LARGE-SCALE CIVIL SYSTEMS

Session Organizers:
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Over the years, civil engineering projects have become larger physically, socially, and intellectually. In general the discipline has not changed its academic paradigms to keep up with these changes. Specifically, new technologies must be integrated to solve problems across many scales of time and size — a systems approach. The speakers in this session have all pushed beyond traditional limits and help us see the civil enterprise across scales.

Starting from a very successful system, Mr. Yoichi Ando will present leading-edge technologies having to do with the continuing development and maintenance of the Shinkansen system. This great technological and logistical achievement requires detailed technical knowledge of geo, structural, mechanical, and aeronautical engineering as well as operations research and social organization. Important elements go beyond the initial design and construction to operations and constant maintenance.

Dr. Michael Todd has integrated the science of fiber optics into field sensing systems, based on first principles of physics. While most of the measurements are of the point variety, Dr. Todd has realized from the beginning that they are truly useful when combined organically to describe the state of the extended system. Dr. Todd will use the work he has done with a 78-channel optical strain gage system developed for, and deployed on, the I-10 in-service interstate bridge as an example of the present (and future) state of the art in optical-based sensing. His work includes analysis and interpretation of data for traffic management and health monitoring.

Dr. Christopher Thewalt is the developer of the Cyclone software for the Cyra/Leica 3D Laser Scanning System and will talk about the frontiers of high definition surveying. The laser scanner captures 3-D surface geometry of complex structures and sites rapidly and accurately. The results are a full set of drawings accurate on the mm scale. The surface geometry of exposed surfaces is remotely captured in the form of dense, accurate "3-D point clouds." The technology has seen rapid growth, with many new companies releasing products to extend hardware capabilities in many competing directions, such as accuracy, resolution, speed, field-of-view, size and weight of the instrument. Despite this attention to the data-gathering devices, there have been relative few companies competing on the software side. There has been a steady growth in the size of the data set that is needed by the end-user, starting at a million points, to the current state of hundreds of millions of points, all usable on a PC class computer. In addition, there has been a client-led revolution in defining new applications that are cost effective, and a clear demand for new tools that facilitate the use of cloud data in new domains. This talk will study the shift of application domains, the change in technology to support the changes, and also identify technologies needed to support future application areas. Real-world applications include compiling complete topo data for the design of a major widening of Highway 880, the K West Coast Main Line asset mapping project, providing the as-built survey of truss connection details for the dome trusses for the restoration of the San Francisco city hall, and the Stanford Digital Michelangelo Project.

Prof. Kazuo Kashiyama will discuss the use of large-scale computer modeling and simulation as a planning and design tool. The effects of natural disasters on urban areas are becoming more and more important as the world's population concentrates in cities. We will see the incredible power of combining numerical computation and geographical information systems (GIS) to realize simulation of natural disasters such as floods and earthquakes. The GIS greatly facilitates the scaling of numerical modeling over scales of time and space.