8th JOINT STUDENT SEMINAR on CIVIL INFRASTRUCTURES

SEPTEMBER 12-13, 2019

IIS UTokyo SYMPOSIUM No. 103

8^{th} Joint Student Seminar on Civil Infrastructures

12-13 September 2019
At
Asian Institute of Technology,

Co-Organized by
School of Engineering and Technology,
Asian Institute of Technology (AIT), Thailand

Takeuchi laboratory,
Institute of Industrial Science, The University of Tokyo, Japan

International Center for Urban Safety Engineering (ICUS)
Institute of Industrial Science, The University of Tokyo, Japan

Organizing Members
Prof. Pennung Warnitchai (AIT, Thailand)
Prof. Toshiharu Kishi (UT, Japan)
Dr. Manzul Kumar Hazarika (AIT, Thailand)
Prof. Kimiro Meguro (UT, Japan)
Prof. Wataru Takeuchi (UT, Japan)

PREFACE

We are very pleased that AIT and IIS is holding this, 8th Joint Student Seminar on Civil Infrastructures. This seminar has been organized since 2007 mainly focusing on three objectives, to experience the organization of international seminar, to improve the presentation skill, and to share the research information and friendships among leading Asian universities. The seminar will include poster presentations by students from each country in different fields, such as transportation, structural, geotechnical, water, and environmental engineering. I wish to express our sincere thanks to Asian Institute of Technology, which has accommodated our special needs including this wonderful venue.

IIS has established Regional Network Office for Urban Safety (RNUS) at SET, AIT since 2002 and dispatched young faculty members from Japan to Thailand to work for education and research including urban safety, remote sensing and GIS, infrastructure health assessment, flood risk monitoring. RNUS also serve to organize seminars and arrange IIS/U-Tokyo alumni party every year. We recognize RNUS as one the core international liaison research office in Paris and New York.

We have invited two distinguished young associate professors from Japan to introduce their cutting edge research ideas, JAXA Bangkok office director to deliver a talk on disaster monitoring from space, JSPS Bangkok Office director to introduce research opportunities in Japan and Director of RS/GIS, Yangon Technological University to introduce their research activities under JICA/JST SATREPS project with IIS/UTokyo. Afternoon session also should be enjoyable for student's poster session as well as hands-on-training for PM2.5 monitoring with portable devices in AIT campus.

May I ask each of you here today to lend your strength and support to AIT and IIS/UTokyo as it strives to enhance and expand ever-growing friendship and scientific exchange activities for excellent scientific researchers.

Thank you very much, Kopun-krap, Arigato-gozaimasu.

Wataru Takeuchi

8th Joint Student Seminar on Civil Infrastructures

Venue: Seminar Room B108, Asian Institute of Technology

Date: 12 September 2019

Time	Topic	Name of speaker
08:30-09:00	Registration	-
09:00-09:05	Remark and Welcome message	Prof. Dieter Trau (Dean-SET, AIT)
09:05-09:15	Introduction of SET, AIT	Prof. Pennung Warnitchai (Head of Dept, of Civil and Infrastructure Engineering, AIT)
09:15-09:30	Welcome message and introduction of IIS, UTokyo	Prof. Toshiharu Kishi (DG, IIS, UTokyo)
09.30-10.00	Group photo & Coffee break	
Invited Professor Section (chair: Wataru Takeuchi)		
10:00-10:20	Big Data Construction of Infrastructural Quantitative Information by Real-Time Spatial Analysis	Dr. Tsukasa Mizutani (ICUS, UTokyo)
10:20-10:40	The Robustness of Networks Regarding Spatial Relationships of Multiple Routes	Dr. Yudai Honma (ICUS, UTokyo)
10:40-11:00	JAXA Sentinel Asia activities	Mr. Masanobu Tsuji (Director, JAXA Bangkok office)
11:00-11:20	Research opportunities in Japan	Mr. Kuniaki Yamashita (Director, JSPS Bangkok office)
11:20-11:40	Research activities at RS/GIS research center, YTU	Prof. Sao Hone Pha (Director, RS/GIS research Center, YTU)
11.40-11.50	Q&A	
11:30-13.00	Lunch	
13.00-14.30	**Student poster session (17 posters)**	
14.30-15.00	Coffee Break	
15.00-16.30	Hands-on-training for PM2.5 monitoring with portable devices in AIT campus	Prof. Takeuchi, UTokyo, Japan
16.30-17.00	Review comments and closing remarks	****

No. of participants

	No. of Student	No. of Faculty	others	
Japan	5	4	6	
Thai	40	5	2	
Myanmar	1	1	0	
Total	**46**	**10**	**8**	**64**

Field trip Program

Date: 13 September 2018

Time	**Descriptions**
08.00	registration
08.30 -12.00	Visit to MRT construction site in Bangkok
Lunch	
13.30-17.00	Visit to historical places in Bangkok

No. of participants

	No. of Student	No. of Faculty	others	
Japan	4 (1only morning)	2	1	
Thai	28	0	2	
Myanmar	1	1		
Total	**34**	**3**	**3**	**40**

Participant list

No	Your name		Your affiliation
1	DieterTrau	Thailand	Dean SET, AIT
2	Pennung Warnitchai	Thailand	Head of Dept, of Civil and Infrastructure Engineering, AIT
3	Toshiharu KISHI	Japan	IIS, The University of Tokyo
4	Yudai HONMA	Japan	IIS, The University of Tokyo
5	Wataru TAKEUCHI	Japan	IIS, The University of Tokyo
6	Tsukasa MIZUTANI	Japan	IIS, The University of Tokyo
7	Masanobu Tsuji	Japan (Thailand)	Director, JAXA Bangkok office
8	kuniaki Yamashita	Japan (Thailand)	Director, JSPS Bangkok office
9	Atsushi Shirahama	Japan	The University of Tokyo (IIS, Honma lab)
10	Ryo Itoh	Japan	The University of Tokyo (IIS, Meguro lab)
11	Takumi Fujiwara	Japan	The University of Tokyo (IIS, Takeuchi lab)
12	Nuntikorn KITRATPORN	Japan (Thailand)	Institute of Industrial Sciences, University of Tokyo (Takeuchi lab)
13	Takahiro Yamaguchi	Japan	The University of Tokyo (IIS, Mizutani lab)
14	Hein Thura Aung	Myanmar	Department of Electronic Engineering Yangon Technological University
15	Piyanut Piyasil	Thailand	Suranaree University of Technology
16	Apinya Boonrang	Thailand	School of Geoinformatics, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, Thailand
17	Shashika Atapattu	Thailand	AIT, Student
18	Triambak Baghel	Thailand	Asian Institute of Technology
19	Gautam Dadhich	Thailand	PhD student
20	Phruck	Thailand	AIT Structural Engineering
21	Yesica	Thailand	AIT Structural Engineering
22	Sudan	Thailand	AIT Structural Engineering
23	Nattapon	Thailand	AIT Structural Engineering
24	Therdkiat Nontapot	Thailand	AIT GTE
25	Ms. Pratichhya Sharma	Thailand	Geoinformatics Center – Asian Institute of Technology
26	Mr. Chathumal Madhuranga	Thailand	Geoinformatics Center – Asian Institute of Technology
27	Mr. Sasanka Madawalagama	Thailand	Geoinformatics Center – Asian Institute of Technology
28	Dr. Tran Thanh Dan	Thailand	Geoinformatics Center – Asian Institute of Technology
29	Dai Tomiyama	Japan	Deputy Director, JSPS Bangkok office
30	Maki Usui	Japan	International Program Associate, JSPS Bangkok office
31	Yusuke Hamabata	Japan	International Program Associate, JSPS Bangkok office
32	Eiko Yoshimoto	Japan	IIS, The University of Tokyo

33	Sao Hone Pha	Myanmar	Yangon Technological University
34	Tanakorn Sritarapipat	Thailand	Suranaree University of Technology
35	Flg.Off. Parinya Channgam	Thailand	Suranaree University of Technology
36	Dr. Pantip Piyatadsananon	Thailand	Suranaree University of Technology
37	Rajitha Sachinthaka Subhasinghe	Thailand	AIT
38	Suyog Giri	Thailand	AIT Masters In structural Engineering,AIT
39	Faisal Ahmed Rajper	Thailand	AIT WEM
40	Thitimar Chongtaku	Thailand	AIT RSGIS, ICT, SET, AIT
41	Warot Watahong	Thailand	AIT RSGIS, ICT, SET, AIT
42	Thantham Khamyai	Thailand	AIT RSGIS, ICT, SET, AIT
43	Dasari Naga Gopinadh	Thailand	AIT Set
44	Anuj Pradhananga	Thailand	AIT Structural engineering
45	John Lorenz S. Tuala	Thailand	AIT Structural engineering
46	Sipho Mashiyi	Thailand	Urban Water Engineering and Management
47	Ronit Sthapit	Thailand	AIT Structural engineering
48	Apantri Peungnumsai	Thailand	AIT RSGIS
49	Suyog Giri	Thailand	AIT Structural engineering
50	Ashish Sapkota	Thailand	AIT Structural engineering
51	Thitimar Chongtaku	Thailand	AIT RSGIS
52	Sadriar Sawumma	Thailand	AIT Structural engineering
53	Usha Ghimire	Thailand	AIT Water Engineering and Management
54	Neelam Thapa	Thailand	AIT Transportation Engineering
55	Harshana Senanayake	Thailand	AIT TRE
56	Tassawat Chansutham	Thailand	GTE
57	Smit Chetan Doshi	Thailand	WEM
58	Iha Pradhan	Thailand	CEIM
59	Bidur Devkota	Thailand	RSGIS
60	Arfarn Cheali	Thailand	Structural Engineering
61	Binod Sapkota	Thailand	Structural Engineering
62	Dr. Manzul	Thailand	Geoinformatics Center – Asian Institute of Technology
63	Metta Masuttitham	Thailand	AIT
64	Apple san	Thailand	AIT

Contents

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- Introduction of SET, AIT
- Welcome message and introduction of IIS, UTokyo

- Invited Professor Section

- Student Poster Session

- Training

- Field Trip

- Students Report

- Remark and Welcome message
- Introduction of SET, AIT
- Welcome message and introduction of IIS, UTokyo

Opening Ceremony

Prof. Dieter Trau (Dean-SET, AIT)

Prof. Pennung Warnitchai (Head of Dept., of Civil and Infrastructure Engineering, AIT)

Prof. Toshiharu Kishi (DG, IIS, UTokyo)

• Invited Professor Section

Title:

Big Data Construction of Infrastructural Quantitative Information by Real-Time Spatial Analysis

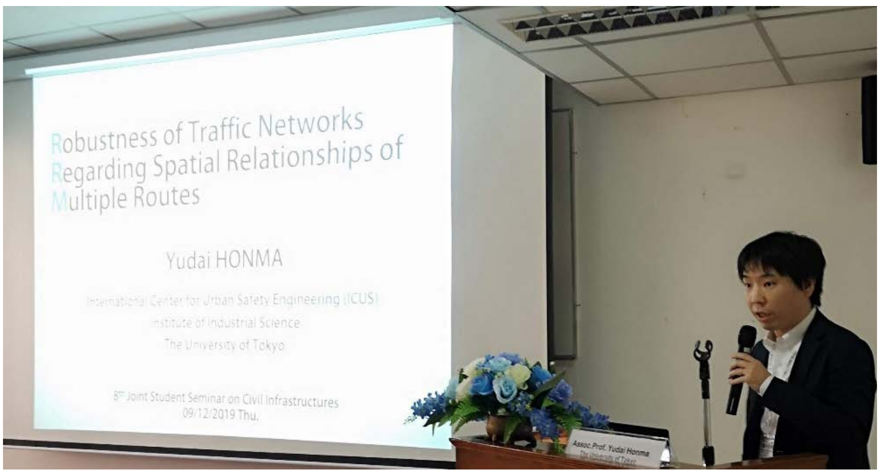
Dr. Tsukasa Mizutani (Associate Professor, ICUS, IIS, UTokyo, Japan)

Dr. Tsukasa Mizutani

Title:

The Robustness of Networks Regarding Spatial Relationships of Multiple Routes

Dr. Yudai Honma (Associate Professor, ICUS, IIS, UTokyo, Japan)



Dr. Yudai Honma

Title:

JAXA Sentinel Asia activities

Mr. Masanobu Tsuji (Director, JAXA Bangkok Office)

Mr. Masanobu Tsuji

Title:

Research opportunities in Japan

Mr. Kuniaki Yamashita (Director, JSPS Bangkok Office)

Mr. Kuniaki Yamashita

Title:

Research activities at RS/GIS research center, YTU

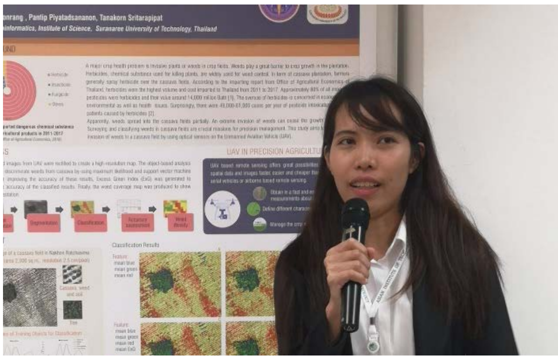
Prof. Sao Hone Hpa (Director, RS/GIS research center, YTU, Myanmar)

Prof. Sao Hone Hpa

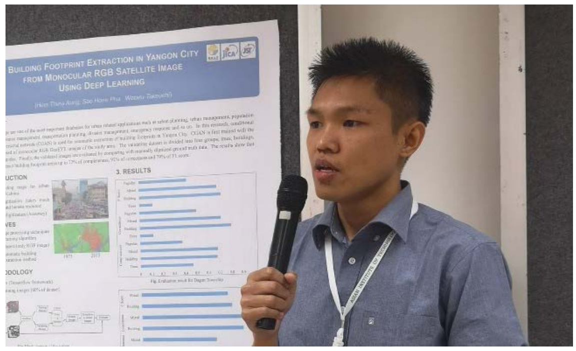
- **Student Poster Session**

Nunitkorn Kitratporn, D1, UTokyo, Japan

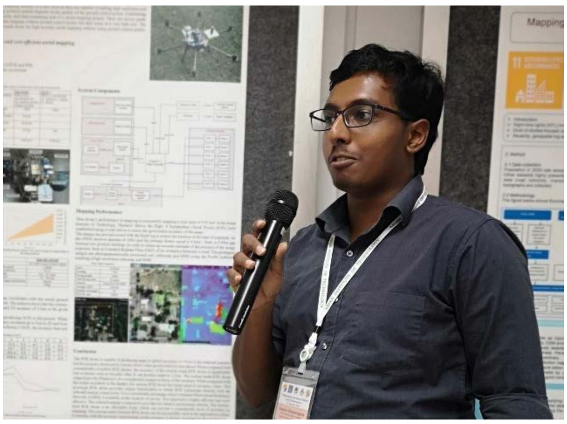
Piyanut Piyasin, SUT, Thailand



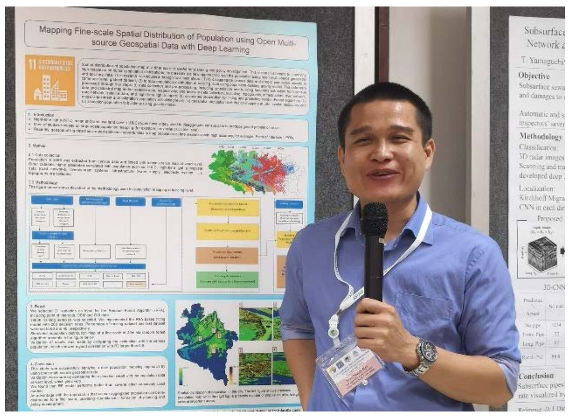
Apinya Boonrang, SUT, Thailand



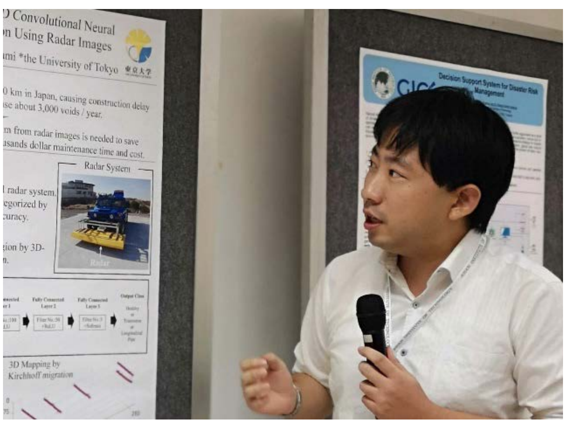
Hein Thura Aung, YTU, Myanmar



Sasanka Madawalagama, AIT, Thailand



Dr. Tran Thanh Dan, AIT, Thailand



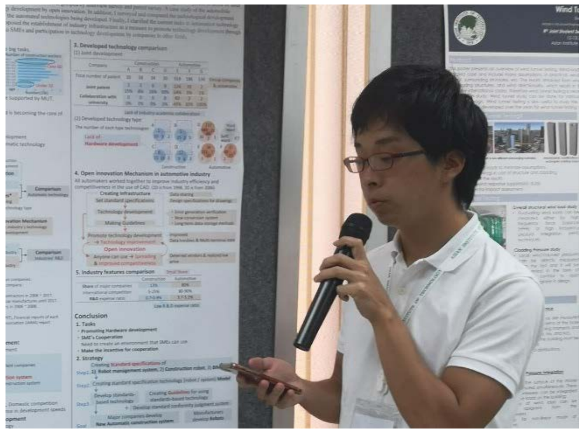
Takahiro Yamaguchi, D1, UTokyo, Japan

Pratichhya Sharma, AIT, Thailand

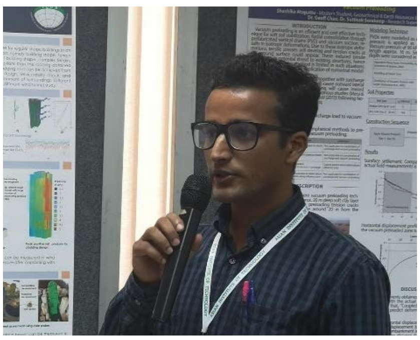
Atsushi Shirahama, D1, UTokyo, Japan

Gautam Dadhich, AIT, Thailand

Chathumal Madhuranga, AIT, Thailand

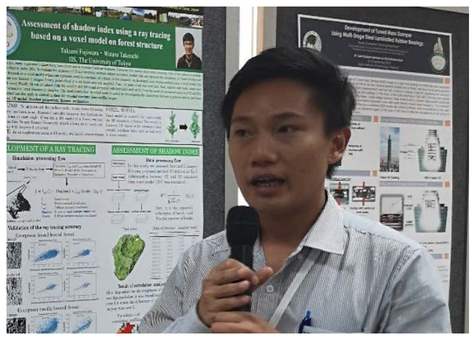


Ryo Itoh, M2, UTokyo, Japan



Sudan Pandey, AIT, Thailand

Shashika Atapattu, AIT, Thailand



Terdkiad Nontapot, AIT, Thailand

Takumi Fujiwara, D1, UTokyo, Jpan

Phruck Chansukho, AIT, Thailand

Nattapon Trumikaborworn, AIT, Thailand

Nunitkorn Kitratporn, D1, UTokyo, Japan

Remote sensing of environment and disaster laboratory

Institute of Industrial Science, the University of Tokyo, Japan

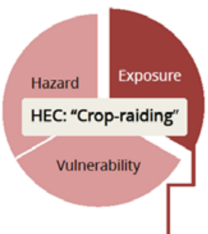
Modeling Inter-annual and Seasonal Distribution of Potential Crop Depredation by Wild Asian Elephant and Potential Movement Connectivity in Eastern Thailand

