

RE: PhD position at Georgia Institute of Technology on Intelligent Sensing-based Infrastructure Condition Assessment and Management Systems and Intelligent Transportation System (ITS)

Georgia Institute of Technology (Georgia Tech) is one of the top 3 civil and environmental engineering schools in the US. We are seeking PhD students who are self-motivated in learning new knowledge and technologies and seeking creative idea and solutions, and have strong backgrounds in the following areas:

- Theory and application of signal (image) processing, machine learning, and pattern recognition.
- Theory and application of data mining, statistics, and optimization.
- Development of feature extraction algorithms using digital images and 3D Line Laser Imaging technologies for real-world applications.
- Development of intelligent sensing systems, including using digital camera and 3D Line Laser Imaging. It also involves hardware integration, data synchronization, and calibration.

Our research includes intelligent sensing-based infrastructure condition assessment and management system and Intelligent Transportation System (ITS). The research focuses include:

- a) development of sensing-based intelligent roadway asset condition assessment, inventory and management systems
 - Develop automatic pavement condition evaluation system using downward 2D pavement images and high-resolution 3D Laser data.
 - Develop sign asset inventory and management systems by using image- and LiDAR- based feature detection and recognition algorithms.
 - Develop automatic roadway geometry extraction (including alignment, super-elevation, slopes, etc.) using images, GPS, and LiDAR data.
- b) Intelligent highway workzone hazard awareness system
 - Developing the reliable highway work zone intruding vehicle detection and tracking algorithms. Probabilistic-based vehicle intrusion decision models need to be developed.
- c) Large-scale Pavement Management System
 - Developing spatial optimization and stochastic models to facilitate decision making process on pavement maintenance and rehabilitation at large scale;

Some research projects are described below:

- National-level research project sponsored by the US Department of Transportation (DOT) for developing a “Remote-Sensing and GIS-enabled Asset Management System (RS-GAMS).” Different state of the art scanning laser technologies are equipped on an integrated intelligent sensing vehicle. First, 0.5 mm high-resolution downward 3D lasers (Figure 1) will be used to automatically detect pavement distresses (e.g. rutting, cracks, etc.) and measure surface macro-texture in relation to friction, raveling, etc. In addition, the sensing vehicle also collects 3D laser cloud data along with 2D image data (Figure 2). Intelligent signal/image processing algorithms will be developed to automatically detect and recognize roadway assets, including signs, pavement markings, cross slopes, etc. In addition, this pavement data is spatially-referenced using GPS, IMU, GPS, DMI, etc. for spatial data integration. And spatial data fusion methods will be developed to extract features of interest, such as pavement distresses, abnormal macro-texture. It is expected we will analyze pavement texture characteristics at macro level and micro level for developing safe, quiet, smooth, and long-life pavements.
- Research project sponsored by the National Academy of Science (NAS) NCHRP IDEA program on “Development of Sensing System for Highway Workzone Hazard Awareness.” Vehicles detection and tracking algorithms will be developed for developing a reliable highway workzone hazard awareness system. In addition, innovative driver behavior study can be conducted using the vehicle trajectories acquired from automatic vehicle detection and tracking algorithms. A probabilistic model will be also developed to quantify the estimation and prediction uncertainties caused by sensing technology. Study of work zone driver behavior based on vehicle trajectory analysis.

- Research project sponsored by Georgia Logistics Innovation Center to develop a maritime awareness system for automatically detecting and recognizing waterway activities (e.g. containers, vessels, dolphins, environmental problems, etc.) through Savannah Port. In addition, another project is to develop a Savannah congestion mitigation system using the advanced sensing system to optimize city traffic flow.

Please contact Professor James Tsai at James.Tsai@ce.gatech.edu if you are interested in the position. For Professor James Tsai's research, please refer to the following web site.

