Multimodal Data Analytics and Integration for Emergency Response and Disaster Management

CNS-1952089
Shu-Ching Chen, Florida International University
NSF-JST PG, FY2020

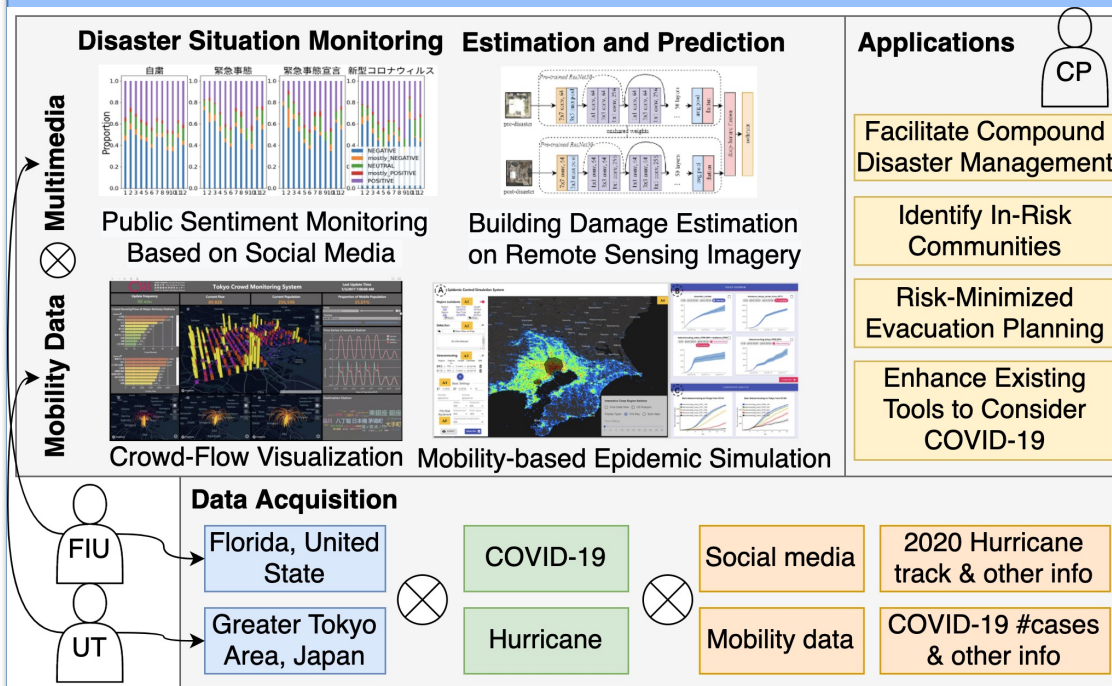## Principal Research Investigators (Name, Institution)

- Shu-Ching Chen, Florida International University
- Steven Luis, Florida International University
- Ryosuke Shibasaki, The University of Tokyo
- Xuan Song, The University of Tokyo
- Renhe Jiang, The University of Tokyo
- Haoran Zhang, The University of Tokyo
- Quanjun Chen, The University of Tokyo

Community Partners (Name, Institution)

- Steve Detwiler, Office of Emergency Management, Miami-Dade Fire Rescue
- Atsushi Nishida, Tokyo Metropolitan Institute of Medical Science
- Mosato Sakata, Blogwatcher Inc.

Project Overview

Visual Schematic

Disaster Situation Monitoring

Public Sentiment Monitoring Based on Social Media

Crowd-Flow Visualization

Estimation and Prediction

Building Damage Estimation on Remote Sensing Imagery

Mobility-based Epidemic Simulation

Applications

CP

Facilitate Compound Disaster Management

Identify In-Risk Communities

Risk-Minimized Evacuation Planning

Enhance Existing Tools to Consider COVID-19

Multimedia

Mobility Data

Data Acquisition

FIU

UT

Florida, United State

Greater Tokyo Area, Japan

COVID-19

Hurricane

Social media

Mobility data

2020 Hurricane track & other info

COVID-19 #cases & other info

Project Vision

Develop new tools to aid emergency managers, under various policies, to better understand the trending, potential impacts and consequent behavior of residents for COVID-19, future pandemics, natural disasters and compound scenarios.

