VIETNAM NATIONAL UNIVERSITY, HANOI
VNU UNIVERSITY OF ENGINEERING AND TECHNOLOGY

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SOCIALIST REPUBLIC OF VIETNAM
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INFORMATION ON DOCTORAL THESIS

1. Full name : Tran Tuan Vinh   2. Sex: Male

3. Date of birth: 08/10/1976   4. Place of birth: Yen Bai

5. Admission decision number: 1006/QĐ-CTSV Dated 07/12/2015

6. Changes in academic process: ....

(List the forms of change and corresponding times)

- Decision No. 1260/QD-ĐT dated December 13, 2018 of the Rector of the University of Engineering and Technology on extending study time for PhD students.

- Decision No. 106/QD-ĐT dated February 4, 2021 of the Rector of the University of Engineering and Technology on returning PhD students to work unit.

7. Official thesis title: Research on methods to determine emission sources, aerosol optical depths and to apply machine learning in air pollution estimation

8. Major: Computer Science .... 9. Code: 9.48.01.01.01

10. Supervisors: ....

1. Prof. PhD. Nguyen Thanh Thuy

2. Associate Prof. PhD. Nguyen Thi Nhat Thanh

11. Summary of the **new findings** of the thesis:

Suggesting a method for determining the source of air pollution emissions based on different satellite data sources, CALIPSO and Sentinel-5P. From the CALIPSO data source, the proposal suggests a method for monitoring emissions based on the classification of aerosols over Vietnamese territory, represented by the area around the AERONET Nghia Do stations (North), Nha Trang (Central), and Bac Lieu (South) from 2006-2015 and Hanoi in 2016-2019. For the air pollutant NO_2, the Sentinel-5P satellite data source has evaluated the level of pollution caused by emissions from factories or transportation during the social distancing period of the COVID-19 pandemic to confirm the close relationship between NO_2 emissions and factories, industrial zones, transportation, and human activities. From the ground-based monitoring data, the thesis proposes a method for

identifying air pollution emission sources caused by burning straw in the Hanoi area based on the estimated amount of straw burned in the fields after harvesting rice crops.

The algorithm for estimating the optical depth of aerosols from high-resolution Landsat 8 OLI satellite images was developed, and the results of the optical depth of aerosols obtained from the algorithm were evaluated with data from AERONET stations and MODIS optical depth data with high correlation. In particular, when evaluated with AERONET stations in Vietnam such as Son La, the correlation coefficient R^2 is 0.99 and RMSE is 0.20, and at Nghia Do station, the correlation coefficient R^2 is 0.97 with RMSE is 0.33.

Models predicting $PM_{2.5}$ for urban and industrial areas characteristic of Bac Ninh province were built based on Landsat 8 OLI AOD data and meteorological data. Based on the results of the models, the thesis conducted an evaluation and proposed a suitable model.

12. Practical applicability, if any:

- Applications in determining the source of air pollution emissions.
- Applications in creating maps of NO_2 concentration, and especially AOD and $PM_{2.5}$ maps with high spatial resolution of 30 m are suitable for areas with narrow ranges to monitor air pollution

13. Further research directions, if any:

- Applying the method of monitoring air pollution emissions by combining multiple satellite data sources.
- Using satellite data sources combined with ground-based monitoring data, emission models to monitor air pollution on different scales.
- Using LiDAR data with column resolution from CALIPSO satellite to monitor pollution levels at different altitudes.
- Researching the application of Landsat 8 AOD estimation algorithm for other satellites.
- Researching and applying machine learning models based on the combination of different data sources that affect the origin and quality of air.

14. Thesis-related publications:

[1] Kristofer Lasko, Krishna P Vadrevu, Vinh T Tran, Evan Ellicott, Thanh T N Nguyen, Hung Q Bui and Christopher Justice, *Satellites may underestimate rice residue and associated burning emissions in Vietnam*, 2017. Environmental

Research Letters, Volume 12, Number 8. DOI: https://doi.org/10.1088/1748-9326/aa751d

[2] Vinh T Tran , Ha V Pham, Thanh TN Nguyen, Thanh X Pham, Hung Q Bui, Anh X Nguyen, Thuy T Nguyen, *Satellite Aerosol Optical Depth over Vietnam, an analysis from VIIRS and CALIOP aerosol products*, Land-Atmospheric Research Applications in South and Southeast Asia, Book Series: Springer Remote Sensing/Photogrammetry, 2018. ISBN 978-3-319-67474-2. DOI: 10.1007/978-3-319-67474-2

[3] Tran Tuan Vinh, Pham Van Ha, Nguyen Thanh Thuy and Nguyen Thi Nhat Thanh (2020), *Analysis of CALIPSO satellite imagery for air pollution source identification in Hanoi, Vietnam*, The 2020 12th International Conference on Knowledge and Systems Engineering (KSE), 73 – 78, ISBN (Xplore compliant): 978-1-7281-4510-5.

[4] Truong X. Ngo, Ngoc T.N. Do, Hieu D.T. Phan, Vinh T. Tran, Tra T.M. Mac, Anh H. Le, Nguyet V. Do, Hung Q. Bui & Thanh T.N. Nguyen (2021) *Air pollution in Vietnam during the COVID-19 social isolation, evidence of reduction in human activities*, International Journal of Remote Sensing, 42:16, 6128-6154, DOI: 10.1080/01431161.2021.1934911

[5] Vinh Tran Tuan, Truong Ngo Xuan, Thuy Nguyen Thanh & Thanh Nguyen Thi Nhat (2023), *An algorithm for retrieving aerosol optical depth from Landsat 8 Operational Land Imager in Vietnam*, Geocarto International, 38:1, 2228748, DOI:10.1080/10106049.2023.2228748.

Date: ……………………..   Date: ……………………..

Signature: …………………   Signature: …………………

Full name: Nguyen Thanh Thuy   Full name: Tran Tuan Vinh

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