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主　論　文　の　要　旨

論文題目　A Study on the Sense and Behavior Model of Vehicle Drivers (ドライバの感性と運転行動のモデルに関する研究)

氏　　名　脇田 敏裕

論 文 内 容 の 要 旨

1 Introduction

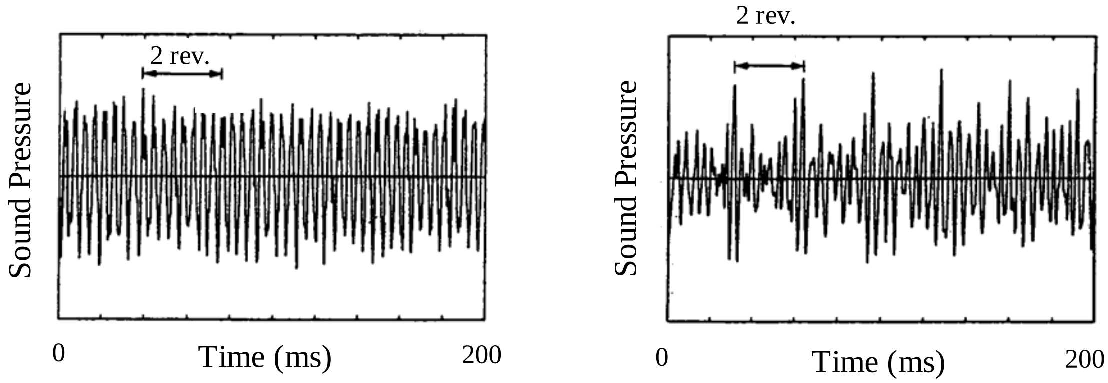
It is important for a driver that the vehicle is suitable for the driver's characteristics such as the body shape, his/her driving style and the skill of driving. This study was made to clarify the modeling approach and to develop the practical models for three driver's characteristics.

First, the objective evaluation model of vehicle noise quality [1] and in-vehicle information system usability evaluation model [2] are proposed. These are the practical research for vehicle product design. Second, the driver identification model using driver behavior signals is proposed [3].

2 Sound Quality Evaluation Model

The intermittent turbid noise, often generated in a vehicle passenger compartment during acceleration, makes passengers feel unpleasant. This type of noise is called a "rumble noise" (**Fig.1**). A quantitative method for evaluating this rumble noise was developed, which exhibited excellent agreement with the experience of human evaluators.

In the first instance, the sound was evaluated based on the human hearing characteristics. Next, the rumble noises in the vehicle passenger compartment were analyzed to determine whether they conform to the model. Our analysis showed that there were many types of amplitude modulation, each of which is



(a) No Rumble (a) Strong Rumble

図 1: Waveform of rumble noise in vehicle passenger compartment.

unique but all of which are sensed as being unpleasant. Subjective evaluation tests were then performed to find quantitative relationships between the many types of amplitude modulation and the sensed rumble noise. Finally, a quantitative objective rating method for the rumble noise was developed based on the above findings. Comparing the objective rating with the human hearing sense revealed a very good correlation between them (**Fig.2**).

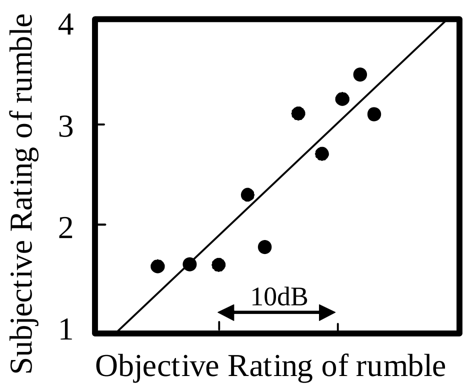


図 2: Relation between objective rating and auditory rating of rumble noise in vehicle passenger compartment.

3 In-vehicle Information System Usability Evaluation Model

Objective evaluation method of in-vehicle information system usability was developed. With the method, the safety and the accessibility of the system can be evaluated, and can be calculated from the system specification. The method use “total task time” as the index of accessibility and “ratio of delayed reaction time” as the index of safety. An auditory interface and a visual interface was compared by the method. The auditory interface was better than the visual interface in safety and accessibility (**Fig.3**).

