Workshop on Applications of Remotely Sensed Data to Transportation

12-13 August 1999
Columbus, Ohio

Joel L. Morrison[1], Carolyn J. Merry[1,2]
Mark R. McCord[1,2], and Prem K. Goel[1,3]

[1]Center for Mapping
[2]Department of Civil and Environmental Engineering and Geodetic Science
[3]Department of Statistics

The Ohio State University

Summary Report Prepared for:
Research and Special Programs Administration
U.S. Department of Transportation
Washington, DC

ODOT Agreement No. 8494

Final Report

Research Foundation Project 864326/733062

September 1999

Workshop on Applications of Remotely Sensed Data to Transportation
12-13 August 1999 – Columbus, Ohio

Center for Mapping
Dept. of Civil & Environmental Engineering & Geodetic Science
Dept. of Statistics
The Ohio State University
Columbus, Ohio

Summary Report Prepared for:
Research & Special Programs Administration
U.S. Department of Transportation
Washington, DC

Introduction

The Ohio State University's Center for Mapping was asked by the U.S. Department of Transportation to bring together academic leaders in transportation and remote sensing in a focused workshop. The goal of the workshop was to develop a consensus on priority research for academic participation and to establish a university consortia approach for performing this research. The intent of this workshop was to provide the Research and Special Programs Administration (RSPA), U.S. Department of Transportation (USDOT) with a research agenda that identified several high priority research clusters of remote sensing applications in transportation that USDOT can support in the coming years under the terms of the Transportation Equity Act of 1998 (TEA-21).

The Applications of Remotely Sensed Data in Transportation Workshop was held on 12-13 August 1999 in Columbus, Ohio. This document serves as the summary report after 1-1/2 days of workshop discussions that concluded with a consensus on a set of recommendations for long-term research thrust areas in the use of remotely sensed data in transportation.

Workshop Format

Preparations for the workshop began in July 1999. The USDOT provided us the list of directors for their ten regional transportation centers and their 23 University Transportation Centers. In addition, university colleagues that were well known in the remote sensing and transportation areas were identified. We also identified several individuals at various State Department of Transportation agencies and Municipal Planning Organizations that were potentially influential for integrating remotely sensed data in their transportation activities. The USDOT and the National Aeronautics and Space Administration (NASA) provided additional government and university contacts. These individuals were personally called and/or emailed and invited to the August workshop (the example letter is shown in Appendix A). Individuals contacted were tasked to send three or more research thrust topics that they felt would need to be addressed to facilitate the use of remote sensing and geospatial information technologies in transportation. These forwarded suggestions served as a starting point for the workshop breakout sessions described below. The final list of attendees at the August workshop is shown in Appendix B. A compilation of the suggested research thrust topics submitted by the attendees was provided to each participant at the beginning of the workshop (see Appendix C).

The agenda that was followed for the workshop is shown in Appendix D. We began the workshop with a morning session – *Setting the Stage*. This session consisted of presentations by representatives from the USDOT and NASA. The USDOT presentations focused on how Section 5113 of TEA-21 requires the USDOT to develop a national policy for using remote sensing and geospatial information technologies in transportation. USDOT is responsible to develop a research program and a technology assessment program to implement this policy. In response to this need, the USDOT held a National Forum on Remote Sensing Applications in Transportation at NASA Headquarters in Washington, DC on 11-12 May 1999. This August workshop is a follow-on to the National Forum to provide input from the university community that can serve as a basis for the development of the research program.

The NASA presentations focused on their mission in the Earth Science Enterprise to accelerate development of a pre-eminent U.S. remote sensing industry. NASA activities in the transportation area were described.