Nuntikorn KITRATPORN and Wataru TAKEUCHI

Institute of Industrial Science, the University of Tokyo, Japan

Abstract: In Thailand, crop depredation by wild elephants have been intensified and negatively impacted local communities' quality of life as well as wild elephant's long-term conservation success. Despite increasing concern and urgent needs for solution, limited studies explore landscape-scale spatiotemporal pattern of this conflict. The goal of this study was, hence, to fill this gap and identify potential conflict distribution across season and year during 2009 to 2018. Specifically, we applied Maximum Entropy (Maxent) method and separately constructed models for resource-related scenario and direct human pressure scenario for wet and dry season (total of 4 models). Then, we applied our proposed two-dimensional conflict matrix based on thresholding approach to categorized predictive results into four groups. With high temporal availability of satellite-derived dataset, we project our model on each year from 2009 to 2017. Multivariate Environmental Similarity Surface (MESS) was calculated to identify dissimilarity between each year, while regression slope was used to identify trend. We identified 2,000 km2 of persistent conflict largely in part of Chantaburi and Ranong provinces due to high habitat suitability in that areas. KBDI was the key limiting factors causing drastic inter-annual response, while land cover changes suggested a subtle influence over time.

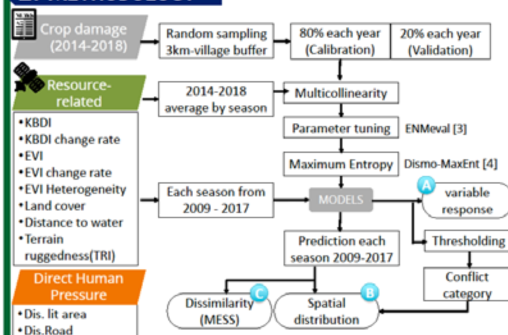
1. Background



- Thailand has 3,000-5,000 wild elephants in 69 areas, 41/69 areas faced HEC [1]
- Species distribution models (SDM), for HEC showed accuracy and realistic, but commonly static[2]

1. Where (spatial pattern) farmers are more likely to encounter wild elephants?
2. What are the influencing conditions, resource-related vs. direct human pressure?
3. Does seasonality and inter-annual condition alter the distribution?

2. Methodology



Max. distribution eq.1 can be achieved by maximizing eq.2

eq. 1 $$q\lambda(x_i) = \frac{e^{\lambda f(x)}}{Z\lambda}$$

$$\frac{1}{m}\sum_{i=1}^{m} \ln\left(q_{\lambda}(x_i)\right) - \sum_{j=i}^{m} \beta_j|\lambda_i|$$

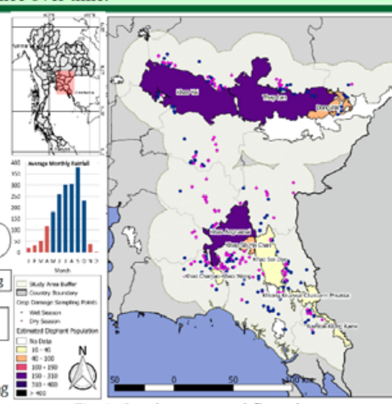


Fig.1: Study area and flowchart

3. Results & Discussion

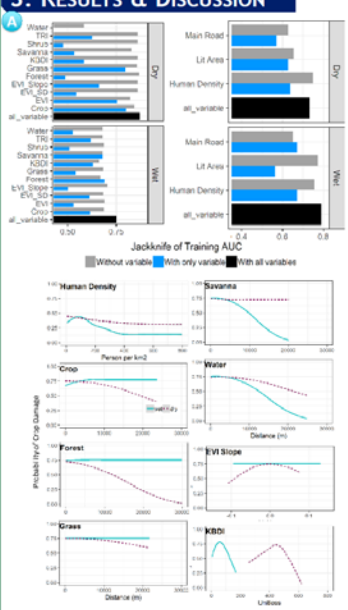


Fig.3: AUC > 0.75 and selected response variables shown differences between season

Fig.4: Thresholding highlighted hotspot with frequent conflict in southern of Angrue nai and north of Khao Yai and Thablan. Changing spatial pattern across season was captured

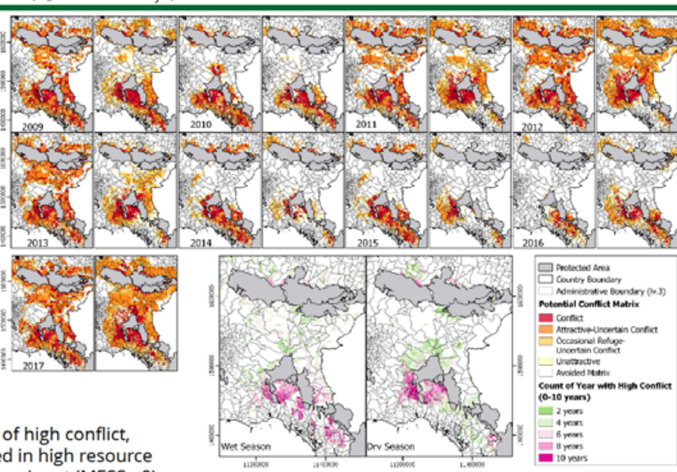
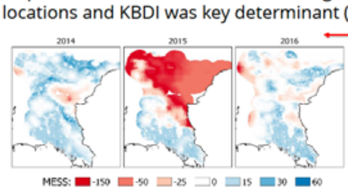
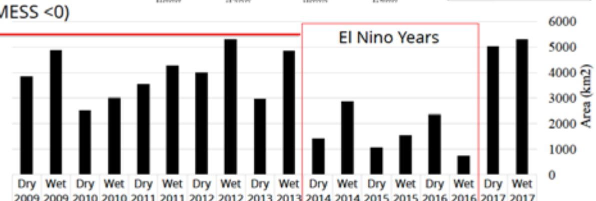


Fig.5: El Nino year reduced area of high conflict, elephants are more concentrated in high resource locations and KBDI was key determinant (MESS <0)





	Dry 2009	Wet 2009	Dry 2010	Wet 2010	Dry 2011	Wet 2011	Dry 2012	Wet 2012	Dry 2013	Wet 2013	Dry 2014	Wet 2014	Dry 2015	Wet 2015	Dry 2016	Wet 2016	Dry 2017	Wet 2017
High Conflict	3825	4855	2510	2994	3538	4280	3999	5306	2965	4848	1404	2852	1063	1545	2360	723	5027	5302

4. Conclusions & Future Work

- Remote sensing dataset is powerful and has potential to improve prediction
- Seasonal distribution is influenced by resource-related > human pressure
- KBDI influenced the change between each year especially in extreme events
- Shrub is important to elephants in dry season, wet season associated to grass
- High re-occurring conflict location is predicted for Rayong and Chantaburi near Angruenai WS (7 and and 6 amphoes respectively) and Nakhon Ratchasima (4 amphoe) near Khao Yai and Thablan
- Future work : to incorporate movement of elephants using circuit theory or least-cost path

Reference

[1]Noonto, B (2009). "Managing HEC based on Elephant and Human Behaviors". PhD thesis. [2] Mateo-Tom´as, Patricia et al. (2012). "Alleviating humanwildlife conflicts: Identifying the causes and mapping the risk of illegal poisoning of wild fauna". In: Journal of Applied Ecology 49.2, pp. 376–385 [3]Takeuchi, W et al. (2015). "Near-Real Time Meteorological Drought Monitoring and Early Warning System for Croplands in Asia". In: 36th ACRS 2015, 1.October, pp. 171–178. [4]Phillips, Steven J., Robert P. Anderson, and Robert E. Schapire (2006). "Maximum entropy modeling of species geographic distributions". In: Ecological Modelling 190.3-4, pp. 231–259.

For further details, contact: Nuntikorn Kitratporn, Bw-601, 6-1, Komaba 4-chome, Meguro, Tokyo 153-8505 JAPAN (URL: http://wtlab.iis.u-tokyo.ac.jp/ E-mail: tita@g.ecc.u-tokyo.ac.jp)

Piyanut Piyasin, SUT, Thailand

Air Pollution Map for Green University at Suranaree University of Technology

Piyanut Piyasin, Parinya Channgam, Pantip Piyatadsananon, Tanakorn Sritarapipat

School Geoinformatics, Institute of Science, Suranaree University of Technology, Thailand

PM2.5

PM (Particulate Matter)

PM: the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using an electron microscope (U.S. EPA, 2018).

- PM10: inhalable particles, with diameters that are generally 10 μ and smaller.
- PM2.5: fine inhalable particles, with diameters that are generally 2.5 μ and smaller.

Health Effects of Particulate Matter (PM)

Small particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into lungs, and some may even get into blood-stream. Exposure to such particles can affect both lungs and heart.

Numerous scientific studies have linked particle pollution exposure to a variety of problems, including:

- premature death in people with heart or lung disease
- nonfatal heart attacks
- irregular heartbeat
- aggravated asthma
- decreased lung function
- increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.

SUT Green University

SUT has joined in UI Green Metric World University Ranking 2014 process. In 2019, SUT was recognized as Green University ranks 14th in the country and the world's top 273 . The results of the survey are evaluated by GREEN METRIC WORLD RANKINGS with six factors;

SUT Zone

The university has managed to solve various problems according to the survey results to be suitable, being accepted as a green university. Around the end of 2018 to 2019, Thailand has faced the problem of air pollution known as PM 2.5. Suranaree University of Technology has concerned about the danger of the PM 2.5 air pollution. For this reason, an air pollution map must be initially produced by investigating the air quality over the campus. Hence, the air pollution map shows the information to support the University Plan for Green University. Based on the university plan, the map can be divided into the following zones.

1. Technopolis Zone
2. Education zone
3. Sports zones
4. Teacher housing zone
5. Student dormitory zone
6. Around campus

SUT Zone Map

PM2.5 value at SUT

Morning data (8.00 - 9.00 am.)

ZONE	Maximum	Minimum	Mean
Around campus	18.8	5	8.3
Education zone	17.9	4.5	7.1
Technopolis Zone	9.4	4.3	6.4
Sports zones	12.8	5.7	9.1
Teacher housing zone	11.1	6.4	8.6
Student dormitory zone	12.4	6.2	9.0

Evening data (4.00 – 5.00 pm.)

ZONE	Maximum	Minimum	Mean
Around campus	16.8	5.2	10.6
Education zone	8.8	3.1	5.4
Technopolis Zone	6.8	4.1	5.4
Sports zones	12.4	5.9	8.9
Teacher housing zone	18	6.1	10.7
Student dormitory zone	14.1	6.1	9.4

PM2.5 value at the city center of Nakhon Ratchasima

PM2.5 value at Zoo

Research

objective

To create an air pollution map with PM 2.5 at Suranaree University of Technology using hand-held device for detecting PM 2.5 (Pocket PM 2.5 sensor)

Material

- Pocket PM 2.5 sensor
- Smartphone
- Notebook
- Vehicle for investigating the PM 2.5 data

Method

1. Data collection points are Suranaree University of Technology, City center of Nakhon Ratchasima, and Nakhon Ratchasima Zoo.
2. Data collections are divided into 2 periods because of the traffic of student behaviors and university staff.
   2.1. Morning data collection time is between 8.00 - 9.00 am.
   2.2 Evening data collection time is between 4.00 – 5.00 pm.
3. PM 2.5 data is collected throughout SUT by using Pocket PM 2.5 sensor with the specified periods.
4. PM 2.5 data is divided into 5 levels using Natural Breaks.

Results and Discussions

In the morning period, the maximum value of PM 2.5 is 18.8 (μg/m³), whereas the minimum value is 5 (μg/m³). The average value is 8.19 (μg/m³).

In the evening period, the maximum value of PM 2.5 is 16.8 (μg/m³), whereas the minimum value is 5.2 (μg/m³). The average value is 10.64 (μg/m³).

It can be concluded that the average value of PM 2.5 in the evening collection time is higher than in the morning collection time because in the evening, students and university staff typically use cars or motorcycles to do a lot more activities, such as exercising, going to do some food shopping in the markets, and travelling over the campus than they always do in the morning collection time.

At the city center of Nakhon Ratchasima, the maximum value of PM 2.5 is 101.1 (μg/m³), whereas the minimum value is 3.9 (μg/m³). The average value is 13.71 (μg/m³).

At Nakhon Ratchasima Zoo, the maximum value of PM 2.5 is 8.8 (μg/m³), whereas the minimum value is 2.5 (μg/m³). The average value is 4.26(μg/m³).

It can be clearly seen that the maximum value of PM 2.5 values at SUT is lower than at the maximum value of the City center of Nakhon Ratchasima around.

Nakhon Ratchasima Zoo is the lowest average value of PM 2.5 (4.26) due to the light traffic in the entrance gate.

Conclusion

The air pollution map with PM 2.5 at SUT was proposed by using Pocket PM 2.5 sensor. The PM 2.5 map can be used to support the Energy and Climate policy that helps to promote the green university.

The air pollution map was produced to present the air quality over six major zones of SUT, compared with the PM 2.5 data of the City Center of Nakhon Ratchasima, and Nakhon Ratchasima Zoo. It is obviously concluded that the amount of PM 2.5 values response directly to the traffic of collection points. Considering the standard of PM 2.5 in developing country, it was assigned from the world quality index (EPA, 2018) whether the standard of PM 2.5 value of Thailand would be around 25-50 (μg/m³). Additionally, the best air quality of Thailand is ranged between 0 to 25 (μg/m³) (Pollution control department, Air Quality and Noise Management Bureau, 2018). Considering the air quality of SUT, it is clearly shown that the university provides the best air quality compared with the standard. This investigated result confirms that SUT maintains a good positional rank regarding the Energy and Climate factor considered as one of the Green University.

Reference

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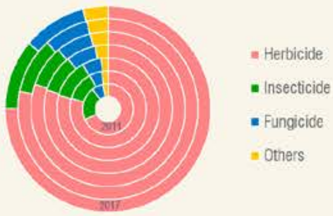
Apinya Boonrang, SUT, Thailand

WEED CLASSIFICATION IN CASSAVA FIELD USING UNMANNED AERIAL VEHICLE IMAGES

Apinya Boonrang , Pantip Piyatadsananon, Tanakorn Sritarapipat

School Geoinformatics, Institute of Science, Suranaree University of Technology, Thailand

BACKGROUND



Thailand imported dangerous chemical substance for agricultural products in 2011-2017

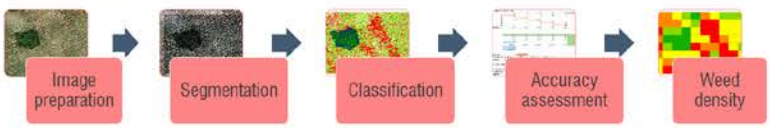
(From Office of Agricultural Economics, 2018)

A major crop health problem is invasive plants or weeds in crop fields. Weeds play a great barrier to crop growth in the plantation. Herbicides, chemical substance used for killing plants, are widely used for weed control. In term of cassava plantation, farmers generally spray herbicide over the cassava fields. According to the importing report from Office of Agricultural Economics of Thailand, herbicides were the highest volume and cost imported to Thailand from 2011 to 2017. Approximately 80% of all imported pesticides were herbicides and their value around 14,000 million Bath [1]. The overuse of herbicides is concerned in economic and environmental as well as health issues. Surprisingly, there were 49,000-61,000 cases per year of pesticide intoxication, most of patients caused by herbicides [2].

Apparently, weeds spread into the cassava fields partially. An extreme invasion of weeds can cease the growth of cassava. Surveying and classifying weeds in cassava fields are crucial missions for precision management. This study aims to classify the invasion of weeds in a cassava field by using optical sensors on the Unmanned Aviation Vehicle (UAV).

PROCESS

The captured images from UAV were rectified to create a high-resolution map. The object-based analysis was used to discriminate weeds from cassava by using maximum likelihood and support vector machine method. For improving the accuracy of these results, Excess Green Index (ExG) was generated to enhance the accuracy of the classified results. Finally, the weed coverage map was produced to show levels of infestation.



