Abstract

With the continuous development of social economy and the improvement of computer science, communication engineering and electronic engineering, automobiles are also gradually transforming from mechanical products driven by internal combustion engines to intelligent products driven by electricity. The electrification and intelligence of automobiles have brought new problems to society: on the one hand, electrically driven vehicles have lower operating noise, which makes pedestrians' perception of vehicles weakened; on the other hand, with the deepening of intelligence, the control of vehicles will gradually be yielded from drivers to vehicles, which will largely cause the lack of human-vehicle trust. If these two problems are not solved, they will largely affect the efficiency of future road traffic and even bring potential danger. Therefore, it is necessary to explore a vehicle external sound effect as the external interaction interface of future vehicles to improve human-vehicle perception and enhance human-vehicle mutual trust.

This paper takes the external sound design of quiet vehicles as the starting point, and divides the external sound design of vehicles into two aspects: quality design and functional design through literature research and combing of sound design related theories and methods. In the research of quality sense design, the paper explores the sound quality categories suitable for quiet vehicles based on human perception of sound quality, and realizes the decomposition of quality sense design elements through psychoacoustic experiments, and constructs the relevant design models, which provides theoretical guidance for the design of quality sense of exterior sound effects of quiet vehicles. In the functional design research, this paper conducted an in-depth investigation and study of human-vehicle conflict based on China's road environment and traffic participants, extracted a total of four categories and six types of human-vehicle interaction needs, and accordingly designed, optimized and verified the interaction information, and explored the design strategy of functional sound effects.

The main results of the research are: (1) Based on the relevant theories of cognitive psychology, the design elements of the external sound effects of vehicles were

experimentally explored from the disciplinary perspective of design, two models of quality component planning model and emotion design model were formed, design parameters for the six sound quality feelings and three emotional dimensions were determined and relevant design methods were proposed. (2) Based on the demand research and design practice, a prototype of sound information concept and sound hardware with intentional interaction was produced, and a set of factorization experiments were organized on the basis of the concept design to determine the optimal design solution and summarize four functional sound design strategies. (3) A set of composite evaluation index system combining subjective and objective metrics and sound landscape theory was developed for the evaluation of vehicle external sound design.

Keywords: External Sound Effect, Human Vehicle Interaction, Quiet Vehicle