10th Geoinformatics Summer School

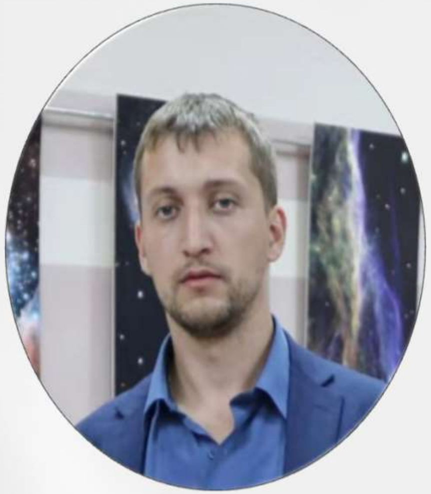
LIESMARS Track 3: Machine Learning

Use of machine learning techniques for rapid detection, assessment and mapping the impact of disasters on transport infrastructure

WUHAN UNIVERSITY

July 6 2019| Wuhan University

OUR TEAM



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Disasters

- Floods
- Earthquakes
- Explosions
- Hurricanes

Disaster management

The organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters

Rapid mapping

The on-demand and fast provision (within hours or days) of geospatial information in support of emergency management activities immediately following an emergency event.

GOAL OF RESEARCH

Develop machine learning based approach for rapid detection, assessment and mapping the impact of disasters on transport infrastructure

Why is it important

- **People's lives are on the line.**

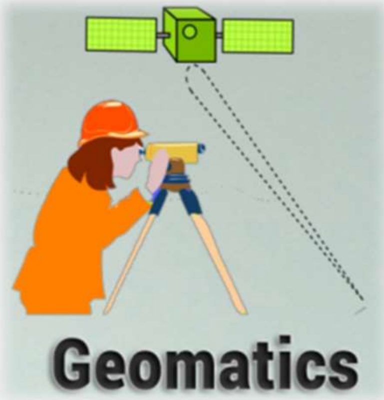
  In 2018, the number of deaths caused by natural disasters **10,809**

- **Time is of the essence**

  Imagery processing and map making takes approximately **5.5 hours**

Most traditional techniques of making this now a days

- Crowdsourcing to allow photos of damages to be uploaded by residents
- Satellite image pre-processing (geocoding, orthorectification, coregistration)
- Extraction of Post-event information
- Manual imagery processing using Geomatics techniques



