



**The Hong Kong University of Science and Technology**

**Department of Mathematics**

**PhD THESIS EXAMINATION**

***Improved Remote Sensing Algorithms and Data  
Assimilation Approaches in solving Environmental  
Retrieval Problems***

*By*

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**ABSTRACT**

Improving air quality and reducing human exposure to unhealthy levels of airborne chemicals are important global missions. Existing monitoring network for tropospheric and ground pollutant measurements are too sparse, therefore spatial variation in places with mixed land use pattern may not be well captured and distinguished. This thesis combines the use of improved satellite remote sensing algorithms, numerical modeling techniques and data assimilation approaches to solve NO<sub>2</sub> and CO<sub>2</sub> retrieval problems throughout recent years.

In the talk, we will explore the mathematical formulation and validation of the newly developed regional product for conducting tropospheric NO<sub>2</sub> vertical column density (VCD) retrieval. In the process, higher spatial resolution satellite products and updated spatial Air Mass Factor (AMF) were adopted, therefore our regional product does a better job in capturing changes of NO<sub>2</sub> within lower troposphere. We will also discuss the machine learning approaches (like ensemble and Gaussian Process Regression) for solving ground NO<sub>2</sub> retrieval problems. The estimation is conducted based on combining satellite-derived NO<sub>2</sub> VCD and several meteorological quantities from WRF model. Different case studies and respective accuracy will be discussed. Research findings open new window into long-term pollutant retrieval and future prediction, at the same time dealing with environmental problems that require continuous monitoring and assessments in long run.

**Date: 02 Jul 2019, Tuesday**

**Time: 10:00 a.m.**

**Venue: Room 3494 (near lifts 25-26)**

**Thesis Examination Committee:**

- Chairman : Prof. Guang ZHU, LIFS/HKUST**  
**Thesis Supervisor : Prof. Jimmy Chi Hung FUNG, MATH/HKUST**  
**Member : Prof. Beifang CHEN, MATH/HKUST**  
**Member : Prof. Shing Yu LEUNG, MATH/HKUST**  
**Member : Prof. Alexis Kai Hon LAU, ENVR/HKUST**  
**External Examiner : Prof. Jhoon KIM, Division of Atmospheric  
Sciences, Yonsei University**

*(Open to all faculty and students)*

**The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).**