

Grand Challenge Research on Smart Monitoring System: Sustainable Self-Sufficient Monitoring System

Hoon Sohn

Department of Civil and Environmental Engineering Department
KAIST, Daejeon, South Korea
hoonsohn@kaist.ac.kr

Similar to an autonomous house cleaning robot such as "Roomba" developed by MIT, we intend to develop an unmanned and autonomous aerial vehicle that can periodically monitor and assess the integrity and performance of large-scale distributed infrastructure systems such as bridges. The success of the proposed project depends on development and integration of the following key enabling technologies.

(1) Fully autonomous UAV for remote inspection

- Development of autonomous mission execution system for remote inspection
- Autonomous three-dimensional path planning to negotiate with the given target structure's topology and sensor locations
- Collision avoidance and multi-sensor-based navigation near the structure

(2) Optics based power and data transmission

- Integration/interface with previously developed guided wave based damage detection techniques and other SHM/NDT techniques
- Use PZT (lead zirconate titanate) transducers for guided wave generation and sensing
- Generate and wirelessly transmit arbitrary laser waveform to excite the PZT transducers
- Wirelessly measure response signals from the PZT transducers

(3) Precision-aiming control

- Aiming-oriented control of UAV to point the remote PZT transducers
- Precision control of the pose of the laser projector and sensing system

The proposed autonomous and sustainable inspection UAV with wireless power and data capability can revolutionize inspection of large-scale distributed infrastructure systems by reducing costs associated with current labor-intensive visual inspection, increasing accessibility to remote and secluded locations, and automating the entire process of inspection. Furthermore, the optics based power and data transmission technique can make obsolete the complex microprocessor and wireless transmitter that are often integrated with an individual sensor unit, making each sensor unit more reliable and inexpensive. It does not require much imagination to vision broader applications and broader impacts that the proposed technology can offer.