UAV IN PRECISION AGRICULTURE

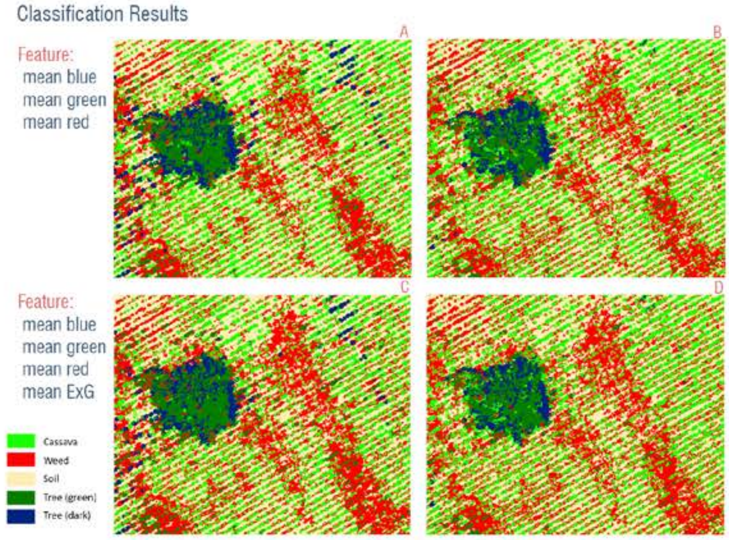
UAV based remote sensing offers great possibilities in acquiring spatial data and images faster, easier and cheaper than the manned aerial vehicles or airborne based remote sensing.

RESULT

UAV image of a cassava field in Nakhon Ratchasima province (area 2,000 sq.m., resolution 2.5 cm/pixel)

Values of Training Objects for Classification

Classification Results



Overall accuracy
ML(A)= 0.8784
SVM (B) = 0.9274

Kappa
ML (A)= 0.8320
SVM (B)= 0.8987

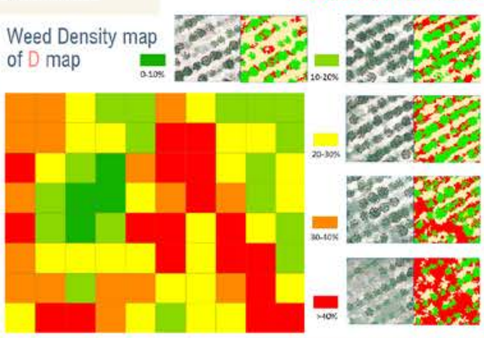
Overall accuracy
ML (C)= 0.8919
SVM (D) = 0.9459

Kappa
ML (C)= 0.8511
SVM (D)= 0.9245

Number of training and testing objects

Class	Training		Testing	
	Polygons	Pixels	Polygons	Pixels
Cassava	100	48,082	171	93,738
Weed	90	50,943	173	77,611
Soil	90	44,792	196	103,226
Tree (green)	30	14,404	34	15,745
Tree (dark)	25	14,287	18	12,196
Total training	335	172,508	592	302,516
All area	11,139	3,200k	11,139	3,200k
Percent	3.01	5.39	5.31	9.45

Weed Density map of D map



DISCUSSION

As the results, these techniques can discriminate weeds from cassava precisely. The accuracies were 83.2-94.6% and Kappa values were 0.83-0.92.

	Classification method	SVM RGB + ExG (D)	SVM RGB (B)	ML RGB + ExG (C)	ML RGB (A)
Rank	Overall accuracy	0.9459	0.9274	0.8919	0.8740
	Kappa hat	0.9245	0.8987	0.8511	0.8320

It is clearly shown that the UAV performs a high capacity in surveying weeds over cassava field. Integrated with the SVM technique of object-based analysis, this method is able to classify the weeds from the cassava field significantly. The result of this study is beneficial to increase the ability of weed management in precision agriculture.

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CONCLUSION

- The SVM classifier shows better result than ML.
- With adding ExG index, it can improve the accuracy of ML and SVM classification method.

Hein Thura Aung, YTU, Myanmar

Building Footprint Extraction in Yangon City from Monocular RGB Satellite Image Using Deep Learning

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Contact: heinthuraung@ytu.edu.mm

ABSTRACT

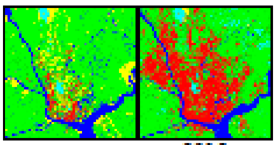
Urban maps are one of the most important databases for urban related applications such as urban planning, urban management, population estimation, resource management, transportation planning, disaster management, emergency response and so on. In this research, conditional generative adversarial network (CGAN) is used for automatic extraction of building footprints in Yangon City. CGAN is first trained with the dataset composed of monocular RGB GeoEYE images of the study area. The validating dataset is divided into four groups; trees, buildings, mixed, and pagodas. Finally, the validated images are evaluated by comparing with manually digitized ground truth data. The results show that CGAN can extract building footprint areas up to 72% of completeness, 92% of correctness and 79% of F1 score.

1. INTRODUCTION

- Urban building maps for urban related applications
- Manual digitization (takes much more time and human resource)
- Automatic digitization (Accuracy)

OBJECTIVES

- Apply image processing techniques and deep learning algorithm
- Reduce datasets (only RGB image)
- Develop automatic building footprint extraction method



1973 2015

2. METHODOLOGY

- Pix2pix (Tensorflow framework)
- 310 training images (80% of dataset)

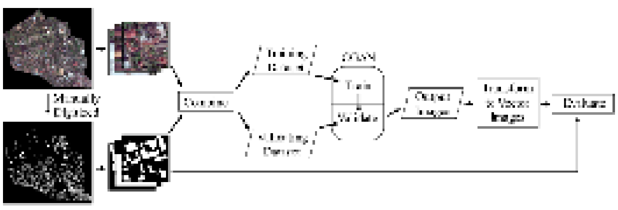


Fig. Block diagram of the system

3. RESULTS

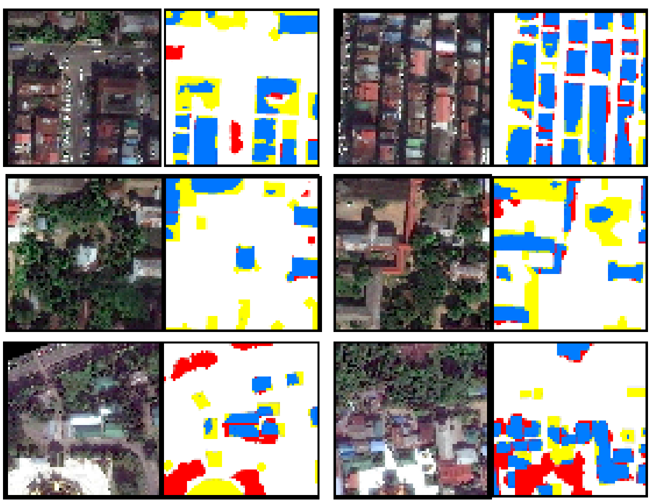


Fig. Input image, Extracted area VS Ground truth area

3. RESULTS

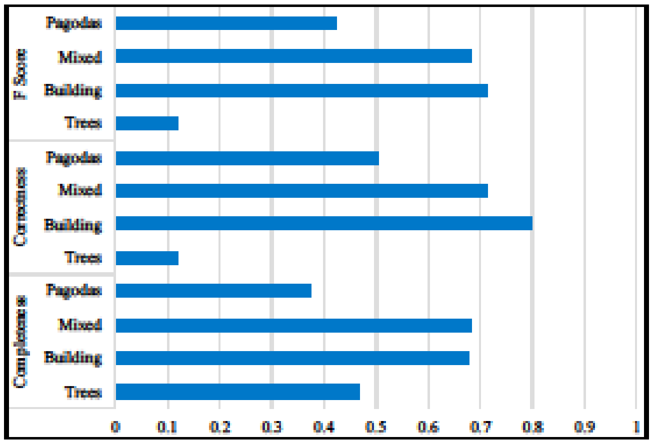


Fig. Evaluation result for Dagon Township

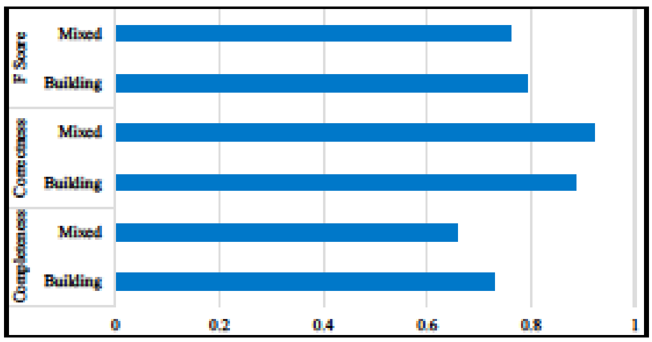


Fig. Evaluation result for Latha Township

4. DISCUSSION

- Poor extraction rate
  - Rusty rooftops, Greenish rooftops
  - Small rooftops surrounded by trees
  - Floor covered with white ceramic tiles (pagodas)
- Similarity of spatial and spectral properties between training and validating
  - Better extraction rate

5. CONCLUSION

- Saves more time than manual digitization
- Lower Accuracy
  - Completeness up to 72%, Correctness up to 92%, F Score up to 79%

Sasanka Madawalagama, AIT, Thailand

Low Cost High Accurate Areal Mapping with Custom Built RTK Drone

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Mapping with Drones

High accurate, high resolution 3D mapping with drones has opened up new possibilities in surveying, engineering, and geoscience applications. Current low cost consumer drones have lifted the drone mapping industry to a new level as they are capable of making high resolution and high accurate maps. Geolocation accuracy of drone map products mainly depends on the quality of the ground control points. Establishing a network of ground control points is often a tedious, costly, and time-consuming task of a drone mapping project. There are survey grade drones available in the market which can do high accurate mapping without ground control points, but they come at a very high cost. The objective of this study is to develop a low-cost custom-made drone for high accurate aerial mapping without using ground control points.

Objective

Develop a prototype drone for high accurate and cost-efficient aerial mapping

Features

- Total cost for the hardware is less than 3000USD
- Integration of high accurate positioning system capable of RTK and PPK
- Direct transmission of GNSS correction data to the drone via internet
- Autonomous mission planning and execution
- Synchronized imaging system

Positioning system

It is necessary to integrate high precision RTK GNSS receiver to gain the required accuracy in the map products. Swiftnav Piksi Multi receiver is chosen as the primary GNSS receiver to fulfill the accuracy requirements. A high precision lightweight helical GNSS antenna is used. The operational environment of the drone has a clear sky view which minimizes the effect of multipath.

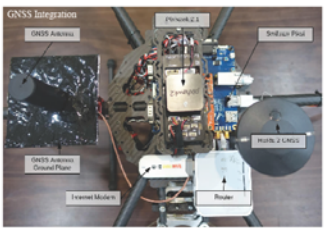
Here 2 GNSS receiver is used in the drone as a redundant GNSS unit for navigation as a standalone receiver. HERE 2 unit is assigned to be the primary magnetometer which has the minimum interference from other electronics.

Two methods were used to send the RTK correction data to the drone in real-time

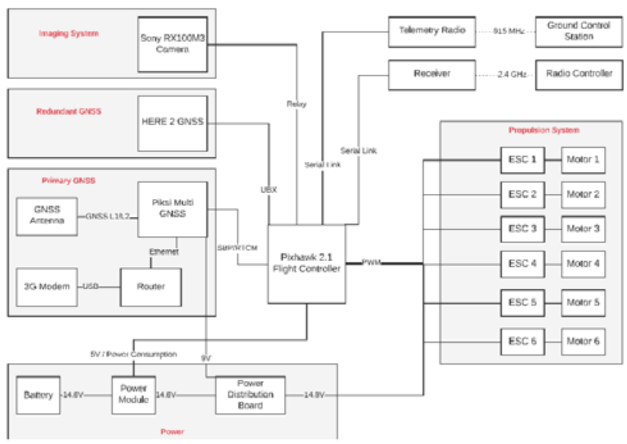
1. Integrating 4G modem to the receiver
2. Using telemetry radio

Table: Features of GNSS Units Used in the Prototype Drone

	Piksi Multi	HERE 2
GNSS tracking	GPS L1/L2, GLONASS G1/G2, BeiDou B1/B2, Galileo E1/E5b	GPS L1, GLONASS G1, QZSS L1, Galileo E1, SBAS
RTK output frequency	10Hz	10Hz
RTK horizontal accuracy	0.01m	-
RTK vertical accuracy	0.015m	-
Standalone accuracy (SBAS)	0.75m	2m
Velocity Accuracy	0.03 m/s	0.05 m/s



System Components



Imaging System

Ultimate data provided by drones for mapping purposes are the images, so the quality of the images directly affects the quality and the accuracy of the map products. Several parameters are considered when choosing the camera for the drone. Which are resolution, resolving power, sensor size, shutter speed, focusing compatibility, triggering compatibility, weight, and price. Sony RX 100 M3 was selected considering the above-mentioned factors. The camera is mounted to a custom build wire rope isolator to minimize the effect of vibration. The camera is triggered by the autopilot by using the relay function

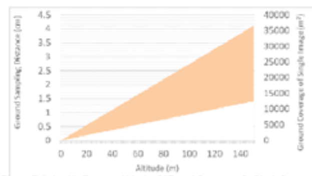


Figure: Relationship Between Altitude, GSD, and Coverage of a Single Image of the Imaging System

	Sony RX 100 M3
Sensor	20.1 MP Exmor R BSI-CMOS
Min shutter speed	1/2000s
Maximum aperture	f/1.8
Focal length	8.8 - 25.7mm
Field of view	34 – 88 deg
Remote Trigger mechanism	Switch
weight	290g

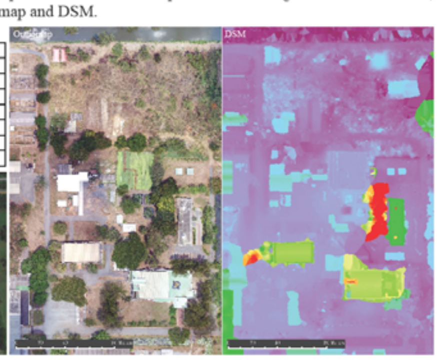
Mapping Performance

Thee drone's performance in mapping is assessed by mapping a total area of 0.05 km² in the Asian Institute of Technology, Thailand. Before the flight, 8 Independent Check Points (ICPs) were established using a total station to assess the geolocation accuracy of the maps.

The images are post-processed with the flight log to extract the location at the time of exposure. As the GNSS receiver operates at 10Hz and the average drones speed is 4.4ms^{-1}, there is 0.44m gap between two position readings. In order to obtain an accurate estimate of the position of the image exposure, built-in Extended Kalman Filter (EKF) of the Ardupilot firmware is used. The geotagged images are photogrammetrically processed into orthomap and DSM using the Pix4D software, resulting a high-resolution orthomap and DSM.

Table: Flight Parameters

Area	0.05km²
Overlap	75%
Flying height	100m
Total flying time	10 mins
Camera	Sony RX100 MIII
Average GSD	2.65cm
Number of images	52
RTK fix rate	100%



Accuracy Analysis

The mapping accuracy is assessed by comparing the map coordinates with the actual ground coordinates established by Independent Check Point Network. The analysis shows that the custom-made drone can make 2D maps to an accuracy of 11cm and 3D accuracy of 13cm in the given scenario without the aid of ground control.

The analysis was further extended to assess the effect of introducing GCPs to the process. When GCPs were used in the photogrammetric process, the accuracy increased up to 5cm in 2D and 6cm in 3D. It was observed that increasing more GCPs after introducing 3 GCPs, the accuracy does not significantly increase.

Table: Accuracy Comparison and Variation with the Number of GCPs

	Number of GCPs	0	1	2	3	4	5
Custom Built RTK Drone	2D Accuracy (cm)	**11.0**	11.5	5.2	4.7	5.2	5.1
	3D Accuracy (cm)	**12.5**	14.7	8.5	7.2	5.8	6.0
Phantom 4 Pro	2D Accuracy (cm)	113.8	365.4	3.0	2.9	2.9	1.7
	3D Accuracy (cm)	2844.7	438.0	42.9	5.8	4.3	3.4

The performance of the custom-built drone is evaluated by comparing it with phantom 4 pro which is a commonly available consumer-grade drone used in mapping. As the Phantom 4 does not use high precision positioning system, the accuracy was low as 3m when no ground control points were used. When 3 GCPs were introduced, the accuracy increases to 5 cm.

Figure: Accuracy variation of the RTK drone

Conclusion

The RTK drone is capable of producing maps to global accuracy of 13cm in the selected scenario, but the accuracy increased by a factor of two when grond control is introduced. When compared with commercially available RTK drones, the accuracy of the custom made RTK drone is significantly less as drones such as Senseflу eBee X can produce maps to 1.5cm. The custom made RTK drone outperforms the Phantom 4, in a considerable margin in terms of the accuracy. When compared with the drones available in the market, the custom RTK drone has better price to accuracy value. This prototype RTK drone provides unique functionality to obtain RTK corrections directly with the onboard internet connectivity. It is a considerable advantage when Continues Observation Reference Network (CORS) is available at the location of survey. This approach is highly efficient and cost-effective. The onboard internet connectivity provides low latency positioning solution. The custom-built RTK drone is an affordable drone which can provide a considerable level of accuracy in mapping. The custom made Ironman RTK drone can be successfully used in the applications where it matches with the accuracy requirements as the accuracy is always governed by the application.

Dr. Tran Thanh Dan, AIT, Thailand

Mapping Fine-scale Spatial Distribution of Population using Open Multi-source Geospatial Data with Deep Learning

Spatial distribution of population map at a finer scale is useful for planning and policy development. This research attempts to improving high resolution on human population distributions, by presenting a new approach to map the population using open multi-source geospatial and ancillary data. The research is conducted through two main steps: (1) to disaggregate census data and predict population density at commune level, gridded dataset, (2) to map population distribution at building level using population-building gravity model. The data were processed through five steps: (i) data collection and pre-processing, including: population and building footprints extraction from census data and cadastral map and/or satellite data, respectively; and ancillary data collection, including: topographic, infrastructure, river network, road network, satellite data, and night-time light imagery; (ii) covariates preparation for fitting and predicting randomForest algorithm; (iii) model adjustment and estimation population at building level; (iv) geospatial population distribution mapping at 30m spatial resolution; and (v) allocation population to buildings using gravity model.

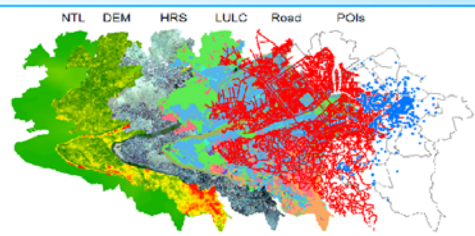
1. Introduction

- Night-time lights (NTL) image and land use land cover (LULC) types have widely used to disaggregate census data to produce girded population map.
- Most of studies focused on large-scale population mapping (for example: provincial or district level).
- Recently, geospatial big data has created additional opportunities to map population at fine resolution with high accuracy, for example: Point of interests – POIs.

