TIP Project Brief – 090023/10H013

Civil Infrastructure
Civil Infrastructure Inspection and Monitoring Using Unmanned Air Vehicles

Develop the technologies required to create small, hovering, Unmanned Air Vehicles (UAVs) for use in the inspection and monitoring of large-scale civil infrastructure elements such as bridges and dams.

Sponsor: CyPhy Works, Inc. (formerly The Droid Works, Inc.)
Framingham, MA

- Project Performance Period: 2/1/2010 - 1/31/2013
- Total project (est.): $4,996 K
- Requested TIP funds: $2,453 K

A number of research efforts are under way to develop "smart" sensor technologies to improve the monitoring of large, critical structures like bridges and dams, but few offer significant improvement over the current state of the practice that relies on visual inspection. CyPhy Works, together with the Georgia Institute of Technology Research Corporation, is attempting to develop a novel and potentially revolutionary inspection system based on small, unmanned, hovering robots fitted with video cameras and other sensors. The proposed Unmanned Air Vehicle (UAV) would slowly move along the sides or undersides of bridges and similar structures while relaying close-up, high-fidelity images and other data to engineers for "Robotic Assisted Inspection" (RAI). Because the robots could work without the need to shut down bridge lanes or to rig safety harnesses and other equipment for human inspectors, they would greatly increase both the speed and safety of bridge and dam inspections. For particularly critical or at-risk structures, inspectors could use a more advanced technology, "Autonomous Robotic Monitoring" (ARM)—one or more dedicated inspection robots that would be stationed at the structure and make periodic flights to detect potentially dangerous changes. Both approaches will require major advances in the current state of the art of small UAVs to allow them to fly and hover safely in potentially gusty winds for long periods with precise positioning. Current UAV technology, for example, uses GPS signals for maintaining position, but the technique is nowhere near precise enough to maintain position within extreme close proximity of a large structure. Moreover this technique becomes impossible to employ when the structure blocks the GPS signal. CyPhy Works envisions an optics-based close-in navigation system that allows the robot to maintain a position and navigate by observing visual cues such as corners or edges of the structure. If successful, the project will produce an advanced class of UAVs that would enable entirely novel, efficient and relatively low-cost techniques for monitoring the health of the nation's existing civil infrastructure. ARM, in particular would monitor our civil infrastructure without the need for an inspector on-site. This capability is critically needed for bridges and dams that are rated as substandard to warn of impending catastrophic failure. ARM requires the technologies developed for RAI, but has even higher technical risks and rewards associated with it.

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