

Integrated Structural Health Awareness



A Georgia Tech Focused Research Program

Integrated Structural Health Awareness



Integrating Research with Industry Practice

Established nondestructive evaluation (NDE) methods are currently relied upon to assess the integrity of a structure, whereas structural health monitoring (SHM) methods are primarily topics of active research. To date, most of the innovations arising from SHM research have not gained acceptance within industry and thus have not been successfully transferred to practice. Some reasons for this are inadequate performance of developed SHM methods, insufficient quantification of performance, unknown sensor longevity, lack of calibration protocols, and few (if any) companies that can supply sensors and instrumentation. Another

recently identified issue is the lack of integration of established NDE methods with new SHM methods.

RESEARCH FOCUS. Our multidisciplinary research effort is directed toward creating, testing, producing and implementing integrated structural health awareness technologies. It includes fundamental research on sensors and methodologies that are targeted to specific structural configurations, damage types, materials and applications. Logistics and quantification of the economic advantages provided by ISHA technologies are also considered, particularly as related to improved damage prognosis.

Vision

Integrated Structural Health Awareness (ISHA) methodologies will:

- Enable timely, accurate and reliable assessment of structural integrity
- Reduce maintenance costs
- Extend the operating life of structures
- Help prevent catastrophic structural failures.

Areas of Application

- Aerospace (aircraft, space vehicles and structures)
- Transportation (automotive, ship and railway industries)
- Civil (bridges, buildings and dams)
- Energy (nuclear reactors, wind turbines, power plants, refineries and pipelines)
- Manufacturing (quality control and process control)
- Bioengineering structures (e.g., prosthetics)

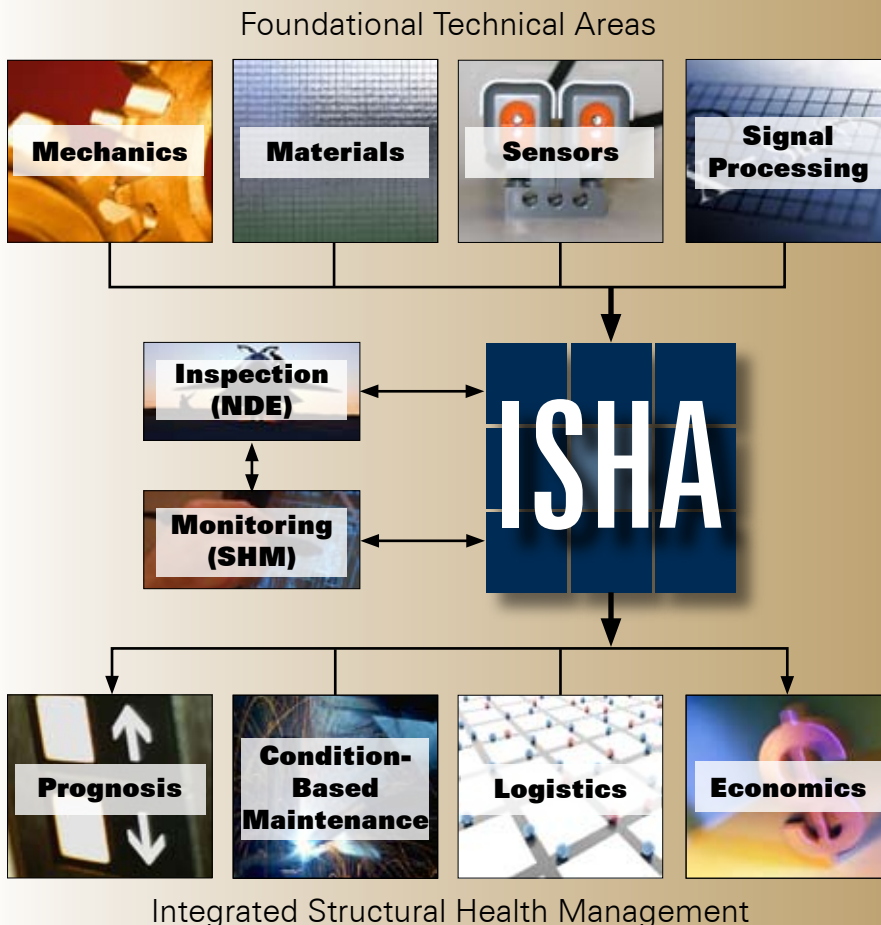


The assessment of the current state of the health of a structure through a combination of in situ sensing, periodic and as-needed inspection, and statistical damage assessment.

An Interdisciplinary Approach

ISHA research at Georgia Tech is performed through a unique mix of expertise, which includes the fields of aerospace, civil and environmental, electrical and computer, and mechanical engineering. To most effectively address global ISHA issues, participating researchers are located at Georgia Tech's main

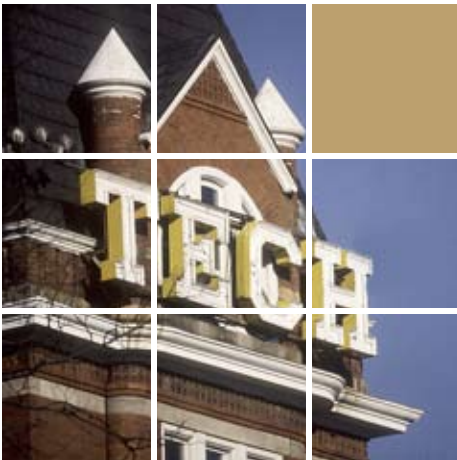
campus in Atlanta, Georgia; the Georgia Tech Research Institute, also located in Atlanta; and Georgia Tech Lorraine, our international campus in Metz, France. The result is a seamless transition from ideas to solutions, and from the laboratory to the field.



Goals

Enable a shift from schedule-based to condition-based maintenance by:

- Developing and maturing ISHA methods
- Incorporating ISHA into plans for integrated structural health management
- Reducing the need for overly conservative structural designs



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Areas of Expertise

Artificial intelligence
 Automation
 Decentralized structural control
 Laser vibrometry
 Laser ultrasonics
 Material microstructure modeling
 Materials characterization
 Measurement systems
 Mechanics of failure
 Mechanics of materials
 Nondestructive evaluation
 Nonlinear ultrasonic methods
 Physical ultrasonics
 Sensors
 Signal processing
 Structural dynamics
 Structural health monitoring
 Ultrasonic bulk and guided wave methods
 Wave and vibrations in solids
 Wireless structural sensing

Selected Current Projects

- Multi-scale SHM for detection, diagnosis and prognosis of aerospace structures (AFOSR)
- High temperature ultrasonic monitoring of critical energy infrastructure (NSF/STTR)
- Structural monitoring of ships from diffuse vibrations (ONR)
- Nonlinear ultrasonic techniques for NDE and fatigue damage assessment (NSF)
- In situ measurement of air content in pavements (GA DOT)
- Measuring residual stress using nonlinear ultrasound (Boeing)