2. Method

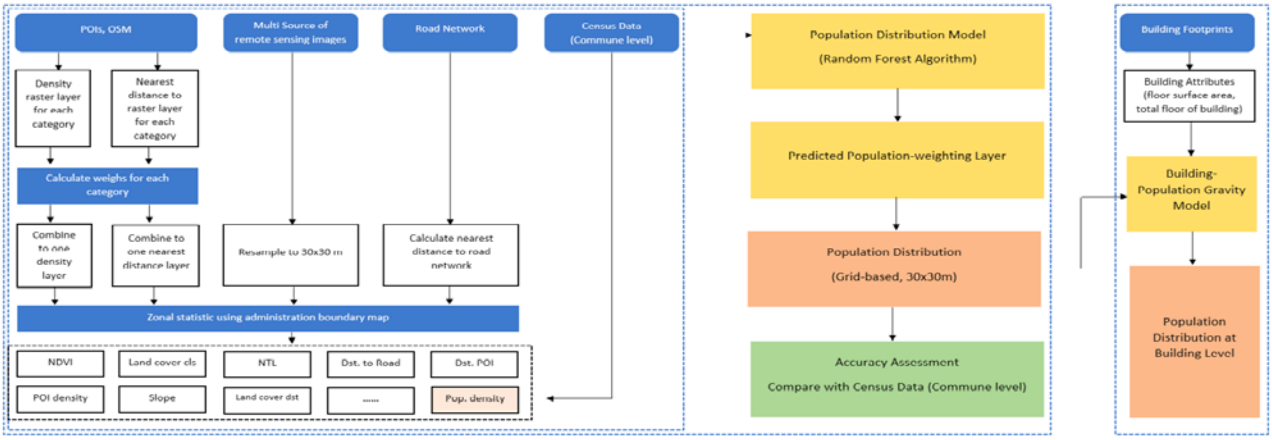
2.1 Data collection

Population in 2009 was extracted from census data and linked with administrative map at ward level. Other datasets highly presented correlated with population such as: LULC, night-time light, geospatial data (road networks, rivers/stream systems, infrastructure (water supply, electricity system, …), topography are collected.



2.2 Methodology

The figure below shows flowchart of the methodology used for population mapping at building level.

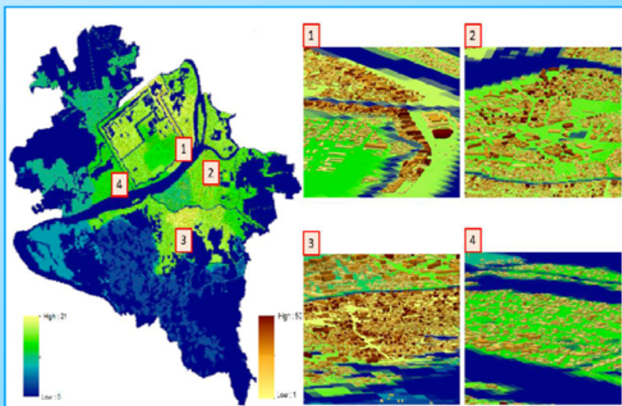


3. Result

We selected 21 variables as input for the Random Forest Algorithm (RFA), including point of interests, OSM and GIS data.
36000 training samples was selected. We implemented the RFA based fitting model with 200 decision trees. Percentage of training dataset and test dataset were set to 60 and 40, respectively.
Simulated population distribution map at a fine-scale of 30m via random forest algorithm presents in the figure below.
Validation of results was made by comparing the estimation with the census population, which showed a good correlation with R2 larger than 0.9.

4. Conclusion

This study was successfully applying a new population mapping approach by using open multi-source geospatial data.
Validation was made by comparing the estimation result with the population data at ward level, which yield very .
We found that RF model performs better than several other commonly used models.
An advantage with the approach is that we can aggregated population can be re-distributed to a fine scale, providing quantitative information of planning and policy development.



Spatial distribution of population in the city. The left figure shows predicted population map while the right figure presents number of population at buildings, in several important areas.

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Subsurface Pipes Detection by 3D Convolutional Neural Network and Kirchhoff Migration Using Radar Images

T. Yamaguchi*, T. Mizutani* and M.Tarumi *the University of Tokyo

Objective

Subsurface sewage pipe amounts up to 470,000 km in Japan, causing construction delay and damages to utilities. Old sewage pipes cause about 3,000 voids / year.

Automatic and speedy pipes detection algorithm from radar images is needed to save inspectors' several months and several ten thousands dollar maintenance time and cost.

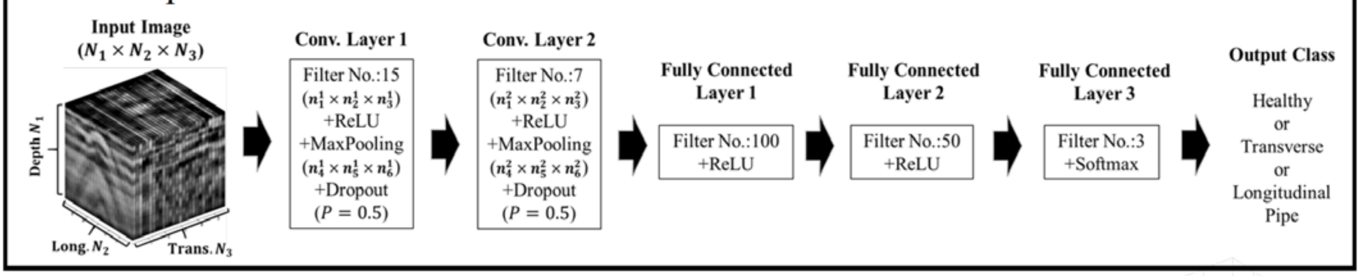
Methodology

Classification:
3D radar images are recorded by multi-channel radar system. Scanning and transverse direction pipes are categorized by developed deep 3D-CNN model about 92% accuracy.

Localization:
Kirchhoff Migration is applied on proposed region by 3D-CNN in each direction to extract peaks' position.

Radar System

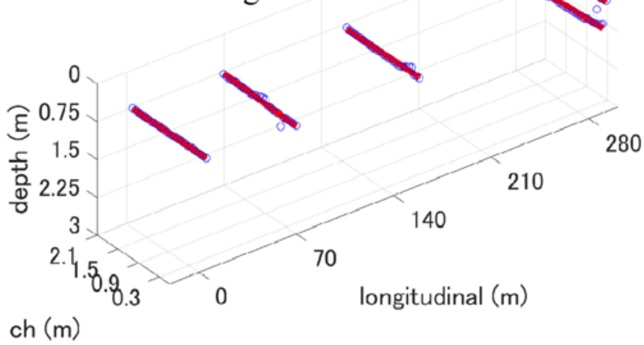
Proposed 3D-CNN Model



3D-CNN Confusion Matrix

Predicted \ Actual	NO PIPE	TRANS. PIPE	LONG. PIPE	PRECISION (%)
No pipe	1134	65	70	89.4
Trans. Pipe	32	676	**1**	95.3
Long. Pipe	97	**2**	1110	91.8
Recall (%)	89.8	91.0	94.0	**Accuracy: 91.6 %**

3D Mapping by Kirchhoff migration



Conclusion

Subsurface pipes' position and direction are successfully detected with 92% detection rate visualized by the combination of 3D-CNN and Kirchhoff migration.

Reference -D. J. Daniels(2004):Ground Penetrating Radar, Institute of Engineering and Technology. -F. Soldovieri *et al.*(2008):A Kirchhoff-Based Shape Reconstruction Algorithm for the Multimonostatic Configuration: the Realistic Case of Buried Pipes, IEEE TGRS, vol. 46 no. 10

Pratichhya Sharma, AIT, Thailand

Decision Support System for Disaster Risk Management

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BACKGROUND

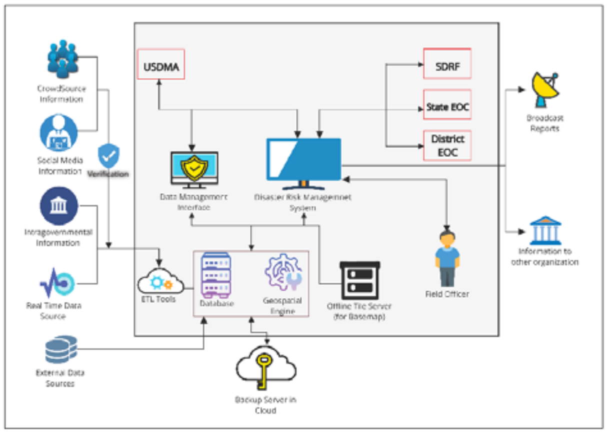
Natural Hazard possesses greater risks due to increasing exposures and vulnerabilities of the elements-at-risk and this may even be further aggravated as a result of climate change. For effective and efficient decision-making during a disaster, a proper flow of information is vital for carrying out the evacuation, rescue and response operations. A Decision Support System (DSS) is developed and being implemented in the state of Uttarakhand in India as a proactive strategy for disaster risk reduction. The state of Uttarakhand is primarily exposed to earthquakes, floods, and landslides (in addition to avalanches, hailstorm, glacial lake outburst floods, lightning storms, and forest fires) and the platform developed can create a Common Operating Picture for an effective response. This system will allow decision makers to spatially analyze the data and get possible geographical information during the disaster.

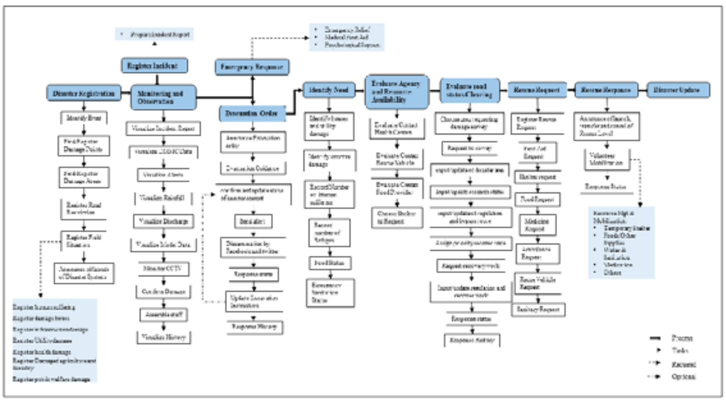
OBJECTIVES

1. Implement an integrated single, secure, and scalable geospatial platform, database and application which is accessible across locations, devices, and agencies for reporting, monitoring, and responding to disasters;
2. Deploy device-independent geospatial applications for Emergency Operating Centers, government agencies, decision-makers, and field staff to help them, monitor, report, analyzes, and respond to emergencies and disasters in the state;
3. Create configurable GIS services and interfaces for quick deployment of visualization, modelling, analytics, and application development.

SYSTEM ARCHITECTURE

The platform is designed to enable coordination and collaboration among different agencies and deploy resources, human resources, and expertise for mitigation, response, and recovery from different geophysical, hydro-meteorological, and man-made disasters. The architecture of the geospatial platform includes components to ingest data from various sources and manage them as a scalable and extensible database. It has two interface for easy and secure administration; (1) The Data Administration Interface to manage the data layers, access levels and API authentications. (2) The Disaster Management System Interface for extracting, geo-tagging and displaying different disasters alerts, monitoring the disaster, preparing disaster response plan and field operations. Data coming from different sources to the system are extracted, standardized, transformed and uploaded to the system database. The geospatial engine renders those data from the database following the OGC standards, which is used by different API running on the platform. All the data stored in the system is automatically synchronized to the cloud database (daily in a normal situation and hourly in a disaster situation).



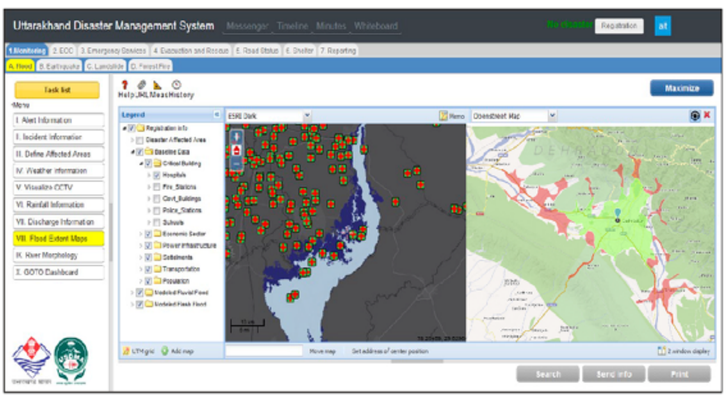


SYSTEM WORKFLOW

In this system menu is designed as in 3 level based on the workflow of the system. In the first level there is process followed by the decision maker during the time of disaster, second level includes the component for each process in the first level and in third level there is list of task for user to look upon under each components.

SYSTEM FUNCTION

GEOSPATIAL PLATFORM



CONCLUSION

A geospatial platform that integrates data from static and real-time data from different sources and having easy ETL for data integration is developed. This system has an advance alert mechanism and a robust BCP for high availability and low fault. With a number of additional functionality, Decision Support System supports access in any language and allows user to perform Geospatial as well as Statistical Analysis on data.

ACKNOWLEDGMENT

NIED
उत्तराखण्ड राज्य
THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

Gautam Dadhich, AIT, Thailand

Farm Level Land Suitability Assessment for Agricultural Crop Using Geomatics

Student Union

Asian Institute of Technology

Gautam Dadhich, PhD Student

RSGIS, School of Engineering and Technology

INTRODUCTION

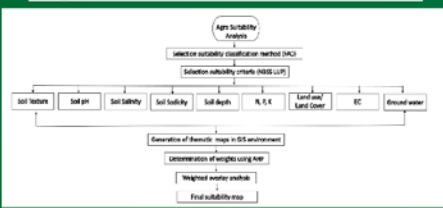
- Farmers are enforced to produce more food resources in limited land and adverse climatic condition to cater exponentially increasing food demand.
- Crop-land suitability assessment can be a suitable solution for sustainable agricultural production.
- In this study effort has been made to carry out land suitability assessment at farm level with easily available evolution parameters (soil health card data).
- The present study has been carried out to evaluate the suitability of the land for wheat crop production by using Multicriteria and GIS application.
- The evaluation of land in terms of suitability classes was based on the method described in FAO guidelines for land evaluation.
- The study was carried out for the Badipur Village, Patan district of the Gujarat state of India.

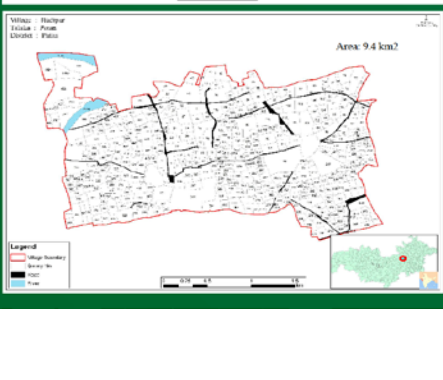
OBJECTIVE

- To determine physical land suitability for wheat crop using a Spatial Multi-Criteria Evaluation (SMCE) approach.
- To analyse the spatial distribution of wheat crop for Badipur Village, Patan District, Gujarat, India)

METHOD

- Relevant parameters listed in soil health card as Nitrogen, Potassium, Phosphate, pH, electrical conductivity and organic carbon are considered for suitability analysis.
- For Multi Criteria Evaluation (MCE), Pairwise Comparison Matrix known as Analytical Hierarchy Process (AHP) was applied.
- Each farm of Badipur village was classified and mapped into four categories of suitability (high suitable, moderately suitable, marginally suitable, and unsuitable) as per *Food and Agriculture Organization (FAO-1976)* qualitative evaluation.





RESULTS

Derivation of weights
Using Saaty's method (AHP)

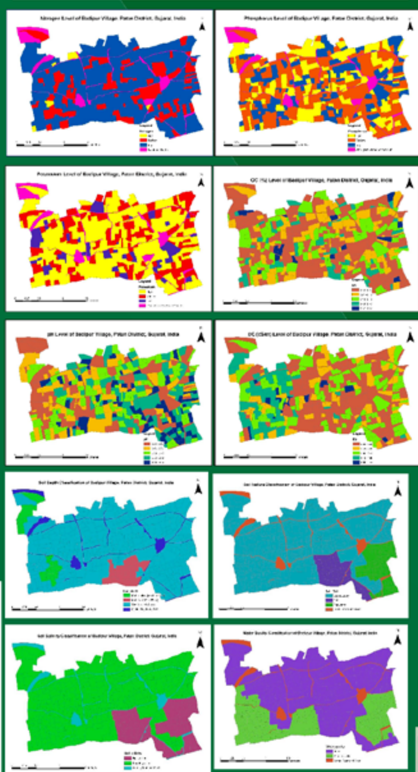
Parameter	Weights
Soil Nutrients	0.301
Soil Salinity	0.219
Soil pH	0.155
Soil texture	0.109
Soil Depth	0.078
Soil Drainage	0.053
Slope	0.037
Soil Sodicity	0.025
Ground Water Quality	0.018

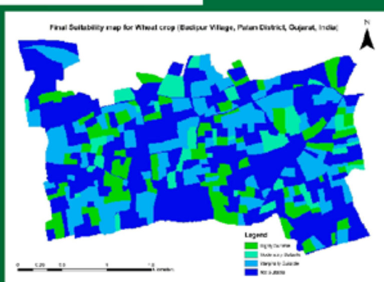
FAO Classification

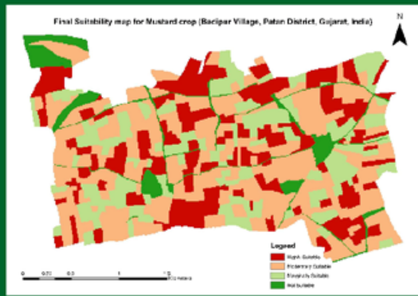
Class	Description
S1	Highly suitable
S2	Moderately suitable
S3	Marginally suitable
N	not suitable

Suitability Criteria (NBSS LUP) Wheat Crop

Sr. No.	Suitability Class	Highly Suitable	Moderately Suitable	Marginally Suitable	Not Suitable
	Parameters / Rank	1	2	3	4
1	Land Use/ Land Cover	Agriculture	Wasteland	Wetland	Builtup
2	Soil texture	Fine	Fine Loamy	Coarse Loamy	Sandy
3	Slope	Less then 1%	1%-2%	2%-3%	More then 3%
4	Soil pH	6.5-7.5	7.5-8.5 and 5.5-6.4	8.6-10	More then 10
5	Soil Salinity (dS/m)	Less Saline (less then 4)	Moderately Saline (4-6)	Highly Saline (6-10)	Poor (More then 13)
6	Soil Sodicity (ESP)%	Less Sodic (less then 15)	Mod. Sodic (15-30)	Highly Sodic (30-40)	Poor (More then 40)
7	Soil Depth (cm)	Very Deep & Deep (More then 100 cm)	Mod. Deep (75-100 cm)	Mod. Shallow (50-75 cm)	Sahllow (less then 50 cm)
8	Soil Drainage	Well	Mod. Well	Somewhat Excessive	Excessive
9	Ground Water Quality	Good	Marginal Saline	Marginal Sodic	Poor
10	Phosphorus	High	Medium	Low	Nil
11	Nitrogen	High	Medium	Low	Nil
12	Potassium	High	Medium	Low	Nil







CONCLUSIONS

- This study provides information at local level that may be utilized by planners and farmers for improving staple food production.
- The distribution of wheat acreage under various suitability classes was, highly suitable: 15.74 per cent (99.13 Ha), moderately suitable: 7.78 per cent (48.97 Ha), marginally suitable: 24.58 per cent (154.76 Ha) and non-suitable: 51.90 per cent (326.84 Ha).
- The distribution of mustard acreage under various suitability classes was, highly suitable: 26.41 per cent (166.31 Ha), moderately suitable: 44.24 per cent (278.58 Ha), marginally suitable: 21.92 per cent (138.04 Ha) and non-suitable: 7.43 per cent (46.77 Ha).
- Results indicate that mustard crop is relatively more suitable then wheat crop over Badipur village.