Disadvantages

- Taking a long time
- Low accuracy
- Dependent on data quality

Advantages of our approach

- **Much faster**
- **More accurate**
- **Less data quality dependent**

CONCEPT

Getting the region of disaster management works

Determining the most important access points

Building possible routes

CONCEPT

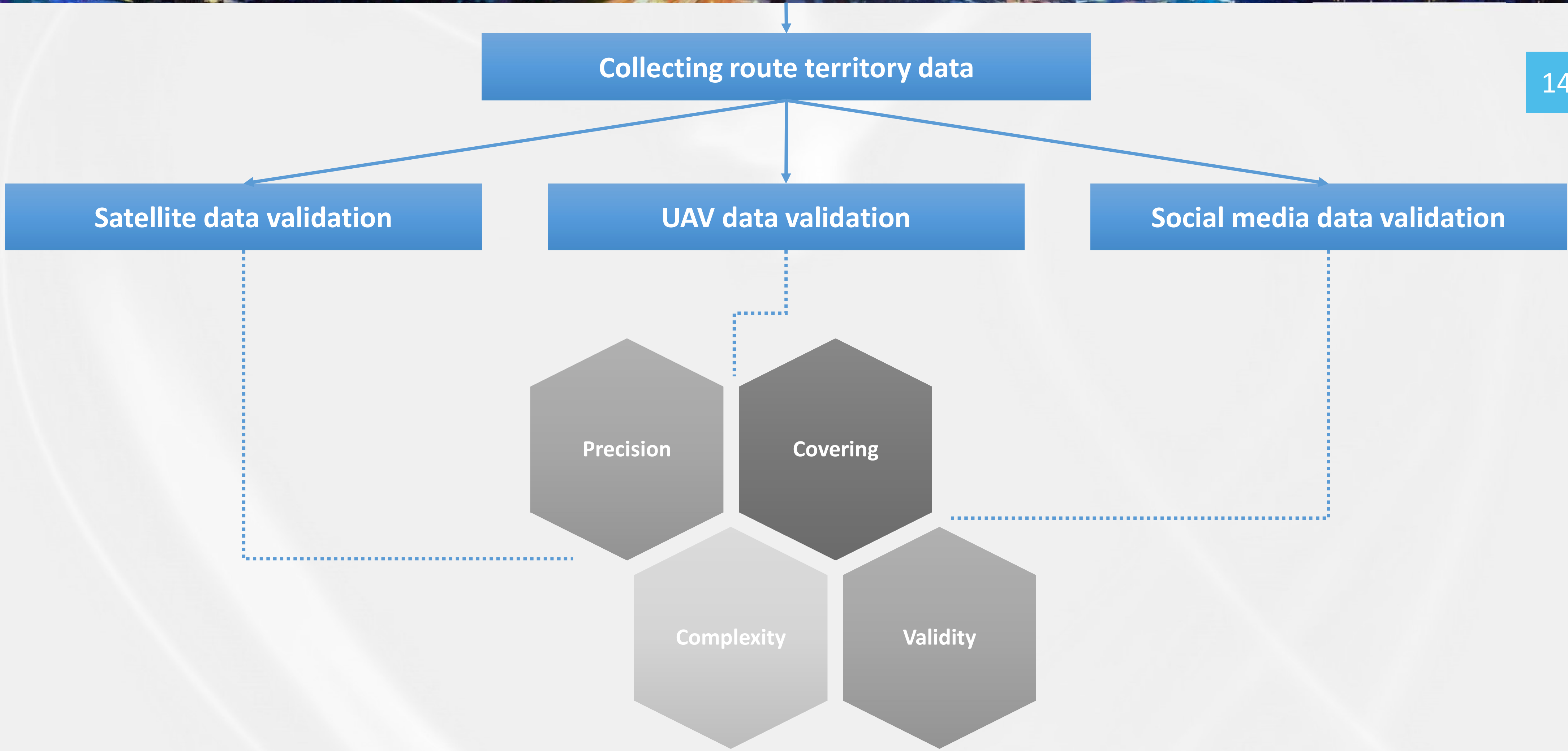
Collecting route territory data

Satellite images

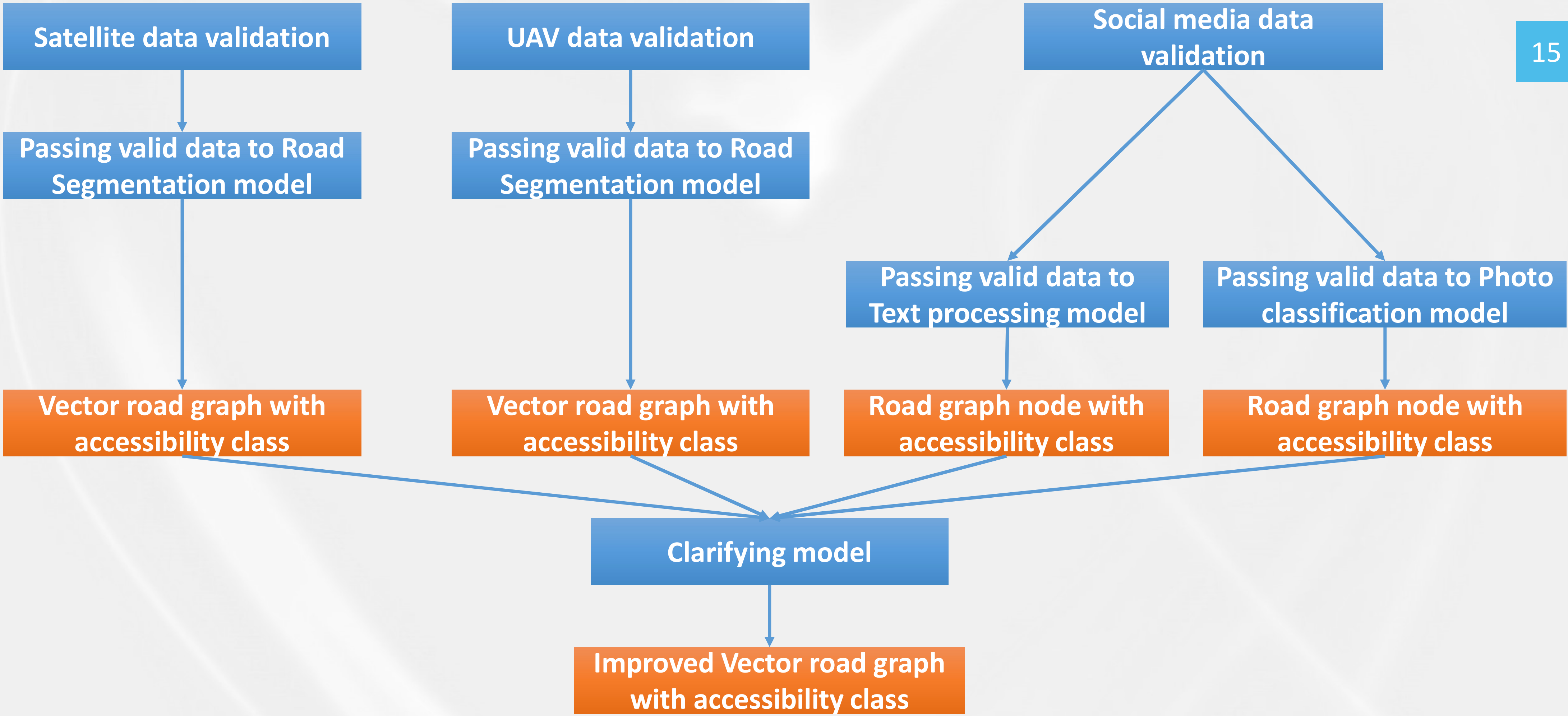
UAV

Social media

CONCEPT


Collecting route territory data
Satellite data validation
UAV data validation
Social media data validation
Precision
Covering
Complexity
Validity

CONCEPT



Satellite data validation
UAV data validation
Social media data validation
Passing valid data to Road Segmentation model
Passing valid data to Road Segmentation model
Passing valid data to Text processing model