<http://www.ce.gatech.edu/people/faculty/area/tse>

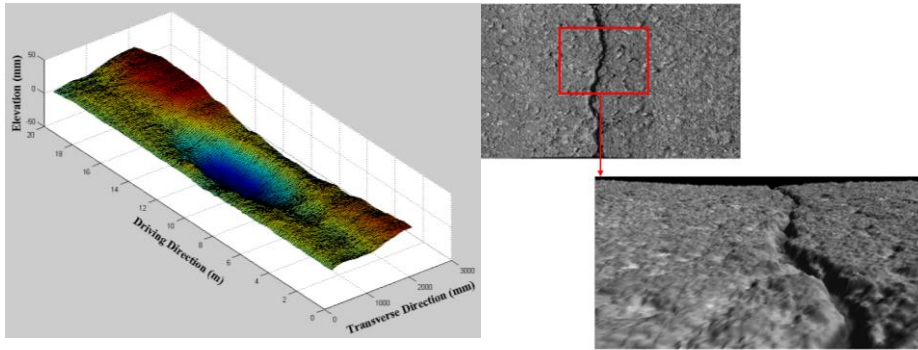


Figure 1: Constructed pavement surface using 3D high-resolution data (rutting and cracks that can be extracted using different frequency ranges)

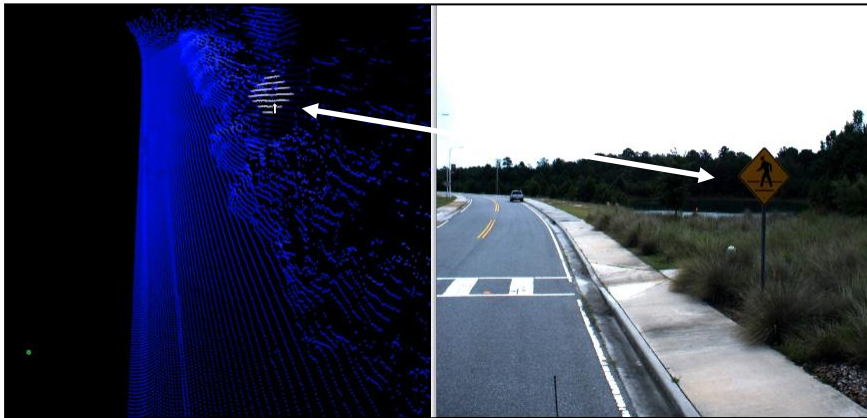


Figure 2: Automatic roadway asset extraction by integrating 3D terrestrial LiDAR data with 2D image.

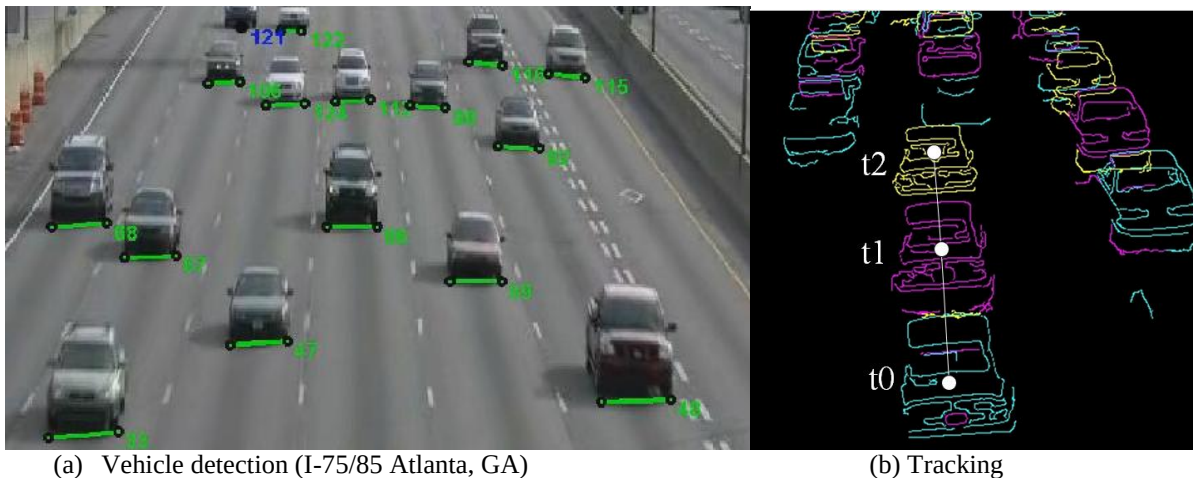


Figure 3: Advanced driver behavior study using vehicle trajectories acquired from automatic vehicle detection and tracking algorithms