Environmental Research, Technology Demonstration and Conference Project

ECF Project:	ECF 2018-14
Project Title:	To examine the feasibility of using carbon dioxide as a tracer gas to study the dispersion of tailpipe exhausts in an urban canyon
Principal Investigator:	Dr Wang Bei, Helen, Department of Construction Technology and Engineering, Technological and Higher Education Institute of Hong Kong of the Vocational Training Council
Total Approved Grant:	$440,527
Duration:	1/9/2019 to 30/11/2021
Project Status/Remarks:	Completed
Project Scope:	Sulphur hexafluoride (SF_6) has been used as a tracer gas for air dispersion studies. However, SF_6 measurements are unsuitable for similar studies in an urban canyon because of high cost and low time-resolution. On the contrary, carbon dioxide (CO_2) measurement could be conducted at a much lower cost and higher frequency. The challenge, however, is to develop a CO_2 tracer gas system, including a measurement sensor network, that could study the dispersion of tailpipe exhausts in an urban canyon even though CO_2 is also emitted from the tailpipe. The development is the subject of this project. The project will also measure wind data within the urban canyon and the prevailing wind outside to support wind field studies in separate projects afterwards.
Summary of the Findings/Outcomes:	This project aims to examine the feasibility of using CO_2 as a tracer gas to study the dispersion of tailpipe exhausts in an urban canyon by developing a suitable CO_2 tracer gas system. This aim has been well achieved: a line and a point CO_2 tracer gas system have been developed and tested in the Technological and Higher Education Institute of Hong Kong (THEi) Tsing Yi campus. The field experimental data and CFD modelling results have both confirmed that the developed tracer gas system would be suitable for characterising vehicle emissions dispersion in real-world street canyons. Experimental data showed that CO_2 gas generated by the test vehicle itself had unmeasurable effect at roadside. Both the line and point sources could produce obvious CO_2 elevations at approximately 30s after the test vehicle passed by. In addition, the CO_2 elevations were much more obvious at the building side than the hill side, and were higher at 0.8 m than 1.6 m. CFD simulations showed the same trends as field experiments, although the simulated roadside CO_2 peaks were higher and earlier than the measured ones. This study demonstrated that using CO_2 as a tracer gas is feasible for investigating vehicle emission dispersion in real-world street canyons.