A luncheon followed the morning session. During the luncheon, logistics on the breakout sessions were presented. The participants were divided into four groups – blue, red, gold and green – ensuring that there were remote sensing and transportation experts within each group. We presented possible research thrust areas that were based on submissions listed in Appendix C. We attempted to present a wide range of possibilities so as not to bias the groups beforehand, but with sufficient specificity to allow the groups working in parallel to focus in a common manner. We asked that they develop their own research thrust areas independently during the first afternoon of the workshop – *Defining the Research Clusters*. Each group was tasked to develop and prioritize four research thrust areas during the 2-hr breakout sessions. These prioritized areas were then presented to the entire group in a plenary session following the breakout sessions. Discussion and questions were moderated during this plenary session. The topics developed by the four groups are shown in Appendix E.

Later that evening, a group selected by US DOT met to narrow the presented research topics into research cluster areas. These topics were presented on Friday morning and after much discussion were separated into five research thrust areas: environmental assessment; infrastructure management; hazards, safety and disaster assessment; flow modeling; and complementary remote sensing tools to enable research in the thrust areas (essential enabling technologies – EET). Following this plenary presentation and discussion period, parallel breakout sessions were held – one session on each topic. Each participant elected to attend the breakout session of his/her choice depending on personal research interests – *Defining the Research Cluster Agendas*. The EET thrust group met during the first part of the session, then individual members attended one of the other sessions by choice. Each group developed a summary of topics in need of research for their research thrust area during the 2-hr morning breakout session. After a group luncheon, the leader for each session then presented to the entire workshop the research topic areas that were identified for each research thrust.

The final summary of the research thrust areas is described in the following section and is posted on the web at www.cfm.ohio-state.edu, under Workshop on Remote Sensing in Transportation.

Summary of Research Thrust Areas

The five research thrust areas identified are the following:

- environmental assessment
- infrastructure management
- hazards, safety and disaster assessment
- flow modeling
- complementary remote sensing tools to enable research in the above areas (essential enabling technologies – EET)

These research thrusts were grouped into five major clusters to promote collaboration between interested institutions.

Environmental assessment

The environmental assessment topic focuses on four research areas.

Application of remote sensing for assessment of transportation emissions. It would be helpful to conduct research on remote sensing and imaging of gases, such as hydrocarbons, CO, NO_x and particulate matter, using the 3-5 μm wavelength area at a spatial resolution of less than 10 m. Measuring vehicular emissions, finding pipeline leaks as indicated by changes in the surrounding vegetation, and determining the impacts of intermodal transport facilities on surrounding air quality and green space are desirable tasks. Joint cooperation with the Department of Energy and the Environmental Protection Agency would allow collaborative research in this area.

Application of remote sensing to examine the relationships between transportation infrastructure and the environment. This research area is conceived to investigate how changes in the transportation infrastructure impact the environment. Also, there is a need to determine how changes in the environment affect the transportation infrastructure. Specific examples of environmental indicators that could be studied using remote sensing include emissions, urban growth, and urban heat islands (UHI). The transportation infrastructure may cause environmental degradation or even regeneration. Such impacts would include increased erosion, increased runoff and flooding, increased stream pollution and biodiversity impact, or even the return of land to more natural vegetative states.

Use of remote sensing for corridor analysis and planning. Remote sensing can be used to locate appropriate corridors for highways, railroads, and pipelines. Wetlands and historical, cultural and archeological artifacts from remote sensing imagery are examples of the types of information required for corridor analysis. Monitoring noxious weeds, such as kudzo, leafy spurge, thistle, and ragweed/golden rod along these corridors is also important.

Use of remotely sensed data to assess and model the impacts of climate variability and change on transportation networks. Climate variability in precipitation, fog, snowfall, and freezing rain may impact ground and air travel. Global climate change would have impacts on sea level rise, which affect ports and lake levels.

Infrastructure Management

The infrastructure management topic focuses on two research areas. For both topics integrating airborne and satellite-based sensors with ground sensors would be required. Scalability and data handling issues are critical tools for this research thrust and should receive explicit consideration in the EET thrust.