- Understand and predict the situation of pandemics to support decision making for emergency management
- Manage hurricanes in the context of the pandemic

Project Overview

Use-Inspired Research

- **Community Partners:**
  - **Florida**: Office of Emergency Management, Miami-Dade Fire Rescue
  - **Greater Tokyo Area**: Tokyo Metropolitan Institute of Medical Science
- **COVID-19 and combining with hurricane/typhoon**
  - Need tools for efficient situation awareness
  - **Goal1:** Identify in-crisis communities
  - **Goal2**: Facilitate disaster management
- **Cultural Differences Between US and Japan**
  - Varying behavioral pattern (e.g., level of public transportation) in collected data
  - **Goal1**: Investigate what the differences are
  - **Goal2**: Develop systems robust to these factors

PG Activities

- **Research Team Meeting:**
  - Investigators from both universities
  - 1 to 4 times/month via Zoom, depending on the project progress
  - Discuss ideas, progresses and future planning
  - Additional project-based meeting on demand
- **Meeting with Community Partners:**
  - Investigators and community partners
  - Monthly or on demand, depending on the partners' schedule
  - Share outcomes and collect feedback
- **Planned Workshop:**
  - Involve community partners and other stakeholders
  - Share outcomes and collect feedback

Project Update

- **Multimodal Data Collection**:
  - Collect data from both Florida and Greater Tokyo Area
  - Develop data acquisition pipeline
- **Literature Review:**
  - Survey disaster management and analysis methods
  - Use social media and mobility data
- **Data Analysis and Visualization**:
  - **Simulate the COVID-19 transmission**
    - ❖ Simulate impacts of various policies
    - ❖ Estimate its economic impacts
  - **Content analysis on social media**
    - ❖ Conduct sentiment analysis for tweets on COVID-19 topics
  - ***Estimate building damage***
    - ❖ Use pre- and post-disasters remote sensing data
  - **Data Visualization System**
    - ❖ Visualize spatiotemporal data, including crowd flow, city-wise traffic, trends of COVID-19, etc.
- **Engagement**:
  - Regular Zoom meetings between US and Japan teams
  - Regular meetings with community partners
  - Planning the workshop to involve community partners and other stakeholders
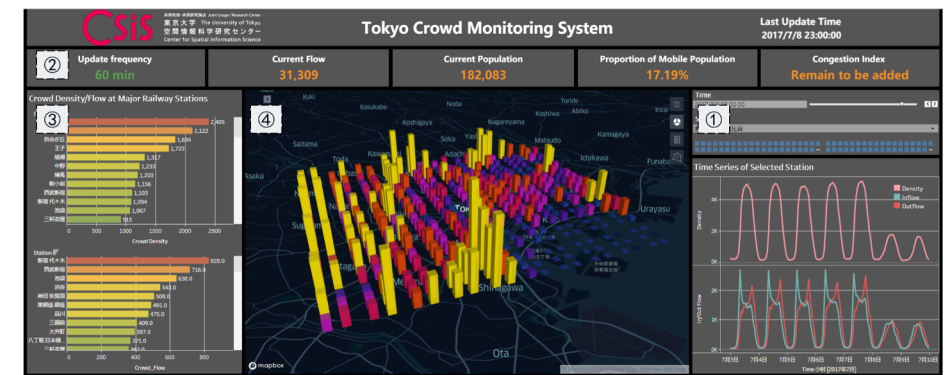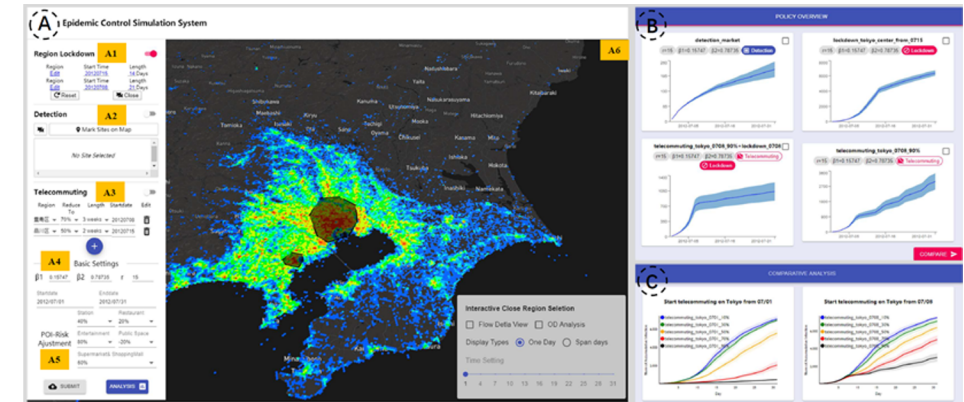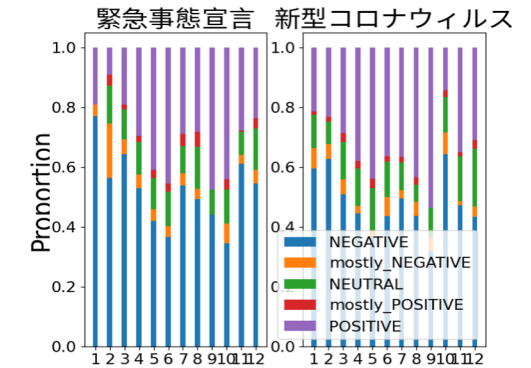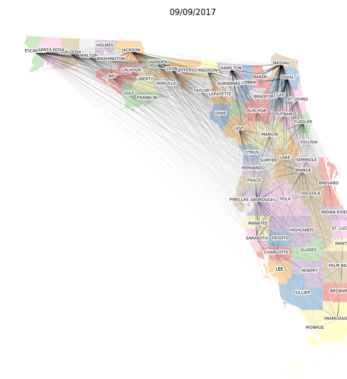
Project Evolution