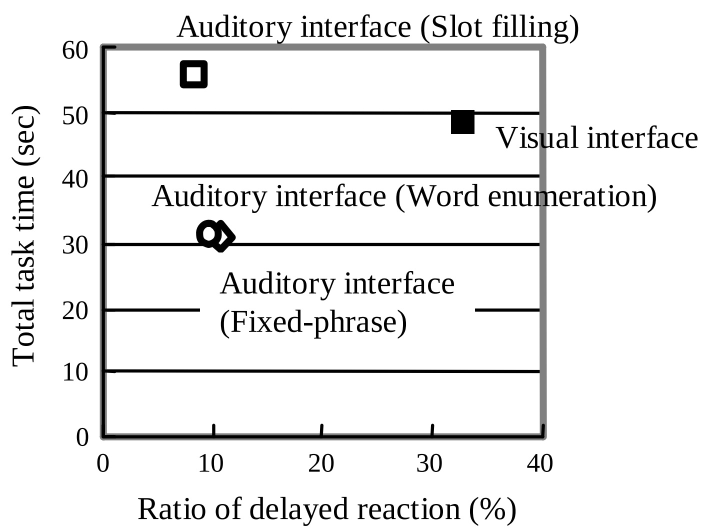


図 3: Usability comparison of visual interface and auditory interfaces.

4 Driver Identification Model Using Driving Behavior Signals

a driver identification model was proposed that was based on the driving behavior signals that are observed while a driver is following another vehicle. Driving behavior signals, such as the use of the accelerator pedal, brake pedal, vehicle velocity, and distance from the vehicle in front, were measured using a driving simulator.

The identification rate obtained using different identification models was compared. As a result, it was shown that the Gaussian Mixture Model to be superior to the typical physical dynamic models (Helly model and the optimal velocity model) (**Fig.4**). Also, the driver’s operation signals were found to be better for the driver identification using the Gaussian Mixture Model than the road environment signals and the car behavior signals. The identification rate for thirty driver using actual vehicle driving in a city area was found to be 73% (**Fig.5**).

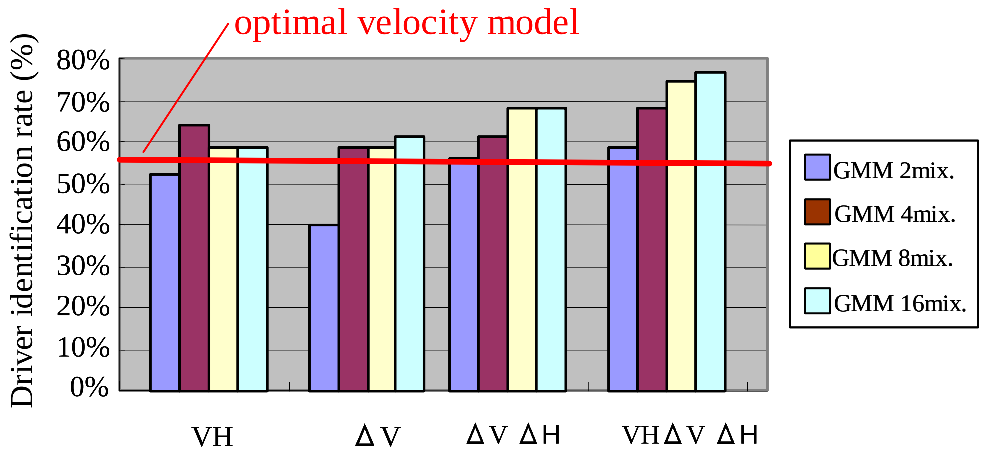


図 4: Driver identification accuracy for GMM and optimal velocity model (V: car velocity, H: headway distance, ΔV: temporal change of V, ΔH: temporal change of H).

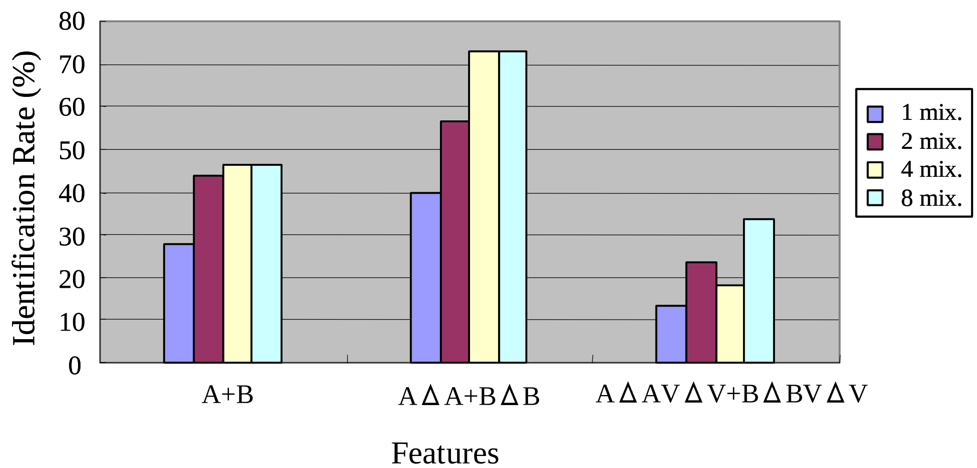


図 5: Driver identification accuracy for multiple likelihoods of GMM (V: car velocity, A: accelerator pedal angle, B: brake pedal angle, Δx: temporal change of x).

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