Development of Decision Support System

Need of tool development

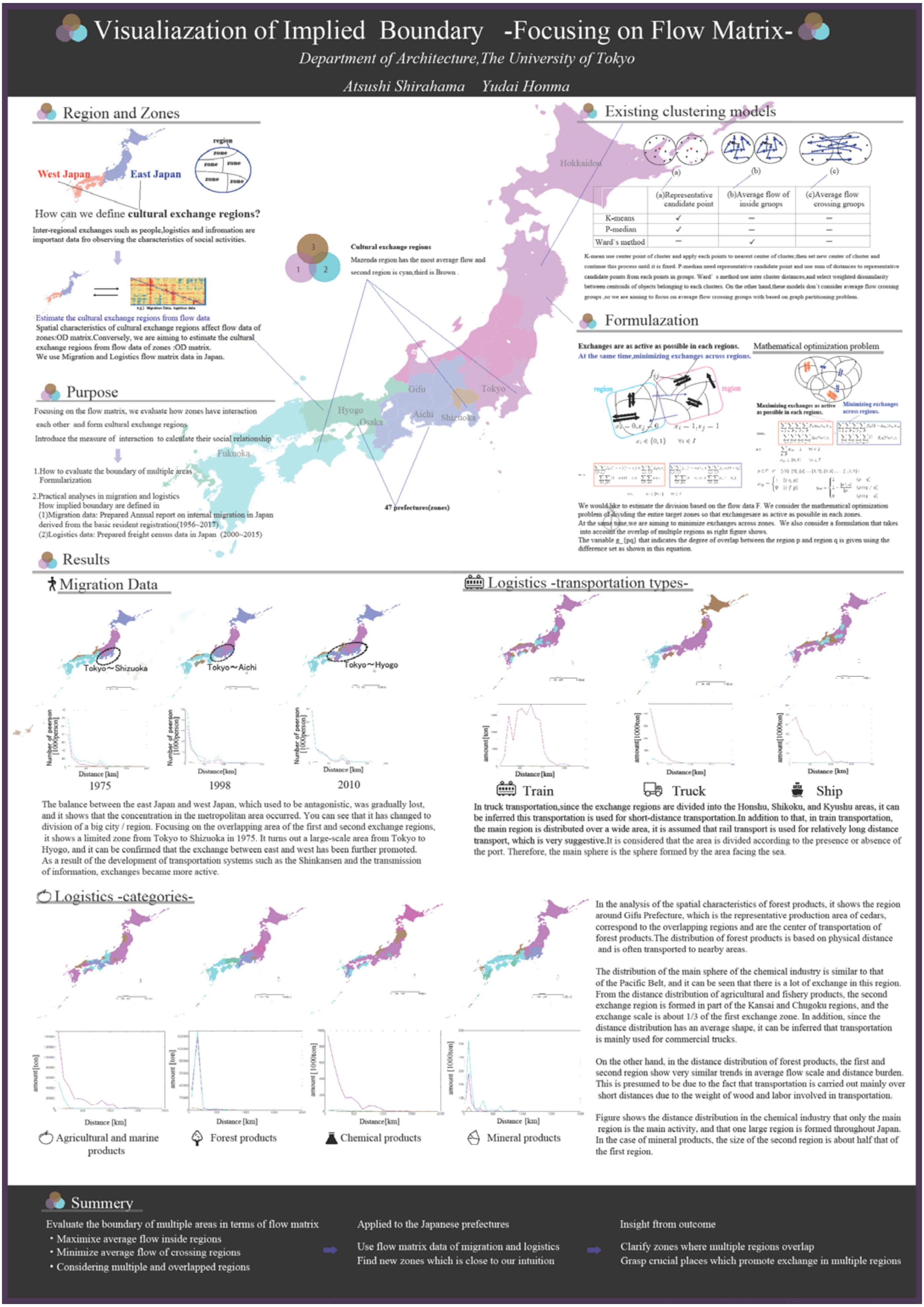
Choosing the most suitable crop to be cultivated for high agricultural production is most difficult task for farmers.

Number of factors like climate, soil, topographic, moisture and nutrient availability, rooting conditions and soil toxicity could make farmers more difficult to select suitable crop.

- The primary use of the *user-friendly, easy, simple tool* is to analyze the suitability of specific crop for user's agricultural land without the need for prior knowledge of computer programming language.
- The system cover <u>46 variety of crops</u> covering Cereals, Pulses, Oil seed crops, Fibre crops, Commercial crops, Plantation crops , Fruit crops, Medicinal and aromatic plants and Spices.
- The DSS provide essential suggestions to improve agricultural productivity based on output.

Tool developed for crop land suitability will solve farmers problem of selecting suitable crop for his land.

Atsushi Shirahama, D1, UTokyo, Japan



Chathumal Madhuranga, AIT, Thailand

Estimation of Forest Above-Ground Biomass Using Random Forest Algorithm Based on ALOS PALSAR and Landsat 5TM Imageries.

Chathumal M.W. Arachchige, S. Nashrrullah, Kavinda Gunasekara, Manzul K. Hazarika

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Abstract

Accurate estimation of forest above-ground biomass (AGB) is crucial factor for sustaining forest management and mitigating climate change. Satellite Remote sensing technology has proved to be an effective method in large scale forest monitoring as well as forest biomass estimation. In this study, focus has been given for a remote sensing approach for estimate the above ground biomass of the western Tiger Landscape of Nepal using combination of Radar and Optical remote sensing data.This study was based on integration of ALOS PALSAR Radar data with Landsat 5TM optical data. Image pre-processing together with a multitemporal approach was carried out for optical and radar imageries, in order to minimize the effects of backscatter noise of Radar imageries as well as the climatic variations of the region. Forest field inventory data was collected in 2010 to 2011 and obtained from the Forest Resource Assessment FRA) Nepal. The emerging Random Forest (RF) machine-learning algorithm is regarded as one of the most precise prediction methods for regression modelling. The objective of this study was to investigate the applicability of the RF regression algorithm for combination of radar and optical data for predicting the forest biomass and test the performance of the RF regression model. In this process ALOS PALSAR radar backscatter, radar texture parameters, Vegetation indexes form Landsat 5TM optical data and digital elevation model data were taken into the random forest algorithm to predict the results. Performance of the model was compared with optical data, radar data and combination of both optical and radar data. The results showed that the RF model produced more accurate estimates of the forest biomass results when it based on optical data (R2 =0.443, RMSE = 101.46 t/ha). Combination of radar and optical data (R2 =0.391, RMSE = 103.52 t/ha) gives good results than it only based on radar data

KEY WORDS: Biomass Estimation, Nepal, ALOS PALSAR, Landsat 5TM.

Introduction

•Rapid and large-scale accurate monitoring and estimation of forest biomass is an essential need in strategic forest management and carbon stock assessment(Nashrrullah et al., 2012).

• Satellite remote sensing plays a major role in monitoring and mapping the forest since the launch of Landsat mission in 1970s. Integration of Synthetic aperture (SAR) along with the optical remote sensing data have been recently utilized for forest applications.

• When considering the SAR data characteristics L band data can penetrate the canopy layer and ALOS PALSAR data has been used in so many biomass estimation studies with optical data for this reason.

• When it comes to modelling the data, there are lot of machine learning algorithms which can be effective in their own way. Among various machine-learning algorithms, the emerging Random Forest (RF) algorithm has been regarded as one of the most precise prediction methods for classification and regression(Wang et al., 2016).

• In this study, the ability of ALOS PALSAR and Landsat 5 imagery for retrieve and predict forest Above ground biomass random forest algorithm is evaluated.

The objectives of this study include the following:
* to model the relationship between field-measured forests AGB and ALOS PALSAR radar backscatter
* to evaluate and compare the accuracy of the random forest biomass prediction models, based on optical, radar and combination of optical and radar AGB predictors
* to map forest AGB spatial distribution by the best model

Methodology

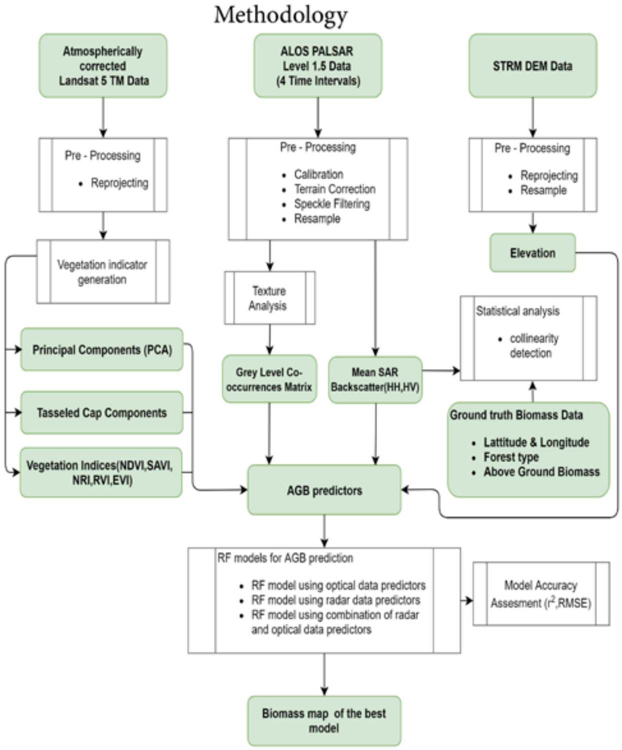

Figure 1: Method flowchart

Summary

This study investigated the potential of data integration of ALOS PALSAR and Landsat 5 data for estimating the forest biomass of the Western Tiger Landscape of Nepal using random forest method. Based on the finding in this research, the following conclusions are drawn:

•The Landsat 5 data could be used to estimate the forest AGB with moderate accuracy, while the ALOSPALSAR data alone is not enough for estimating the forest AGB.

• When combining ALOS PALSAR data with Landsat 5 optical data, RF model gives best results than AGB estimation only based on Radar backscatter.

• Principle components, tasseled cap components and radar texture parameters plays an important role when predicting the results

Study Area

This study is based on the area of western Terai Landscape, focusing two districts, Kailali and Kanchanpur, of Nepal. With the elevation range from 130 to 1900m above the mean sea level, this area stretches from lowland of Terai in the south and touches a bit portion of Siwalik region in the northern part.

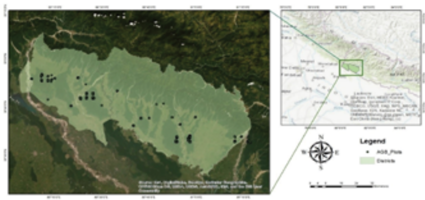

Figure 2: study Area

Results and Discussion

In this study, the above ground biomass estimation tested with the relation between RADAR backscatter and the above ground biomass filed data. According to these 208 plotted points and the R2 values, it is shown that non-linear regression curves are not perfectly fit the data. When comparing with the HV and HH polarization, HV polarized backscatter gives best estimate as it

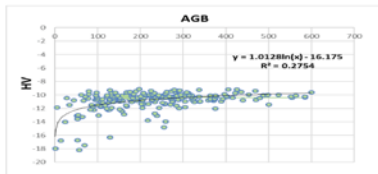

Figure 3: Radar backscatter Saturation

In this study, focus has been given for three different random forest models. Model based on optical data (12 predictor variables), Model based on radar data(22 predictor variables) and model based on combination of radar and optical data(34 predictor variables). Random forest modelling results were taken separately for radar model, optical model and combination of radar and optical model.

AGB Model	Training Dataset			Validation Dataset		
	R^2	RMSE	MAE	R^2	RMSE	MAE
RADAR	0.916	55.125	44.203	0.227	113.787	89.333
RADAR+Optical	0.925	51.78	39.94	0.391	103.523	80.774
Optical	0.905	56.61	43.387	0.443	101.459	78.526

Table 1: Random Forest Results

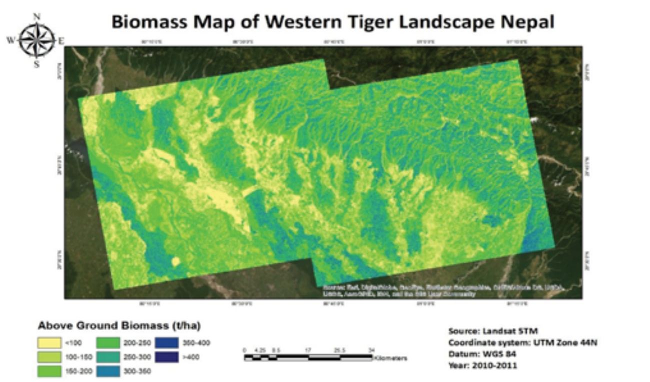

Figure 3: Biomass map from optical model

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Acknowledgement

The ALOS/PALSAR data and the AGB ground truth data was obtained from a JAXA Mini Project 2011-2012 carried out for estimating above ground forest biomass of the Western Tiger Landscape of Nepal in 2011

Ryo Itoh, M2, UTokyo, Japan

Automatic construction technology development & Open innovation for Productivity improvement in Japanese construction industry

Ryo ITOH , Meguro Lab, IIS, The University of Tokyo

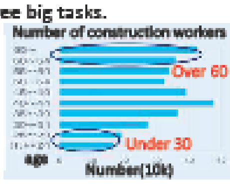
Abstract

In the Japanese construction industry, there is an urgent need to improve productivity through automatic construction technology development in terms of labor shortages and industrial promotion. In this research, the current situation is grasped by interview survey and patent survey. A case study of the automobile industry was conducted as an example of technology development by open innovation. In addition, I surveyed and compared the technological development environments in both industries and the contents of the automated technologies being developed. Finally, I clarified the current tasks in automation technology development in the construction industry. And I proposed the establishment of industry infrastructure as a measure to promote technology development through open innovation. This will promote dissemination to SMEs and participation in technology development by companies in other fields.

Background

In Japanese construction industry, there are three big tasks.

1. Improve labor productivity (2016, MLIT)
   Decrease in construction workers
   Construction demand will be maintained
   Difficulties in new recruits



2. Open innovationin technology development
   Demand for new technology in different fields
   Some projects (e.g. ICT construction machine) are supported by MLIT.
3. Utilization of BIM
   BIM will be used from design to maintenance and is becoming the core of construction projects.

