Ministry of Science and ICT

IITP Institute of Information & Communications Technology Planning & Evaluation

# APPLICATION FORM
# (JOINT RESEARCH)
## HIGH POTENTIAL INDIVIDUALS GLOBAL TRAINING PROGRAM)

### AGREEMENT

As stated above, I submit this application form to IITP that conducts "High Potential Individuals Global Training Program" supported by Ministry of Science, ICT in South Korea. IITP may disclose the information below to the public for the purpose of providing information and matching a research partnership between your institute and a Korean university.

* IITP : Institute for Information & communications Technology Planning & Evaluation

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| Printed Name of Chief of Research | Dr. Yong Kwon Cho | Date(mm-dd-yyyy) | 01/31/2020 |
| Signature of Chief of Research |  | | |

☞ ***(Note)*** *This application is to identify the willingness to participate in this research and to find a research partnership for research institutes in Korea. Therefore, in its sole discretion, it is acceptable to contain only minimal information. (max. 3 pages)*

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|---|---|---|---|---|---|---|---|
| **1. Research Title** | Intelligent Disaster Site Condition Assessment using Unmanned Vehicles | | | | | | |
| **2. Research Area** | **A.I.** | **Big Data** | **Cloud Computing** | **Block Chain** | **AR/ VR** | **ICT/SW Convergence** | **Other ICT /SW** |
| | **X** | **X** | | | | | |
| **3. Chief of research** | Title | Associate Professor | | Contact | E-mail : yong.cho@ce.gatech.edu | | |
| | Name | Dr. Yong K. Cho | | | Tel : +01-404-385-2038 | | |
| **4. Affiliation** | Name | Georgia Institute of Technology | | Classification | (X) University ( ) Research Institute<br>( ) Industry ( ) ETC. | | |
| **5. Capacity for students (5 or less)** | | **Support for students** ***(all necessary)*** | | ( X ) Visa support<br>( X ) Research Mentoring<br>( X ) Research Space<br>( X ) Accessibility to Research equipment | | | |
| **6. Research Objective** | 1) Investigate point cloud segmentation methods using deep learning to predict navigability, debris level, and risk of collapse of the disaster site<br><br>2) Present an automatic structural damage assessment method using images and laser scanned data | | | | | | |

## 7. Research Summary

Mobile robots play an important role in search and rescue operations in post-disaster scenarios such as earthquakes and hurricanes due to the hazardous nature of these sites. Mobile robots can use LiDAR devices to scan affected infrastructure and identify the hazard level of different buildings on the disaster site. This research aims to investigate Artificial Intelligence (A.I.) and data-driven technologies for mobile robots to efficiently scan a disaster site and detect damaged regions based on the acquired 3D point clouds.

The first research objective is to investigate point cloud segmentation methods so that the robot can translate raw data into important semantic information in real-time (Figure 1). This semantic information includes navigability, debris level, and risk of collapse of different regions of the disaster site. This information is important to decide which areas to scan and which areas to avoid for the disaster relief team.

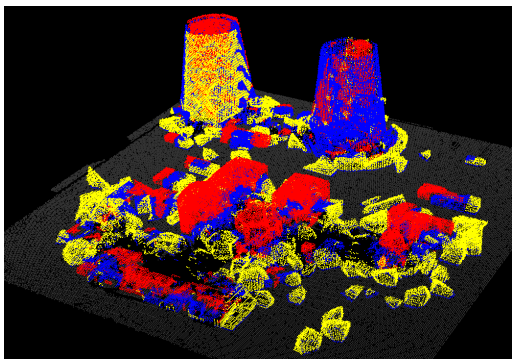

Figure 1: An example of the automated point cloud segmentation for a nuclear power plant disaster simulation

The second research objective is to quantify the damage levels on the disaster site based on the acquired 3D point clouds. There could be many potential indicators of structural damage including tilt, horizontal displacement, cracks, and debris (Figure 2). This research aims to compare and contrast different damage indicators based on their accuracy and relevance in structural damage assessment.

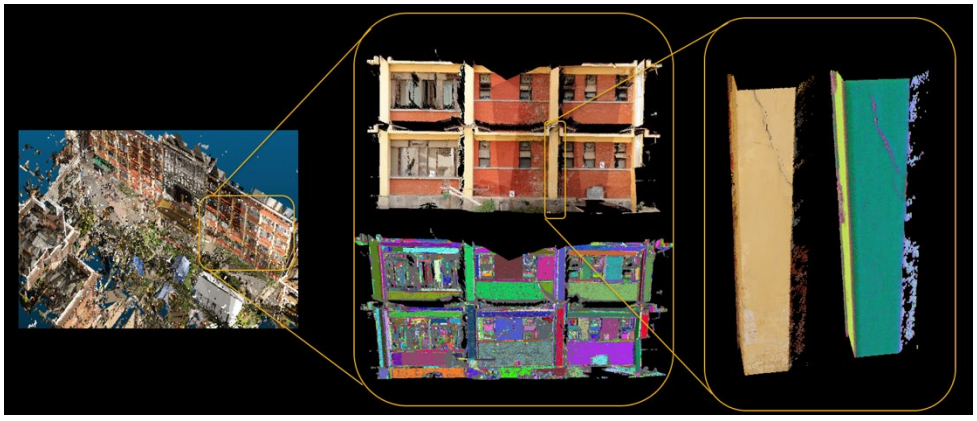

Figure 2: Feature-based crack detection from a point cloud scene

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| | The proposed research will be evaluated using the Guardian Centers disaster training facility as an experimental testbed (Figure 3). Guardian Centers is an 830-acre facility located in Perry, Georgia featuring simulated urban disaster conditions including a collapsed steel structure and a collapsed concrete structure. This environment allows the research team to investigate the ability of the proposed disaster relief robotic system to complete scanning missions under challenging conditions.<br><br>  <br><br>Figure 3: The Guardian Centers in Georgia, USA |
| **8. Need for funding from Korean government** | As the purpose of the proposed technology is to support immediate response and recovery in the national disaster sites, it is essential for the government agencies for disaster management and response. Since several earthquakes and fires have occurred in recent years, Korea is no longer safe from natural and man-made disasters. Moreover, Korea is a densely populated country, and skyscrapers are being crammed into small areas. For this reason, The Korean government agencies should have the techniques to respond quickly and accurately to the disasters. Therefore, the research on the disaster response should be encouraged and supported at a national level. |
| **9. Request for Korean Universities** | In the above research and development, our research team (RICAL at Georgia Tech) has specialties in the technologies for unmanned data acquisition at disaster sites. The team has developed unmanned ground/aerial vehicles (UAV/UGV) for scanning and mapping inaccessible areas. In addition, the team also has investigated AI and computer vision technologies and published relevant research papers to various renowned scientific journals. However, our team lacks expertise in structural analysis and risk assessment from the geometric model that we created from the raw data. In the proposed research, the structural analysis using obtained 3D geometry data is fundamental for the accurate risk assessment. Thus, if we conduct joint research with a Korean research institute that can rapidly perform structural analysis and risk assessment with the acquired field data, the research outcomes will be more implementable to disaster situations in Korea and useful for the rescue and recovery teams to make safe and effective decisions. |