TIP Project Brief – 080060/9H9015

Civil Infrastructure
Development of SCANS^{n} for Advanced Health Management of Civil Infrastructures

Develop an extensible and self-powered sensor network using a peer-to-peer communication protocol for nondestructive evaluation (NDE) and health monitoring of bridges, buildings, pipelines and other major infrastructure components.

Sponsor: Acellent Technologies Inc.
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- Project Performance Period: 2/1/2009 - 8/30/2012
- Total project (est.): $5,990 K
- Requested TIP funds: $2,995 K

Acellent Technologies, Inc. (Sunnyvale, Calif.) plans an advanced intelligent sensor network using NDE techniques to monitor the structural health of entire bridges, buildings and other major structures down to the level of individual components. A key feature of the planned Scalable Cognitive Autonomous Nondestructive Sensing network (SCANS^{n}) is the relative ease with which the network could be extended to cover larger and larger structures. Individual nodes in the network will communicate with each other in a “peer-to-peer” network scheme that will allow the system to grow exponentially (hence the superscript 'n'). Each individual SCANS^{n} node will be a self contained entity that includes an embedded array of multi-frequency piezoelectric actuators and sensors for NDE detection and evaluation of cracks, along with sensors to detect mechanical parameters such as strain, displacement and acceleration, and environmental factors such as temperature and humidity. The system will exploit advanced flexible electronics packaging to facilitate applying the SCANS^{n} node to curved surfaces and other difficult shapes. The SCANS^{n} node will use energy harvesting through photoelectric cells or piezoelectric systems to derive power from sunlight or mechanical strain and vibrations in the structure. On-board data processing elements will create 3-D representations of local damages and use wireless communications to link with nearby nodes in a distributed system. At higher levels the SCANS^{n} network will link into a Global Integrity Monitoring (GIM) data system that will be able to evaluate the overall health of the entire structure and feed into higher level systems that will monitor collections of SCANS^{n} instrumented structures of a regional basis. SCANS^{n} entails several difficult technical challenges that require TIP support. The hardware will require integrating both active and passive sensors—together with a power source and a wireless communications system—into a miniaturized, flexible package, requiring significant advances in materials and design. The signal processing algorithms at the individual node level and data mining algorithms at higher levels also will require research advances. If successful, SCANS^{n} will offer a relatively inexpensive, adaptable and easily extensible network solution for monitoring the structural health of bridges, buildings, pipelines and other major infrastructure components.

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