Purpose

1. Identify the Task in automatic technology development
2. Propose an Open-Innovation strategy for automatic technology development

Methodology

Automatic construction technology development

- Contractors Interview → Current situation
- Patent research (Automatic construction technology) → Features*
- Patent research (Automatic driving technology) → R&D Features* (Automatic driving)
- Features* + R&D Features* → Comparison (Automatic technology)

*joint patent, technology type

- Case study (CAD technology development), Patent research (CAD technology), A car manufacture Interview → Open innovation Mechanism (Automotive industry's technology development)
- Literature survey (Contractors' management status) → Features (Construction industry)
- Literature survey (Car manufactures' management status) → Features (Automotive industry)
- Features (Construction industry) + Features (Automotive industry) → Comparison (Industries' R&D)

Interview target
9 technology development managers of 4 major construction companies.
2 technical development managers of a major automotive company.
Patents
122 patents for automatic technology by 4 major general contractors in 2008 ~ 2017.
1,240 patents for automatic driving technology by 3 major car manufactures until 2017.
4 patents for CAD technology by 3 major automotive makers in 2006 ~ 2008.
References
Data in Industrial Property Information Training Center (INPIT), Financial reports of each company, MLIT report, Japan Automobile Manufacturers Association (JAMA) report

Results & Discussion

1. Current situation of technology development

(1) Process & Bottleneck in technology development

Proposal → Selection → Development → Practical realization

1) Finding partners
← Connection to different field companies
Screening new partners
2) Idea of new construction system
← Understanding whole construction system
& Innovative ideas

(2) Current problems

- Intra-industry cooperation ← Rigging, Domestic competition
- Industry-academia collaboration ← Difference in development speeds

2. Features in automatic technology development

(1) Contents of automatic construction technology
Developing the same kind of technology
(2) Technology development progress pattern
1) Remote control of machine → Machine automation,
2) Development of a new work robot

3. Developed technology comparison

(1) Joint development

Company	Construction				Automotive		
	A	B	C	D	E	F	G
Total number of patent	20	38	34	30	918	186	136
Joint patent	3	3	9	9	124	10	2
	15%	8%	26%	30%	14%	5%	1%
Collaboration with university	0	0	0	0	60	3	2
	0%	0%	0%	0%	48%	30%	100%

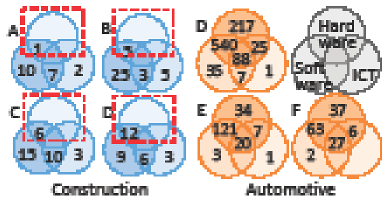
Group companies & universities

Lack of industry-academia collaboration

(2) Developed technology type

The number of each type technologies

Lack of Hardware development



4. Open innovation Mechanism in automotive industry

All automakers worked together to improve industry efficiency and competitiveness in the use of CAD. (2D is from 1998, 3D is from 2006)

Creating Infrastructure
- Set standard specifications — Data sharing; Design specifications for drawings
- ↓ Technology development — ・Error generation verification ・New conversion system ・Long-term data storage methods
- ↓ Making Guidelines

Promote technology development → Technology improvement — Improved Data troubles & Multi-terminal state

Open innovation

Anyone can use → Spreading & Improved competitiveness — Deterred vendors & realized low price

5. Industry features comparison

	Construction	Automotive
Share of major companies	13%	80%
International competition	5-25%	80-90%
R&D expense ratio	0.7-0.9%	3.7-5.2%

Small Share

Low R & D expense ratio

Conclusion

1. Tasks

- Promoting Hardware development
- SME's Cooperation
  Need to create an environment that SMEs can use.
- Make the incentive for cooperation

2. Strategy

Step1. Creating Standard specifications of 1) Robot management system, 2) Construction robot, 3) BIM data

Step2. Creating standard specification technology (robot / system) Model

Step3. Develop standards-based technology | Creating Guidelines for using standards-based technology
+ Develop standard conformity judgment system

Goal: Major companies develop New Automatic construction system | Manufacturers develop Robots

Future Work

- Evaluation of technology development in bidding system and construction cost
- BIM utilization level in the world

Sudan Pandey, AIT, Thailand

Wind Tunnel Testing

Sudan Pandey

Master in Structural Engineering, Asian Institute of Technology (AIT)

8th Joint Student Seminar on Civil Infrastructure

12-13 September 2019

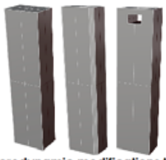
Asian Institute of Technology, Thailand

Abstract

This poster presents an overview of wind tunnel testing. Wind loads provided in most codes and standard are for regular shape buildings in an isolated case and include many assumptions. In practical, wind loadings are influenced by several factors namely building shape, terrain effect, surrounding structures, etc. The results obtained from wind tunnel study incorporates the effects of building shape, complex terrain, surrounding structures, and wind directionality, which results in the accurate results with minimum assumptions than the loading obtained from the international codes, therefore wind tunnel testing is necessary. The saving on the structure and cladding cost can be achieved from wind tunnel study. Wind tunnel study can be done for various purposes like; wind loads for structural design, serviceability check, and cladding design. Wind tunnel testing is also useful to study the effect of the structure on the wind environment of surroundings. Different techniques are developed over the years for wind tunnel testing. This poster presents a brief introduction to different wind tunnel study.

Why Do Wind Tunnel Testing?

Proposed development in two different surrounding scenarios



Aerodynamic modifications to rectangular building shape

- Accurate wind loads to minimize assumptions
- Significant savings in cost of structure and cladding
- Assurance of the results
- Facilitates wind response suppression study
- Environmental impact assessment

Wind Tunnel Testing

Overall structural wind load study

- Fluctuating wind loads can be measured either by high frequency force balance (HFFB) or high frequency pressure integration (HFPI) techniques.

Cladding Pressure study

- Local wind-induced pressures can be directly measured from the test and it will be represented in the form of pressure contour to assist façade engineer in design.

Environmental wind study

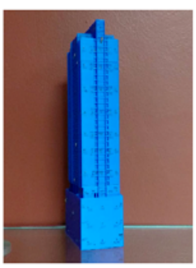
- The pedestrian comforts at key areas such as walking, entrances, recreational areas can be evaluated by integrating local wind models with wind tunnel results.

Overall Wind Load Study

Force balance model

High Frequency Force Balance

- The fluctuating wind loads are measured using force balance in terms of the base shear forces, base bending moments and base torque (Fx, Fy, Mx, My, and Mz).
- Mode of vibration of the building must be linear with the height.
- Assumed wind load distributions.

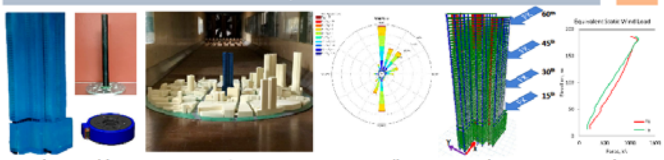


Pressure model using rapid-prototype technique

High Frequency Pressure Integration

- Pressure on the surface of the model can be measured simultaneously. These measured pressures can be integrated to obtain the loads on the building.
- Distributions of wind load can be directly obtained from the measurement.
- Capable for non-linear mode of vibrations.

Overall Wind Load Study

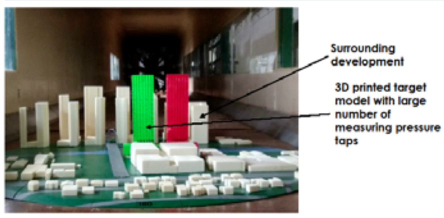


a) b) c) d) e) g)

a) High density foam target model made by using CNC technology
b) Carbon fiber sting and multi axis force sensor
c) Setup for HFFB test in wind tunnel
d) Wind rose showing the wind climate at the proposed site
e) Application of wind load in commercial software like ETABS
f) Time history point loads at different elevations
g) Equivalent static floor by floor wind loads

f)

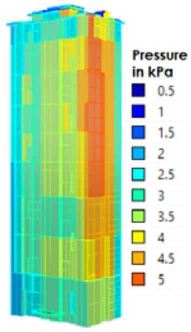
Cladding Pressure Study



Pressure model with surrounding buildings

Pneumatic tubes connected to pressure model

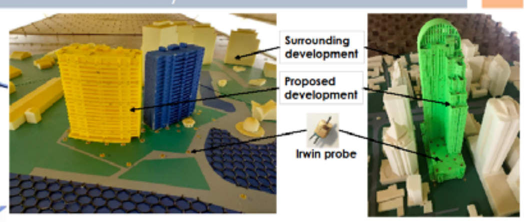
Pressure sensor



Peak positive net pressure for cladding design

The cladding pressure on façade can be measured in wind tunnel and scaled to full scale pressure after combining with the local wind climate.

Environmental Wind Study



Wind environment assessment using Irwin probes

- Wind speed at pedestrian height can be measured in wind tunnel to assess the wind environment around the proposed development in terms of pedestrian comfort and safety.

Conclusion

- Various kinds of tests and study related to wind speeds and wind loadings can be conducted in wind tunnel facility.
- Effects of different aerodynamic modifications can be studied.
- Wind tunnel testing provides the accurate wind loads with minimum assumptions.
- Wind tunnel testing provides economic results.

Further information, please contact at : pdy_sdn14@gmail.com

Shashika Atapattu, AIT, Thailand

Application of Numerical Modelling to Predict the Lateral Deformations caused by Vacuum Preloading

Shashika Atapattu - Master's Student, Geotechnical & Earth Resources Engineering (GTE), AIT
Dr. Geoff Chao, Dr. Suttisak Soralump - Research Supervisors

INTRODUCTION

Vacuum preloading is an efficient and cost effective technique for soft soil stabilization. Radial consolidation through prefabricated vertical drains (PVD) and vacuum suction, results in isotropic deformations. Due to these isotropic deformations, tensile stresses will develop and tension cracks at the ground surface could appear. These induced tensile stresses are a potential threat to existing structures, hence the application of this method is limited in such situations. This study will focus on the application of numerical modelling to investigate this effect.

Vacuum preloading often applied together with surcharge preloading. Surcharge preloading will cause outward lateral movements while vacuum preloading will cause inward movements. Therefore, according to various studies (*Mersi & Khan (2012), Chai et al. (2005), Ong & Chai (2011)*) following factors influence the lateral deformations;

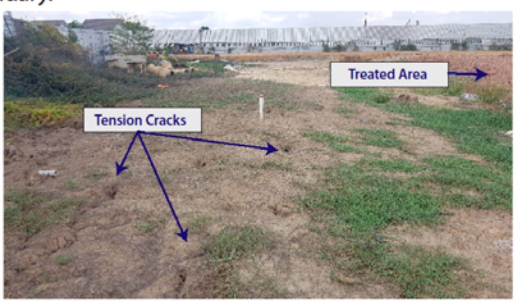
- Soil properties: c_c, c_v, s_u, k_v, k_h
- Stress state: Lateral stresses
- Loading conditions: Ratio of surcharge load to vacuum load, Surcharge loading rate
- PVD Length

Summery of the analytical and emperical methods to predict lateral deformations due to vacuum preloading;

Method	Description	Limitation
Imai et al. (2005)	Analytical solution based on elastic theory	Not applicable for combination of surcharge and vacuum preloading
Chai et al. (2005)	Analytical solution based on elastio-plastic theory	Not applicable for combination of surcharge and vacuum preloading
Chai et al. (2013)	Empirical solution, Applicable to vacuum + surcharge	Cannot predict lateral deformations influence zone
Liu et al. (2018)	Analytical soulution to obtain lateral beformations along influence zone	Not applicable for combination of surcharge and vacuum preloading

SITE DESCRIPTION

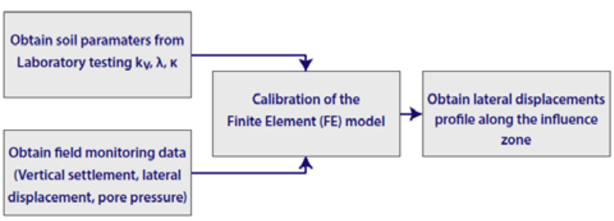
Site is located in Bangkok, where vacuum preloading technique is applied to improve approx. 20 m deep soft clay layer ($s_u \approx$ 2 ton/m^2). During vacuum preloading tension cracks were observed up to a distance around 20 m from the boundary.



NUMERICAL MODELING

Numerical modelling was done using GeoStudio SIGMA/W software package with "Coupled/PWP" analysis. Plane strain modelling was performed, using the equivalent plane strain approach to model radial consolidation by *Indraratna & Redana (1997)*.

Methodology



Modeling Technique

PVDs were modelled as a boundary condition, and vacuum pressure is applied as a negative water pressure head. Vacuum pressure of 90 kPa was applied in the field with PVD length approx. 16 m. Smear effect and vacuum loss with depth were considered in the model.

Equivalent Plane Strain Permeability, k_{hp} (*Indraratna & Redana, 2000*)	$\frac{k_{hp}}{k_h} = \frac{0.67}{[\ln(n) - 0.75]}$; $n = \frac{\text{PVD Spacing}}{\text{PVD Thickness}}$
Modelling of Smear Zone	Calculating the equivelent horizontal permeability of undisturbed soil and smear zone
Distribution of Vacuum Pressure with Depth (*Indraratna et al., 2005*)	Trapezoidal vacuum pressure distribution with depth

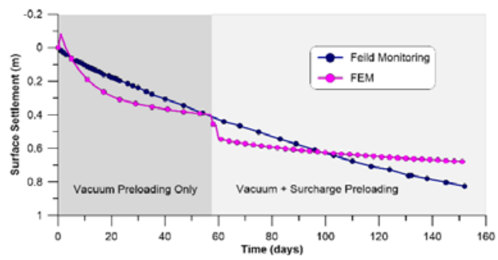
Soil Properties

Soil Type	γ_t (kN/m3)	OCR	λ	κ	ø	k_h (cm/s)
Medium Soft Clay (0 - 2 m)	17	2	0.33	0.07	30°	1.7×10^{-9}
Very Soft Clay (2 - 20 m)	14.6	1	0.17	0.017	23°	3.9×10^{-10}

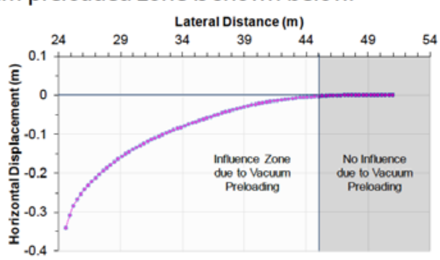
Construction Sequence

Results

Suraface settlement; Comparission between FE results and actual field measurements is shown below.



Horizontal displacement profile along the lateral direction of the vacuum preloaded zone is shown below.



DISCUSSIONS

- Surface settlements obtained from the FE analysis matches reasonably with the actual field measurements. Therefore, this shows that, "Coupled/PWP" analysis in SIGMA/W can be used to predict deformations due to vacuum preloading.

- From the horizontal displacement profile, it can be seen that, horizontal displacement becomes zero at 45 m from the center of the embankment (embankment width is 24 m). Therefore, influence distance due to vacuum preloading is 45 – 24 = 21 m. In the actual field condition, farthest tension crack was observed at 20 m.

- Further studies will be done to eshtablish a design chart to obtain the influence distance of vacuum preloading. PVD length and Ratio of surcharge loading to vacuum load will be considered as variables.

Terdkiad Nontapot, AIT, Thailand

Time-Lapse Electric Imaging Investigation of Seawater Intrusion in Laboratory Scale

Terdkiad Nontapot
Manager of Asian Center of Soil Improvement and Geosynthetics,
Asian Institute of Technology
Contact: n.terdkiad@gmail.com

Introduction

Coastal aquifers are precious freshwater storage, which is susceptible to seawater intrusion that refers to the movement of seawater in subsurface due to land-use change, groundwater pumping, climate variations, and sea-level fluctuations. In coastal aquifer where freshwater is contaminated with seawater, corresponding to freshwater, seawater, and freshwater-seawater mixing zones may have different electrical resistivity. Therefore, time-lapse electric imaging has been widely used to monitor the movement of salinity change interface in the coastal aquifer at elapsed times.

Electric imaging in the laboratory scale has been studied by many researchers. However, the finite scale of laboratory affects resistivity results. Therefore, researchers have purposed a method of correction, which can terminate the scale effect on resistivity results. The correction method by using RES3DMOD software is one of the correction methods that has been studied and shown that this method is suitable to use for correction of resistivity results in a laboratory-scale investigation. RES3DMOD can generate the synthetics apparent resistivity that occurs when the effects of laboratory-scale are corrected. The measured apparent resistivity was corrected by using the correction factor as follow

$$K_c = \frac{\rho sd}{\rho syn}$$

Where

K_c = Correction factor
ρ_{sd} = Resistivity of material
ρ_{syn} = The synthetic apparent resistivity from simulation

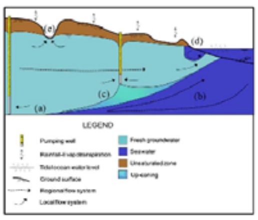


Figure 1 Simplified diagram of a shallow coastal unconfined aquifer (Werner et al., 2013).

Objective

To investigate seawater intrusion in laboratory scale by using time-lapse electric imaging method.

Methodology

The Flow chart of the methodology is shown in Figure 2. A tank model was constructed to measure the mixing zone by time-lapse electric imaging. Fine to coarse sand was filled into a box of 50×100×100 cm. (Figure 3). The sand aquifer was saturated by tap water in 24 hours. After aquifer was saturated, 10,000 mg/L solution of saltwater and 200 mg/L of food color, was injected to soil aquifer. Electric imaging was measured every one hour with 12 electrodes and Wenner array configuration, using the SYSCAL R1 Plus. The measurement was corrected by a 3D forward modeling method.

Time-Lapse Electric Imaging
Non-corrected resistivity value
↓
Core sample measurement
Sample resistivity (Real resistivity)
↓
Determine correction factor
↓
Resistivity correction
↓
Resistivity inversion

Figure 2 Methodology of the study

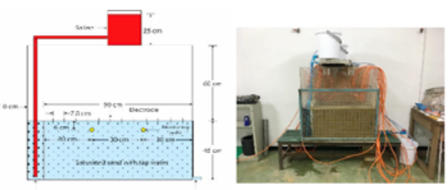


Figure 3 Measured tank for the study

Results

Figure 4 presents the movement of saltwater in the laboratory box. At the initial stage, it is saturated by tap water that saltwater has not been injected to an aquifer. After one hour of injection, the saltwater wedge can move with five cm. at the bottom, while after six hours of saltwater injection, it arrives at 6 cm. at the top, 17.5 cm. at the middle, and 37.5 cm. at the bottom. Moreover, after 20 hours of saltwater injection, it reaches 8 cm. at the top, 40 cm. at the middle, and 80 cm. at the bottom.

Time-lapse resistivity results of laboratory model after applying correction are shown in Figure 5. At the initial stage, resistivity section demonstrates 69 Ωm to 105 Ωm. of resistivity value on the left side of the section, while 159 Ωm to 177 Ωm is displayed on the right side of the section. This resistivity result conforms to resistivity value of the water-saturated sand sample with 97.24 Ωm Resistivity result after one hour of saltwater injection represents the movement of low resistivity value (50 Ωm). After 6 hours, resistivity can detect some contamination that presents low resistivity value (33 to 69 Ωm) at the left side. After 20 hours, it demonstrates low resistivity value (33 to 69 Ωm) at the left side of a box, the movement distance is larger than the resistivity result of 6 hours. Besides, high resistivity value is presented between 25 to 38 cm., it demonstrates dry aquifer that is affected by groundwater collection for fluid conductivity determination. Figure 6 shows the percentage change of resistivity measurement.