Passing valid data to Photo classification model
Vector road graph with accessibility class
Vector road graph with accessibility class
Road graph node with accessibility class
Road graph node with accessibility class
Clarifying model
Improved Vector road graph with accessibility class

METHODOLOGY

Data

- Satellite
- UAV
- Social media

Methods

- Natural language processing
- Deep learning
- Image processing
- GIS approaches
- Programming

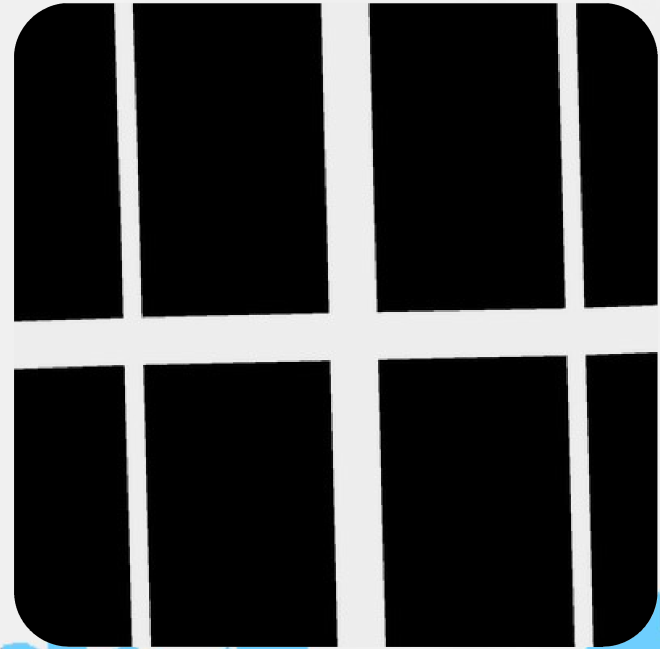
TASKS

- Collect and mark satellite images dataset
- Collect and mark UAV images dataset
- Build Deep learning model for satellite image processing
- Build Deep learning model for UAV image processing
- Collect location based social media photos and text dataset
- Build NLP model for social media text data processing
- Build Deep learning model for social media photos data processing

