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**Recent findings in on-board vehicle emission measurement in Hong Kong**

In this presentation, we shall discuss our recently applications of PEMS data which include: 1) estimating the emission factors of vehicles with abnormally high real-world NOx emissions, 2) integrating data from various government departments for estimating the altitude of the travelling vehicles, and 3) analyzing the emissions from the latest Euro 5 liquefied petroleum gas (LPG) taxis.

To understand the effect of abnormally high real-world NOx emissions, emission data of different vehicle brands are compared. The vehicles with abnormally high NOx emission were further studied in test cell under various cycles: cold NEDC, hot NEDC, reverse NEDC or one local cycle. It is found that, for the cold and hot NEDC cycle, the NOx emissions are low. However, NOx emissions become much higher for the reverse NEDC and the local cycle. The presence of defeat device in these vehicles is suspected.

For the vehicle known to have defeat device, the same tests were performed after remediation by the vehicle supplier. It is observed that i) NOx emissions from both the reverse NEDC and the local cycle are significantly reduced; ii) NOx emissions from hot NEDC were slightly increased after the remediation. Real-world measurements were also carried out for the vehicles before and after remediation and found that NOx emission reduction brought by the remediation is much smaller than the laboratory test results. The real-world measurements were conducted both in summer and winter, the effect of the ambient temperatures to NOx emissions is found to be considerable.

Hong Kong is hilly, and therefore accurately estimating road grade is important in modeling vehicle emissions. Recently, a methodology has been developed to estimate road grade. This involves combining data from barometer, GPS with dead reckoning, road network and measured road height. Estimated road grade will be used to enhance the accuracy of our vehicle emission model in future.

Nearly all the taxis in Hong Kong use LPG as fuel. As taxi is one of the major contributors of roadside emissions in Hong Kong, it is the focus of our real-world measurement. First, by measuring taxis in a wide range of ages, their deterioration rate is studied. Moreover, Fourier Transform Infra-red analyzer (FTIR) was used to measure hydrocarbon emissions of the latest Euro 5 taxis. The results show that butane (accounting for 75% of LPG) is the dominated hydrocarbon species in the hydrocarbon emissions. Moreover, some peaks of ammonia and nitrous oxides are observed.