the clutch pedal is depressed at the same time, and the timing of the shift is erroneous. This map is converted to matrix form input, Matlab print results: shift lever timing error, score = 0.

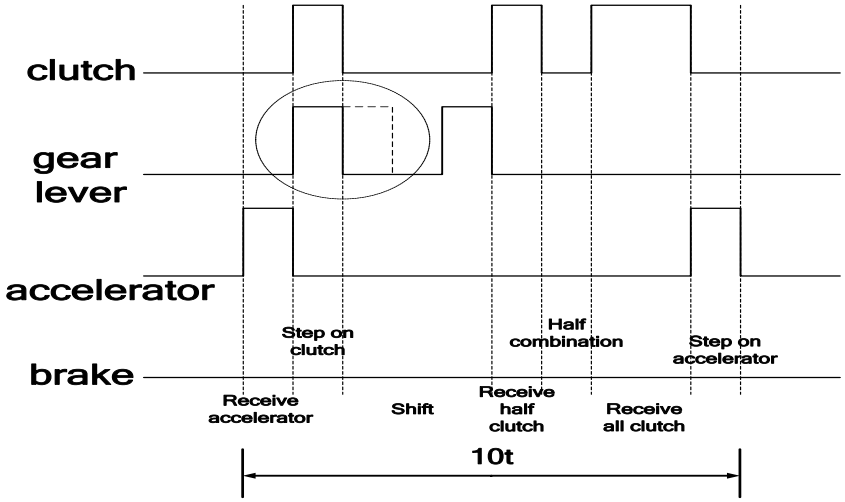

Figure 4. Timing of the wrong driving

(2)If there is a timing error in the operation of the component, it is determined that the driving error of the set is 0. The relative position of each column 1 in the matrix deviates from the standard matrix ratio.

(3)Driving unskilled, no increase or decrease in driving action, no timing errors, then driving the right, according to the driving matrix to determine the dimension of the score.

figure 5 shows the reorganization action without errors, but unskilled driving, that is, before and after the shift appeared in the waiting time of its matrix performance for more than two columns, making the matrix dimension is 4×12, Matlab print results: score = 80.

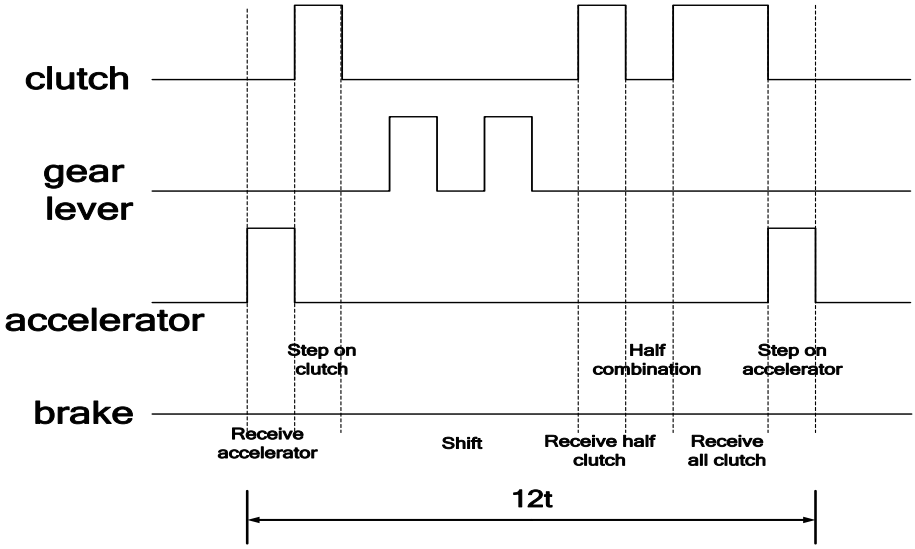

Figure 5. Driving unskilled

Conclusion

In this paper, the driving action is analyzed. Based on the change of the state of the components during driving, the analog data such as displacement of the sensor are processed. A driving matrix is obtained. The standard matrix is set, and the standard matrix is used as a template to evaluate the driving action. Three evaluation criteria are put forward, which are implemented in Matlab programming, and the matrix obtained by processing the driving data collected at acceleration is taken as input, the corresponding results are obtained, and the quantitative evaluation can be carried out, which fully demonstrates that the evaluation method has objectivity and good quantitative evaluation of performance.

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