Data

100 Google Maps **RGB** satellite images of city area

100 Labeled ground-truth images



Algorithms used

- DBSCAN
- Logistic regression
- Tensorflow

DBSCAN

Density-based spatial clustering of applications with noise

DBSCAN

Density-based spatial clustering of applications with noise

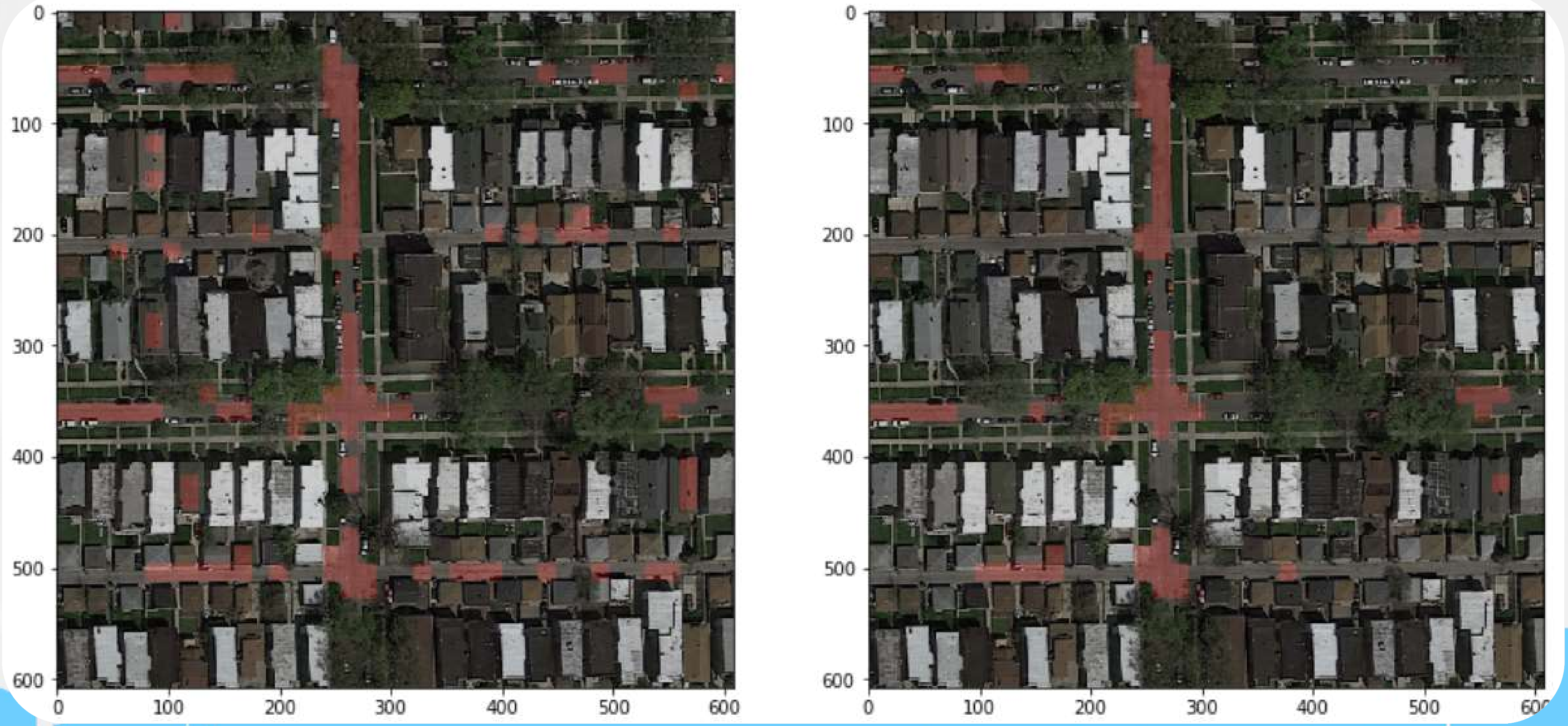
Logistic regression

- **Classification of patches 16*16**
- **Standardization of features**
- **Balancing the data**
- **Image conversion to gray scale level image**
- **Detecting boundaries applying Sobel filter on a gray scale images**
- **Features: mean and standard deviation of each channel**

$$G_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

Logistic regression

Tensorflow



LIMITATIONS

- **Model territory scalability**
- **Model data variations scalability**

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