

## AIS M.S. Program Courses

### AIS Core Courses

- 12-740 Data Acquisition, Sensing, and Instrumentation for Infrastructure Systems
- 12-741 Data Management
- 12-742 Data Analysis and Mining
- 12-743 Computational Search and Decision Support
- 12-744 AIS Systems Project Preparation Course
- 12-745 AIS Systems Project Course

### AIS Related Courses in CEE

- 12-600 AutoCAD
- 12-604 Transportation Engineering
- 12-605 Design and Construction
- 12-610 International Collaborative Construction Management
- 12-631 Structural Design
- 12-635 Structural Analysis
- 12-636 Geotechnical Engineering
- 12-703 Numerical Methods in Engineering
- 12-704 Probability and Estimation Methods for Engineering Systems
- 12-711 Building Information Modeling
- 12-712 Intro to Sustainable Engineering
- 12-713 Industrial Ecology and Sustainable Engineering Design
- 12-714 Environmental Life Cycle Assessment and Green Design
- 12-716 Advanced Life Cycle Assessment
- 12-750 Infrastructure Management

Courses can also be taken in other engineering departments, College of Computer Science and elsewhere.

## M.S. & Ph.D. Concentration Advanced Infrastructure Systems

AIS graduates will understand one or more specific processes related to an infrastructure system and the functional needs for intelligent infrastructure behavior. Experiencing a range of data capture, data modeling/management, and analysis technologies/methods, graduates will be able to appropriately perform data-driven decision making and develop the ability to design and evaluate systems for intelligent behavior in an infrastructure-oriented domain.

M.S. and Ph.D. degree programs in this area are available to qualified students. Financial aid is available on a competitive basis.

### Please Contact Us

Graduate Admissions  
Civil and Environmental Engineering  
Carnegie Mellon University  
Pittsburgh, PA 15213-3890



(412) 268-2940  
(412) 268-7813 FAX  
[www.ce.cmu.edu](http://www.ce.cmu.edu)  
[cee-admissions@andrew.cmu.edu](mailto:cee-admissions@andrew.cmu.edu)

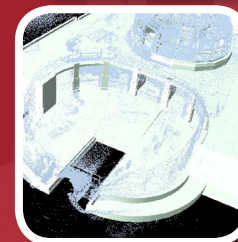
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## Concentration in Advanced Infrastructure Systems

Research and Education  
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# Example Research Projects



Infrastructure systems and the processes to design, build, and operate those systems must become intelligent, able

to continuously determine their conditions, perform self-assessment and support proactive decision making that improves their performances, increases their life spans and reduces life-cycle costs and impacts.

The **Advanced Infrastructure Systems (AIS)** group in Civil and Environmental Engineering at Carnegie Mellon University seeks to be among the world's leading education and research groups focused on making this vision a reality.

## Vehicles as Bridge Sensors

In collaboration with Biomedical Engineering faculty and faculty from the University of Pittsburgh, we are exploring new structural health monitoring technologies that envision a set of moving vehicles equipped with sensors able to capture the dynamic interaction between the vehicles and the bridges and translate that information into bridge condition.

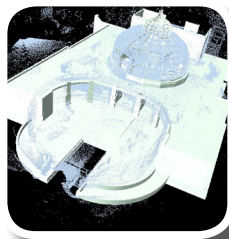
## Ultrasonics for Structural Health Monitoring of Pipes

With colleagues from Electrical and Computer Engineering we monitor pipe segments using guided wave ultrasonics. The challenge is to distinguish changes of interest, caused by damage, from benign changes produced by operational and environmental variations. We have success using analysis methods from machine learning, pattern recognition, time-reversal acoustics, and other advanced approaches to signal processing.



## Geospatial Analysis of Events in Water Distribution and Wastewater Collection Systems

We are examining approaches to perform spatial clustering on the various events that occur in water distribution systems (e.g. breaks) and wastewater collection systems (e.g. blockage) to better understand where and why these events happen in such networked pipe infrastructure.



self-improvement and self-healing.

## Self-Configuring HVAC Systems

In collaboration with faculty from the School of Architecture, we are researching ways to create a unified framework for an HVAC system that would work within five independent and synergistic functionalities: self-recognition, self-monitoring, self-assessment,



## Benchmarking Energy Consumption in Residential Buildings

With faculty from Electrical and Computer Engineering and the University of Maryland Eastern Shore, we are researching ways to provide

consumer feedback on appliance-level electricity consumption in a project funded by the National Science Foundation.

## Generating & Utilizing As-Is BIM for Construction & Facility Management

To increase the fidelity and usage of Building Information Models (BIM) during construction and facility operations, the information contained in such models should reflect the as-is conditions. In collaboration with faculty from the Robotics Institute, we are investigating the use of 3D imaging sensors and other in-situ sensors to monitor and capture as-is conditions, and are formalizing approaches to process and fuse data collected by such sensors to generate and represent as-is BIMs.

## IBM Smarter Infrastructure Lab

A division of the Pennsylvania Smarter Infrastructure Incubator at Carnegie Mellon, the IBM Smarter Infrastructure Lab is housing many of the projects of the AIS group, with the goal of determining what actionable information about the condition and usage of our critical infrastructure systems is needed and how best to capture and deliver it.