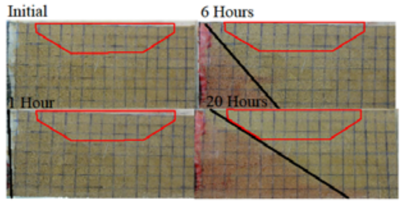


Figure 4 Visual observation of saltwater movement

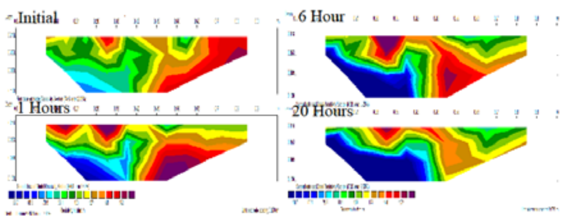


Figure 5 Electric imaging results

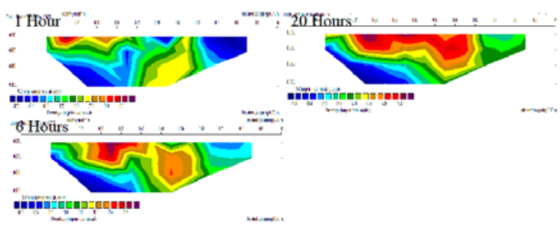


Figure 6 Percentage change results of resistivity

References

Giao, P., Chung, S., Kim, D., & Tanaka, H. (2003). Electric imaging and laboratory resistivity testing for geotechnical investigation of Pusan clay deposits. *Journal of Applied Geophysics, 52*, 157-175

Werner, A. D., Bakker, M., Post, V. E., Vandenbohede, A., Lu, C., Ashtiani, B. A., et al (2013). Seawater intrusion processes, investigation and management: Recent advancesand future challenges. *Advances in Water Resources, 51*, 3-26.

Acknowledgement

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Takumi Fujiwara, D1, UTokyo, Jpan

Remote sensing of environment and disaster laboratory

Institute of Industrial Science, The University of Tokyo, Japan

Assessment of shadow index using a ray tracing based on a voxel model on forest structure

Takumi Fujiwara・Wataru Takeuchi

IIS, The University of Tokyo

Abstract: Nowadays, many vegetation indices have been developed to monitor Earth environment. However, few indices show forest structure. One of the indices to estimate forest structure is shadow index (SI). To evaluate the accuracy of SI and inversely estimate radiant emittance, models that can represent the complexity of forest structure are necessary. So we focused on a voxel model which can represent complex structures of a forest. In this research, we developed a ray tracing method using a voxel model. The target of simulation was Sentinel-2 images. Firstly, point cloud of a test forest area was acquired. Then, the point cloud was voxelized. Next, shadow and shade values were calculated in each voxel. Finally, SI was simulated from the voxel model (SIV) and compared with Sentinel-2-derived SI. From the result of correlation analysis of SI and SIV, SI performs well where the forest structure is complex. The result shows that the voxel model is useful for investigating the relationship between vegetation indices and forest structure. Our method can also apply to estimating three dimensional structures from satellite images.

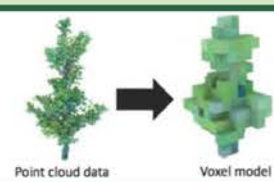
Keyword: Forest, 3D model, Shadow proportion, Inverse estimation

BACKGROUND: To understand the carbon cycle, many research using satellite imagery has been done. However, satellite imagery has limitations in observation time or view angle. If we got a 3D model of a forest, we can simulate various Sun-Target-Sensor-Geometry, which allows us to carry out various analyses with improved accuracy.

OBJECTIVE: As an application using a 3D model, we clarify sensitiveness of shadow index.

VOXEL MODEL

Voxel model is suitable for estimating the 3D structure of forest. The model is discrete 3D space with elements that contain attribute data such as leaf area or stem volume.



DEVELOPMENT OF A RAY TRACING

Simulation processing flow

Acquired point cloud (SfM from aerial images) → Voxelization → Calculate L_{dir} and L_{dif} using SMARTS (Simple Model of the Atmospheric Radiative Transfer of Sunshine)

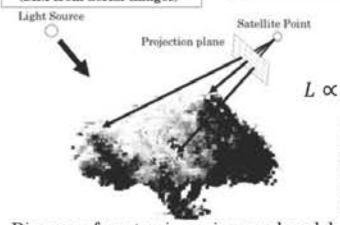


Diagram of ray tracing using voxel model

$$L \propto L_{dir}(1 - Shadow) + L_{dif}Shade \quad \text{(Eq 1)}$$

- L : Luminance
- L_{dir}: Direct normal irradiance
- L_{dif}: Diffuse horizon irradiance
- Shadow : Direct normal radiant emittance
- Shade: Diffuse horizon radiant emittance

Validation of the ray tracing accuracy

Evergreen broad-leaved forest

Target image

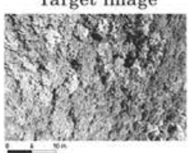
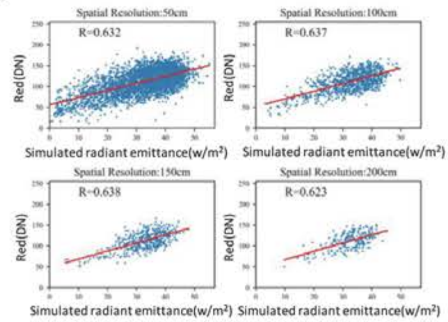


Image simulated



Evergreen needle-leaved forest

Target image

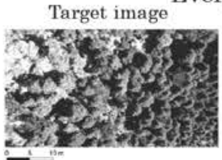
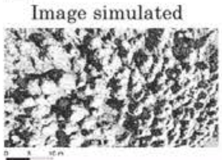
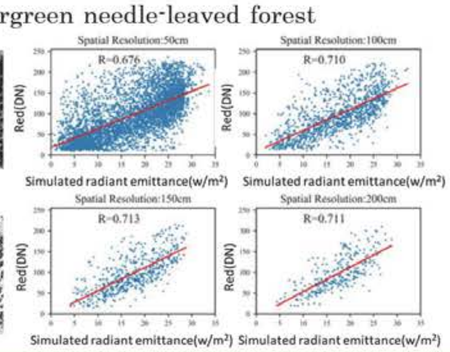


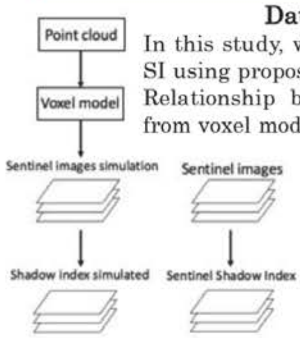
Image simulated





ASSESSMENT OF SHADOW INDEX

Data processing flow



In this study, we assessed Sentinel-2 imagery SI using proposed method. SI defined as Eq 2. Relationship between SI and SI simulated from voxel model (SIV) was examined.

$$SI = \frac{1}{\frac{1}{N}\sum_{j=1}^{N} r_j} \quad \text{(Eq 2)}$$

Here, r_j is the apparent reflectance of band i and N is the number of bands.

Test area

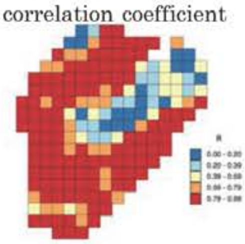
Date of Sentinel imagery used

Date	Sun Azimuth	Sun Zenith	R
2018/1/24	157.11	56.428	0.360
2018/2/23	152.36	47.85	0.431
2018/3/10	150.09	42.308	0.457
2018/4/19	141.9	27.459	0.540
2018/5/19	130.414	20.128	0.568
2018/5/24	128.168	19.464	0.590
2018/7/13	121.592	20.219	0.604
2018/8/17	136.751	26.168	0.544
2018/10/21	161.830	46.214	0.428
2018/11/25	164.412	56.104	0.336
2018/11/30	164.242	57.069	0.324

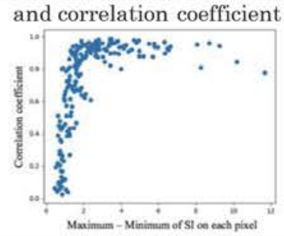
Result of correlation analysis of SI and SIV

SI is dependent on the roughness of a forest surface. From the two figures below, it was found that correlation coefficient was over 0.8 when the difference of maximum and minimum of SI in year was over 2.

Distribution of correlation coefficient



Relationship of the difference of max and min of SI in year and correlation coefficient



CONCLUSION AND FUTURE TASK

- Using the proposed ray tracing, we can expect inverse estimation of various vegetation indices as well as SI.
- My future task is estimate 3D model from satellite imagery for various analyze global scale.

For further details, contact: Takumi Fujiwara, Bw-601, 6-1, Komaba 4-chome, Meguro, Tokyo 153-8505 JAPAN (URL: http://wtlab.iis.u-tokyo.ac.jp/ E-mail: ftakumi@iis.u-tokyo.ac.jp)

Phruck Chansukho, AIT, Thailand

Development of Tuned Mass Damper Using Multi-Stage Steel Laminated Rubber Bearings

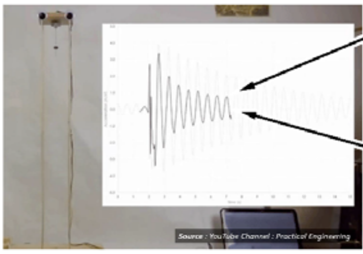
Phruek Chansukho*, Pennung Warnitchai**
*Graduated Student in Structural Engineering, Asian Institute of Technology (AIT)
**Professor in Structural Engineering, Asian Institute of Technology (AIT)

8th Joint Student Seminar on Civil Infrastructure
12-13 September 2019
Asian Institute of Technology, Thailand

Abstract

This poster presents the dynamic behavior of Tuned Mass Damper (TMD) made of a rigid mass placing on multi-stage steel laminated rubber bearings. It is possible to design this type of TMD to be very massive (several hundred tons or more), very long natural period (several seconds), very deformable (several meters of lateral displacement) and yet very compact, making it ideal for suppressing the dynamic response of large civil engineering structures such as tall buildings. In this study, a lab-scale prototype of TMD with 2-ton mass and natural periods of 0.71 sec is tested by using a small shaking table. Under simple harmonic table motions with a constant displacement amplitude and varying frequencies, the TMD exhibits an unsymmetrical resonant curve with peak leaning toward lower frequency. This nonlinear resonant response behavior can be very well predicted by a nonlinear SDOF model with softening stiffness, which is represented by the well-known Duffing equation. This softening behavior is an important aspect of this type of TMD since its effective use depends on the tuning of TMD's effective natural period to that of the structure.

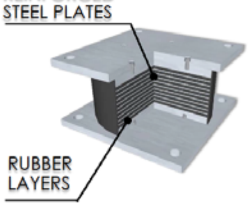
Demonstration of Tuned Mass Damper (TMD)



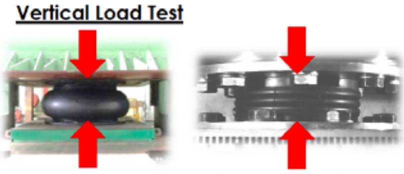
Response of structure without TMD

Response of structure with TMD

Rubber Bearings



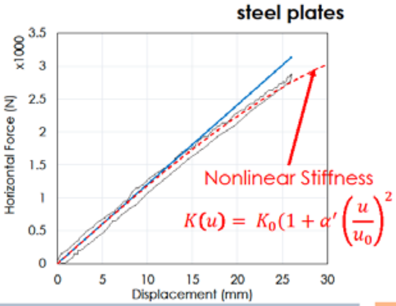
Vertical Load Test



Pure Rubber **Rubber with reinforced steel plates**

Horizontal Load Test

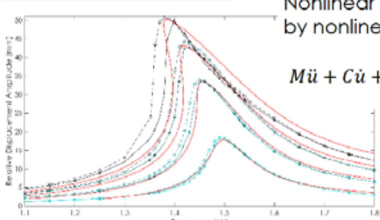
High Horizontal Deformabi



$$K(u) = K_0\left(1 + \alpha'\left(\frac{u}{u_0}\right)^2\right)$$

Dynamic Properties of This TMD

Harmonic Excitation Test

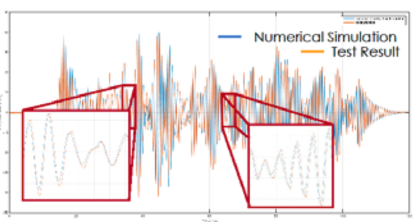


Nonlinear Softening Effect is predicted by nonlinear equation of motion

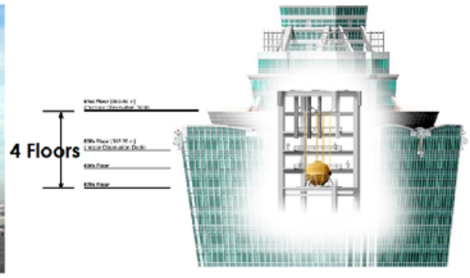
$$M\ddot{u} + C\dot{u} + K_0\left(1 + \alpha'\left(\frac{u}{u_0}\right)^2\right)u = -M\ddot{u}_g(t)$$

Damping Ratio $\cong 2 - 3\%$

Numerical Simulation vs Test Result Under Narrowband Random Excitation

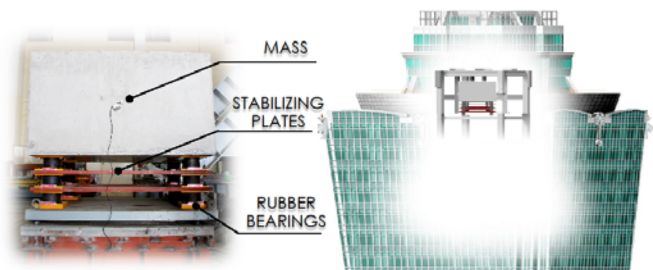


Tuned Mass Damper (TMD) in Real Application



Taipei 101 Building **TMD in Taipei 101**

TMD with Multi-Stage Rubber Bearings

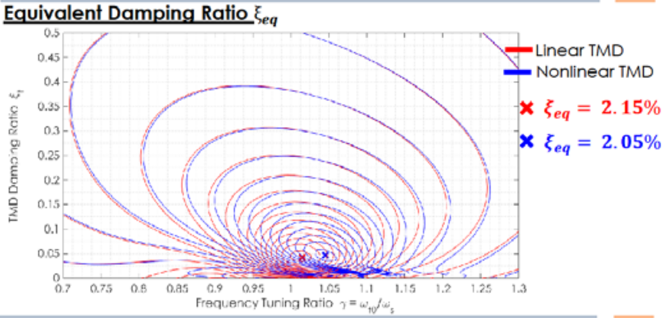


TMD with Multi-Stage Rubber Bearings

Advantages
- **Compact Design (Less Space Consumption)**
- **Can Carry Huge Mass**
- **High Horizontal Deformability**

Effectiveness of This TMD

Equivalent Damping Ratio ξ_{eq}



Conclusion

- This type of TMD has **a nonlinear stiffness softening effect**
- A mathematical model of TMD which accounts for the nonlinear effect was **developed**
- The model can **accurately predict** the behavior of TMD under various dynamic excitations
- The control effectiveness of a nonlinear TMD is similar to that of a linear TMD, but optimal tuning ratio is different due to **the shifting resonant frequency.**

Further information, please contact at : phruek_c@outlook.com

Nattapon Trumikaborworn, AIT, Thailand

Developing of Multi Agent Simulation for Disaster Management : A Case Study of Tsunami Evacuation at Khao Lak, Thailand

Nattapon Trumikaborworn(1) ,Panon Latcharote(2), Pennung Warnitchai(3)

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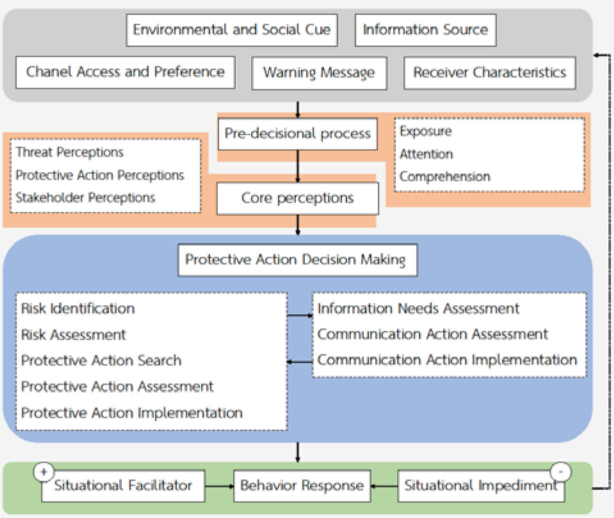
(3) Professor, Dept. of Civil and Infrastructure Engineering, Asian Institute of Technology, Thailand

8th International Joint Student Seminar on Civil Infrastructures, 12-13 September 2019, Asian Institute of Technology, Thailand

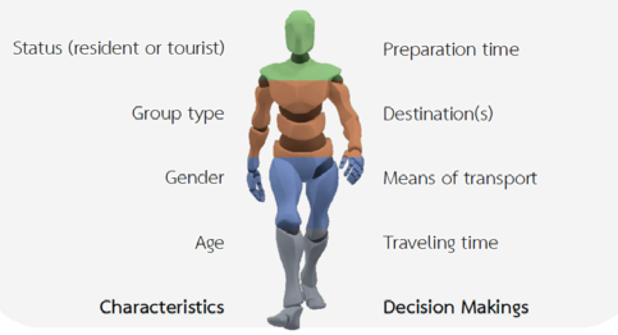
Abstract

Saving life from a tsunami mainly depends on effectiveness of early warning system and evacuation measures, known as evacuation system. The effectiveness of the system could be reduced due to lack of proper evaluation and maintenance process. Currently, Thai government agencies, private sectors and local communities practise tabletop exercises and drills to evaluate and maintain the effectiveness of the system and their evacuation plan. Two challenges have been highlighted in this research including 1) how to evaluate and identify effective evacuation measures by using a computer simulation and 2) how to rise people awareness on tsunami response by using a computer game. We select Khao Lak in Phang Nga province, Thailand as a study case because this area has a very high exposure and vulnerability to the tsunami. Conducting the current practices might not be sufficient to ensure the successful evacuation process for this area. Therefore, we are developing a computer simulation as an alternative tool for evaluating and identifying effectiveness of evacuation measures. To achieve a practical simulation tool, multi-agent simulation is customized and applied using the actual conditions of the study area. Variety of population is modeled individually called an agent, which is differentiated by living status (i.e., resident or tourist). This results in variety of decision makings in the simulation prior to different combination characteristics of an agent. As simulation results, the estimated casualties and sensitive parameters, will be used to identify effective evacuation measures of the area. The later, simulation will be developed to be a computer game for raising awareness of the player similar to participate in the tsunami evacuation drill.