1. *We learned that COVID-19 becomes an emerging and challenging disaster and the research on the management of COVID-19, future pandemic, and natural disaster in the context of COVID-19 is on demand. Therefore, the scope of our research moved from evacuation planning of hurricanes based on multimodal data to developing tools and techniques to facilitate the management of COVID-19, future pandemics, and compound disasters.*

2. *We learned that an important obstacle in managing a global pandemic such as COVID-19 is to automatically identify the communities in crisis and understand their problems and demands. When an outbreak happens, communities are impacted in a very different way. Thus, we prioritize automated in-crisis community identification based on multimodal data, especially on mobility and social media data.*

3. *We learned that due to the cultural differences between Japan and US, the data might not be available at the same granularity level, especially for mobility data. Thus, we have investigated and implemented existing methods and planned for research to bridge the gaps in granularities. Meanwhile, we have planned for conducting research on transferring the data analysis methods developed by Japan to US, vise versa.*
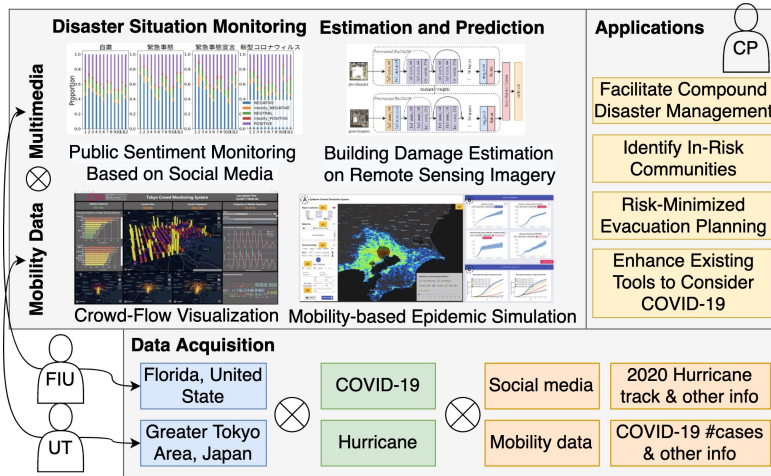
Multimodal Data Analytics and Integration for Emergency Response and Disaster Management
CNS-1952089
Shu-Ching Chen, Florida International University
NSF-JST PG, FY2020

Visual Schematic

Project Vision

Develop new tools to aid emergency managers, under various policies, to better understand the trending, potential impacts and consequent behavior of residents for COVID-19, future pandemics, natural disasters and compound scenarios.

- Understand and predict the situation of pandemics to support decision making for emergency management
- Manage hurricanes in the context of the pandemic

Use-Inspired Research

Community Partners: (1) **Florida**: Office of Emergency Management, Miami-Dade Fire Rescue; (2) **Greater Tokyo Area**: Tokyo Metropolitan Institute of Medical Science

1. **COVID-19 and combining with hurricane/typhoon**
Need tools for efficient situation awareness: (1) identify in crisis communities; (2) facilitate disaster management
2. **Cultural Differences Between US and Japan**
Investigate what differences are and develop systems robust to them

PG Activities

- **Research Team Meeting** for investigators from both universities to discuss ideas, progresses and future planning (1 to 4 times/month via Zoom, depending on the project progress; and additional project-based meetings are scheduled on demand)
- **Meeting with Community Partners** for investigators and community partners to share outcomes and collect feedback (Monthly or on demand, depending on the partners' schedule)
- **Planned Workshop** to involve community partners and other stakeholders, share our research outcomes, and collect feedback