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AI-based method for determining vehicles with illegal muffler from pass-by noise

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Although environmental standards for road traffic noise are slowly improving, some areas, such as along arterial roads, are still exposed to severe noise environments. One of the vehicles that can seriously damage the feelings of local residents is a vehicle equipped with illegal muffler. Such vehicles are inspected by result of stationary noise test, but the tests are time-consuming and laborious. If it is possible to estimate illegal vehicle from its pass-by noise, it will contribute to more efficient street inspection.

Therefore, this study investigated whether it is possible to identify vehicles that exceed its limit value of stationary noise test from pass-by noise using AI. As a first step of the research, measurements were conducted with a single microphone, and the AI model was calculated by measurement data after confirming by hearing that no sounds other than pass-by noise were mixed in. As a result, even for vehicles that were not correlated with the training data, the AI model was able to accurately determine illegal vehicle or legal vehicle without providing any information such as driving conditions, or measurement positions. In addition, a microphone array-based AI model was created and its accuracy was verified, with a view to making it applicable to vehicles in traffic flow. As a result, the microphone array model was not sufficiently accurate due to a lack of training data and variations in vehicles. The accuracy was greatly improved by re-training using data measured on the road.

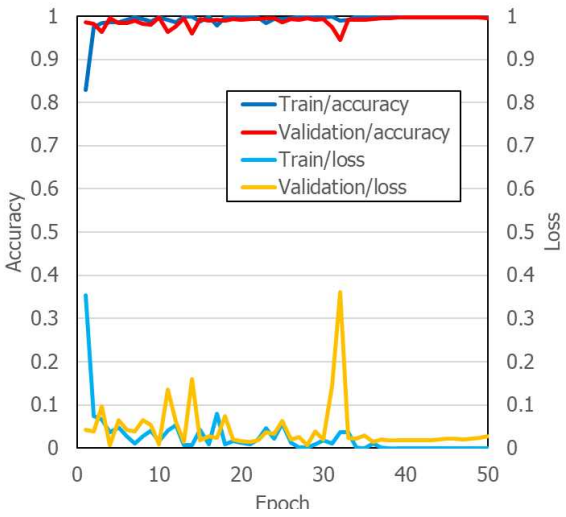

Fig.1 Calculation of AI-model by using training data measured by microphone array

Table1 Verification results of AI-model for microphone array created by test site data and measureddata on public road

Probability [%]			Prediction of AI model	Results of street	Stationary noise level
Illegal	Legal	Other			
0.0	100.0	0.0	Legal : Correct	Legal	Not tested
0.0	100.0	0.0	Legal : Incorrect	Illegal	100
28.0	72.0	0.0	Legal : Correct	Legal	Not tested
0.0	100.0	0.0	Legal : Correct	Legal	Not tested
1.7	98.3	0.0	Legal : Correct	Legal	Not tested
4.3	95.7	0.0	Legal : Correct	Legal	Not tested
0.0	100.0	0.0	Legal : Correct	Legal	Not tested
46.5	53.5	0.0	Legal : Correct	Legal	94
7.3	92.8	0.0	Legal : Correct	Legal	Not tested
5.7	94.3	0.0	Legal : Correct	Legal	Not tested
16.8	83.2	0.0	Legal : Correct	Legal	Not tested
37.3	62.7	0.0	Legal : Correct	Legal	93
0.0	100.0	0.0	Legal : Correct	Legal	Not tested