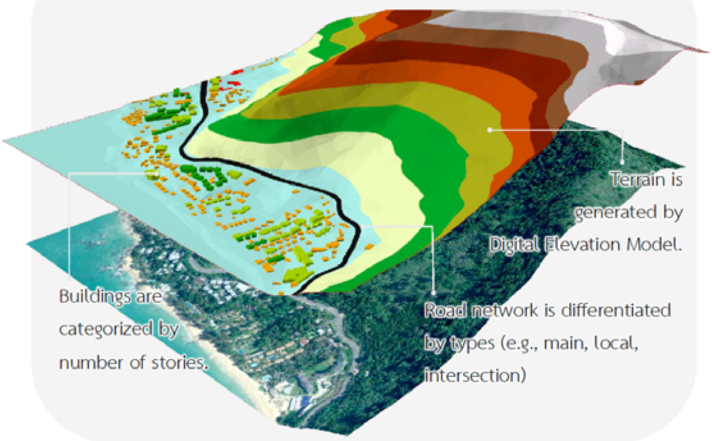
Agent Logics



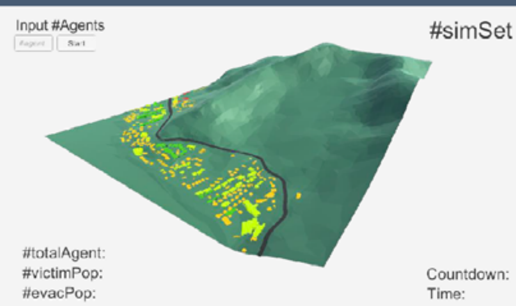
Multi Agent



Geospatial Data to 3D Model as Environment of the Simulation



Tsunami Evacuation Simulation



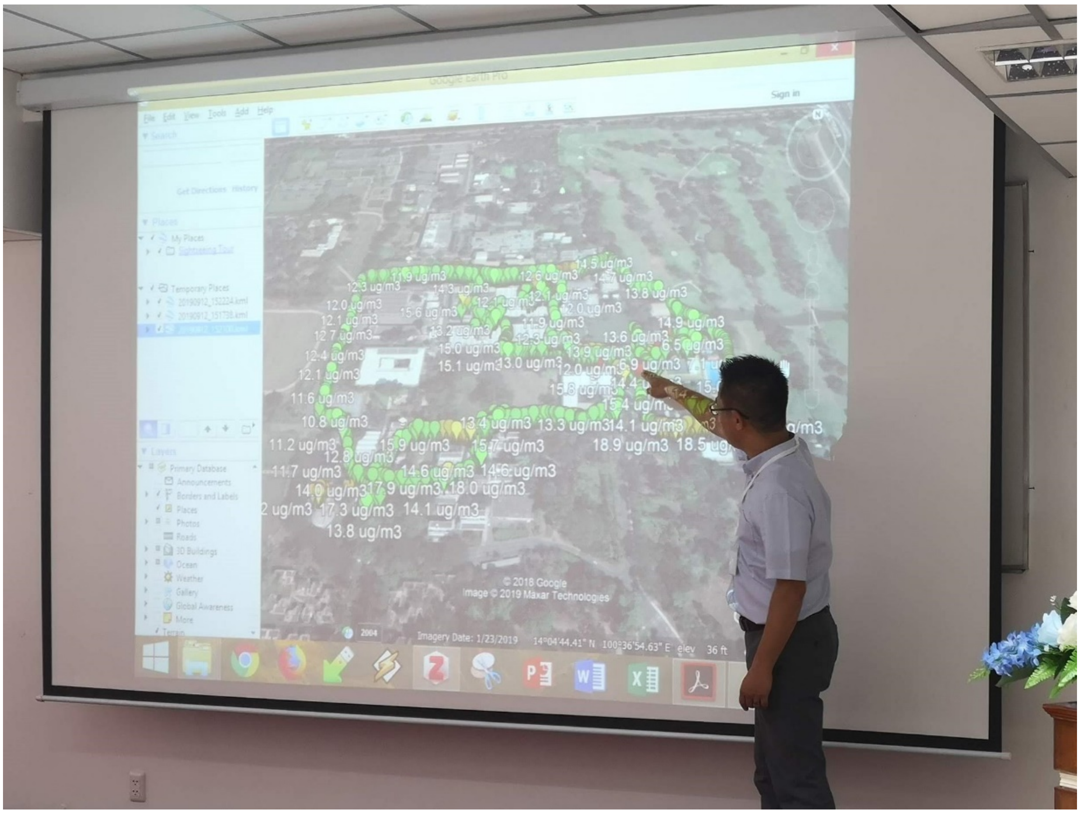
Tsunami Evacuation Game

Further information, please contact at: nattapon.trum@gmail.com

Group photo of participants

- **Training**

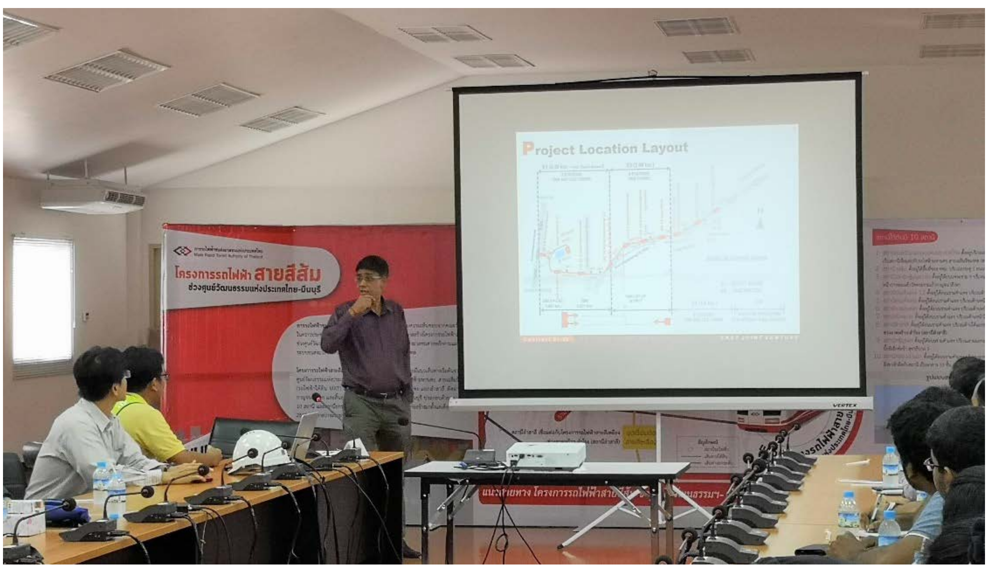
Title:
Hands-on-training for PM2.5 monitoring with portable devices in AIT campus
Prof. Wataru Takeuchi (IIS, Utokyo, Japan)



- **Field Trip**

MRT construction site

Dr. Pastsakorn K. - Deputy Design Manager AGATE Consultants



Beni M. Lekhak - Engineering Manager CKST

Group photo of participants at MRT

Group photos of participants at Palace

・Students Report

Report from Geoinformatics Center Visit and International Student Seminar

Nuntikorn Kitratporn D1, The University of Tokyo, Japan

Objectives

1. To visit Geoinformatics Center (GIC) at Asian Institute of Technology (AIT)
2. To present at the *8th International Joint Student Seminar on Civil Infrastructures*

Activities achieved during the visit

• On 10th September 2019, Ms. Nuntikorn visited GIC at AIT and presented research findings. She also received briefing on UAV building and GIC projects

• On 11th September 2019, Ms. Nuntikorn received training on drone operation by GIC staffs and joined data collection at Rama 2 expressway construction site

Fig 1: Research Presentation at GIC (left) and field visit at Rama 2 Expressway (right)

● On 12-13 September 2019, Ms. Nuntikorn attended the *8th International Joint Student Seminar on Civil Infrastructures*

a. On 12th, in the morning she attended special lectures on big data application for infrastructure monitoring and decision optimization. In the afternoon, she presented in poster presentation and participated in student workshop collecting pm2.5 data using portable sensors. We were able to map level of pm2.5 in AIT campus.

b. On 13th, she visited MRT orange line construction site and learned about various tunneling/construction process, such as building underneath expressway, and building through different soil profile across Chao Praya river. We went down to one of the to-be-station, observed the entrance of tunnel boring machine (TBM) and talked to experts on the site.

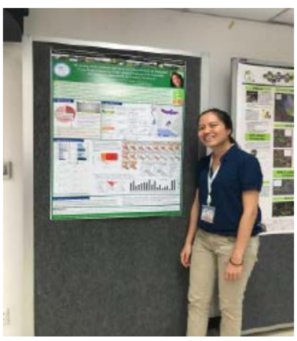


Fig 2: Poster presentation (left), pm2.5 workshop (center), and MRT construction site visit (right)

Report on 8th Joint Student Seminar on Civil Infrastructures

Takahiro Yamaguchi, D1, The University of Tokyo, Japan

8th Joint Student Seminar on Civil Infrastructures was held on 12th September at Asia Institute of technology (AIT) in Bangkok, Thailand. I am a Ph. D. student at Mizutani Lab., IIS and attended the conference. After the poster presentation, I had many discussions with Thailand and Myanmar university students about the research. Before the conference, I designed the poster for the first time. Research topic is about my doctoral thesis theme, subsurface utility pipe detection by ground penetrating radar and deep learning approach. Because of the space limitation, it is a good chance for me to learn how to construct research poster. About discussion, some presentations focus on remote sensing image analysis by neural network and geotechnical infrastructure water sensing by electrical method. These research shares the same theoretical background as my research topic. Therefore, it is interesting for me to discuss about the challenge and idea of the research.

Other than poster session, Prof. Mizutani and Prof. Honma offer their research topics. Prof. Kishi and professors from AIT and faculties from JAXA and JSPS provide presentations about their organizations and histories. It is a rare experience to discuss about transportation network theory and resilience with Prof. Honma. After poster session, Prof. Takeuchi introduces PM2.5 measurement and conduct demonstration in campus. Tomorrow morning, we visit construction site of underground railway tunnels. We learned social challenges and culture in Thailand. There are many foreign students in AIT mainly from India and other southeast Asian countries. It is a precious time to know each other and talk with them about research and lives in the university abroad.

Seminar Report on 8th Joint Student Seminar on Civil Infrastructures

Takumi Fujiwara, D1, The University of Tokyo, Japan

On 12th, in the morning, professor session was held. Firstly, the topics were big data analysis and operations research. The topics of big data analysis was detecting the pipe buried in ground using a remote sensing technology such as radar or laser. The content was interesting because it was related for my research topic. After that, Sentinel-Asia and research opportunities was introduced from Japan Aerospace Exploration Agency(JAXA) staff and Japan Society for the Promotion of Science(JSPS) staff respectively. The introduction of Sentinel-Asia was precious opportunities to knowing recent situation for international cooperation project in Asia. In the afternoon, Student poster session was held. I presented my master research. The number of presenter was about 20 people and not only AIT student but also student came from another country mainly in Asia. It was inspiring for me to know research topics of students of the same age.

On 13th, I visited in MRT orange line construction site and learned about various tunneling/construction process. I received explanation about tunnel boring machine (TBM).

Report on 8th Joint Student Seminar on Civil Infrastructures

Atsushi Shirahama, D1, The University of Tokyo, Japan

8th Joint Seminar on civil infrastructure was the first poster session for me as a presenter. It was so amazing opportunity to discuss across different topics and studies with most intelligent students from all around Asia. In addition to that, we also learned a lot from presentation of professors and their comments which opened our eyes to next step.

I`m sure that this opportunity enhance student`s motivation and my future decision toward new perspectives. I discussed with international students not only in sessions but also during lunch time and dinner time and found that most important things in communication is to respect different norms and way of thinking. Even after I came back to Japan, I still text to some of them who I met in seminar. Even I have been to Thailand twice as a tourist before, this experience in AIT was so impressive for me.

For other students, I highly recommend this great opportunity to bring you next stage.

Report on 8th Joint Student Seminar on Civil Infrastructures

Ryo Ito, M2, The University of Tokyo, Japan

There are three main things I got through this seminar.

First, I experienced the first poster presentation in English. I re-published the theme that I dealt with in my graduation research. Since I changed my laboratory in the master's program, this theme has been continued up to now, apart from my degree studies. I haven't had the opportunity to present this research since graduating, so I was very thankful. Also, because it was in a poster format, it was possible not only to update the content when graduation presentation, but also to reorganize it into a different format, so that the research content could be reorganized and the understanding was deepened. Although this was my first experience overseas in English, this experience has lowered my psychological hurdles for future participation in conferences and research presentations overseas.

Second, I interacted with professors and students in other laboratories in ICUS, including U-Tokyo. This raised my feelings for research and overseas activities. I heard about various topics, such as research and future careers, and exchanges.

Finally, I visited Thailand for the first time. During this stay, I observed the surroundings of Bangkok. It was very interesting because it was also different from other Asian countries that I visited. Roads are distinctive. Urban areas have very tall expressways. In contrast, the suburbs are very flat, with highways and ordinary roads running side by side. There were very few intersections and traffic lights, and I thought that in Thailand the flow of transit traffic was more important than regional traffic and segmentation. When visiting individually, public transportation such as railroads will be used, so it was also a valuable experience to have been able to visit mainly using road traffic.

Report on 8th Joint Student Seminar on Civil Infrastructures

Asian Institute of Technology, Thailand

On 12 September 2019, Mr. Nattapon Trumikaborworn, Mr. Phruek Chansukho, and Mr. Sudan Pandey attended *8th International Joint Student Seminar on Civil Infrastructures*
Mr. Nattapon presented his poster entitled “Developing of Multi Agent Simulation for Disaster Management: A Case Study of Tsunami Evacuation at Khao Lak, Thailand”. He received comments and discussed with the audiences about his poster, for example, how can this simulation be applied to other emergency responses. An audience also stated that a mobile game would be a good idea to raise awareness of players about evacuation process. Even though the simulation can recommend solutions for evacuation measures for the study area, it is another challenging step to implement the solutions practically to the community.

Mr. Phruek Chansukho gave a brief presentation on his poster of “Development of Tuned Mass Damper Using Multi-Stage Steel Laminated Rubber Bearings”. During the discussion phase in the presentations, some interested audiences came and ask for deeper information of this research. The example of questions are; how does Tuned Mass Damper (TMD) work to suppress the floor acceleration of tall buildings? What are the differences between this TMD using multi-stage rubber bearings and traditional pendulum TMD? After audiences understood the mechanisms of TMD and the considerable advantages from this newly developed TMD, all of them agreed that this innovation is beneficial to structural engineering society.

Mr. Sudan Pandey
Mr. Sudan explained the different procedures of wind tunnel testing that are being conducted in AIT-TU wind tunnel. The title of his poster is “Wind Tunnel Testing”. Mainly, he illustrated the three different tests: High Frequency Force Balance test for the overall wind load test, pressure test for cladding design pressure, and wind speed measurement for pedestrian level wind assessment. During the discussion phase, different questions were raised. Some of the questions were, why do we need to do wind tunnel testing? Why there are different kinds of tests and how they are conducted? Few audiences also raised the question about the material used to make the scaled-down model of the structure and they were amazed to know that the pressure models were printed by 3D printer in AIT Solutions. After explaining the overall procedure of different wind tunnel testing, their necessity, and the advantage of doing wind tunnel testing, audiences understood the importance of wind tunnel testing.

Summary Report for the 8th International Joint Student Seminar on Civil Infrastructure

Terdkiad Nontapot

Objective

To present research poster at the 8th International Joint Student Seminar on Civil Infrastructure

Summary of activities

On 12th September 2019, I attended the lecture in a topic of big data application for infrastructure monitoring and decision optimization. In afternoon session, I presented a research poster in a topic geophysical investigation at a coastal site in Phuket, Thailand. Besides, I have a chance to participated a workshop for PM 2.5 monitoring around AIT campus.

Summary of the research poster

Coastal aquifers are precious freshwater storage, which are susceptible to seawater intrusion that refer to movement of seawater in subsurface. The deleterious effect of seawater intrusion is reduction of available freshwater reserve. Additionally, contamination of freshwater in coastal aquifer normally occur, thereby one percent of seawater result in freshwater unfit for drinking. To design method of protecting seawater intrusion, appropriate measurement and monitoring methods are very needed. Geophysical methods especially electric and induced polarization imaging have widely been used for seawater intrusion monitoring and mapping because of difference in electrical properties between freshwater and seawater. This research was studied in Phuket, where is the biggest island of Thailand. Phuket is the most popular place, where tourist usually visit. In additional, Phuket is also industrial and agricultural city, which normally use high amount of water. Groundwater has become importance since water demand in Phuket would increase to 101,000,000 m3 in 2037, whereas, water reserve is only 46,000,000 m3. While water demand is increasing, improper discharging of groundwater from coastal aquifers is conducted, which leads to seawater intrusion problem in Phuket.

In this study electric and induced polarization imaging were conducted to investigate seawater intrusion both by laboratory experiment and field survey, where were investigated at a coastal site, Phuket, Thailand. In laboratory experiment was successfully delineated salt water-freshwater interface, which 97.24 Ωm of resistivity refer to freshwater, whereas, contaminated freshwater with Cl- concentration 1,500 mg/L to 3,000 mg/L present 15 Ωm to 33 Ωm of resistivity and chargeability 0.72 mV/V to 5.76 mV/V. Field investigation in Chalong display seawater intrusion at 5 m. to 26 m. below ground surface, extension of seawater intrusion is 175 m. into coastal aquifer. Contaminated freshwater shows 3 Ωm to 22 Ωm of resistivity, while 74 Ωm to 119 Ωm of resistivity represent freshwater aquifer. In addition, chargeability result of less than 20 mV/V represent sand aquifer, while more than 20 mV/V show clay layer.

This study demonstrate that geophysical investigation is effectively for access seawater intrusion situation, which can be used for solving seawater intrusion problem.


B108
Welcome
RNUS Joint Student Seminar on
Civil Infrastructure
08.00 – 18.00 hrs.
12 September , 2019
B108 (1st Floor)
8th International Joint Student Seminar on Civil Infrastructures
12 - 13 September 2019
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