Measurements & Tests
Simulation
Lit. Study

Category(ies) of vehicle: ALL → tests done only on L3 for the time being

(JAPAN) DEVELOPMENT OF AUTOMATIC ILLEGAL REPLACEMENT MUFFLER DETECTION SYSTEM AT NTSEL

NORESS & MANIPULATION
SINGLE EVENT
ENFORCEMENT

MAIN MESSAGES FROM THE PRESENTATION(S)

- NTSEL (National Traffic Safety and Environment Laboratory) is working on developing automatic sensing system from remote location, which detects vehicles equipped with illegal replacement muffler traveling on the road.
- By using microphone array, it was shown that it is possible to measure individual vehicle's pass-by noise in real-time.
- By using AI (Artificial Intelligence) created by deep learning, it was shown that it is possible to judge the vehicles whose proximity stationary noise level exceeds limit value from pass-by noise with high accuracy. However, the application is limited to motorcycles running alone.
- Now, NTSEL try to combine these two technologies to develop an automatic monitoring system that can measure individual vehicle's pass-by noise from the traffic flow and automatically judge whether it is illegal replacement muffler or not.

SUMMARY

Real-time noise source localization technique:

- When road traffic noise is measured with a single microphone, it is not possible to measure individual vehicle's noise in the traffic flow.
- Therefore, NTSEL developed a system that can measure each vehicle's pass-by noise in the traffic flow separately by using a microphone array.
- Microphone array is consisted of 31 microphones and a camera.
- Sound source localization is calculated by delay and sum beamforming algorithm.
- The calculation is executed by FPGA (Field Programmable Gate Array) and results are obtained at 25fps (frames per second).
- The system can measure sound pressure level emitted by a vehicle, but it cannot judge whether it is a vehicle equipped with illegal replacement exhaust muffler or not because it is judged by result of proximity stationary test in Japan.

Judgment method of illegal replacement exhaust muffler from pass-by noise:

- In Japan, street inspection is conducted by proximity stationary noise test. In case the results of the measurements exceed the limit value, a maintenance order will be issued.
- There is no correlation between proximity stationary noise and pass-by noise because the contribution rate of the noise source (engine, intake/exhaust, tires, etc.) at the measurement point is different each other. Therefore, it is difficult to judge illegal replacement muffler from pass-by noise.
- Deep learning is applied to determine illegal vehicle from pass-by noise.
- We will create AI model to classify illegal replacement muffler and legal mufflers.
- Accuracy is 90% or higher in creating AI-model.
- 6 L3-category vehicles were measured at public road. All of them were uncorrelated with the vehicles which were used to create the training data. AI model can judge 5 vehicles correctly.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS

- Since the purpose of this system is to detect illegally modified vehicles, it does not take into account driving manners.
  For the time being, work done only on motorcycle because easier to be prepared for testing.

REFERENCES

- TFVS-04-08 : Development of automatic illegal replacement muffler detection system at NTSEL