Physical inventory of transportation. A remotely sensed image could serve as a background for various transportation data sets. Remotely-sensed data could also help to update the accuracy of transportation network maps (paper and digital) if important features, such as centerline files (highways and rail systems), *point* locations (*e.g.*, intersections, bus stops) and intermodal centers (air-, surface- and seaports), could be extracted and/or delineated. There is a need to extract *furniture,* such as guardrails, signs, and bridges, along the transportation network. Extracting attributes, such as geometrics and the type of surface (asphalt *vs.* concrete), is also important. Change detection, particularly automatic change detection, is important for all these data sets. The necessary frequency for updating these items would be different depending on whether the goal is mapping, navigation (*e.g.*, rerouting snowplows, trucks or private vehicles) or vehicle control (where there would be a need to know the usable road width, for example). It is also worthwhile to determine appropriate time and mapping scales for state- and region-wide inventories to support various transportation applications.

Condition assessment. Remote sensing could also assist in assessing the condition of transportation network components. Discovering seepage along pipelines is an example. Potholes and pavement markings, rutting, and cracking could be used as inputs to pavement management systems. Off-pavement and off-track elements are also important and could include road cuts and drainage patterns. Airborne sonar sensors might eventually be used to monitor bridge conditions. Monitoring the condition of components of rail networks is also important, and although private companies often perform such monitoring, public agencies might use remote sensing in an oversight capacity.

Hazards, safety and disaster assessment

The hazards, safety and disaster assessment topic focuses on two research areas.

Traveler information system. Near-real-time information is needed on road construction and weather conditions (fog, snow, ice, and storm) for traveler information systems. Integration of the data with existing databases and an appropriate delivery system for this information need to be developed for each local area.

Regional disaster assessment and response. Important data on flood events, hurricanes, tornadoes, wildfires, earthquakes, volcanic events, and lightning that can be obtained through remote sensing need to be integrated with transportation models. These types of remotely sensed data are of value in regional disaster assessment and response, particularly for long-term planning activities. These data might also be useful for hazardous materials routing and for dealing with terrorism events.

Remote sensing to improve near-term and long-term planning studies for an evacuation event needs to be considered. In addition, remote sensing might be useful to plan, monitor and manage evacuation events.

Flow modeling

The flow modeling topic focuses on three research areas.

Traffic counting and classification and analysis. Remote sensing could enhance the present practices used to determine level of service, vehicle miles (kilometers) traveled (VMT/VKT), average annual daily traffic (AADT), and vehicle classifications and counts. Efficient methods to derive these and other transportation statistics using remotely sensed data obtained from air or satellite-based platforms need to be developed. The modeling aspects of traffic flow need to be considered. Data obtained from airborne or satellite platforms would emphasize densities and velocities and might prove helpful in calibrating and validating travel demand models. Current models would need to be modified to use this additional remote sensing data. The impact of network geometry and roadside features on traffic flow might also be investigated with remotely sensed data. Remotely sensed data can help produce more accurate land use estimates. Such land use estimates can be coupled with contemporary flow observations to calibrate flow models that use land use measures as input. Enhancing ITS (intelligent transportation system) data and linking these data with remote sensing data for use in urban and regional scale traffic applications might prove valuable. Images could also be incorporated in many parking studies and might prove helpful in determining circulation patterns in downtown areas or at special events.

Observation of intermodal behavior. Remote sensing might help to determine passenger and freight flows and to assist in observations of intermodal centers (park-and-ride facilities, ports, TOFC/COFC, air/rail/bus/ferry terminals) and also identify congestion points and patterns. Remote sensing might help to estimate the demand at terminals, as well as assist in modeling the relationships and interactions between these demands.

Visualization and exploratory data analysis. Data mining of multisensor databases (ground-based sensors (*e.g.*, loop detectors) and image data (*e.g.*, video)) for hypothesis generation and geographic visualization of traffic flow data is critical. Spatial accuracy of data is also important.

Complementary remote sensing tools to enable research in the above areas (essential enabling technologies – EET)

Essential enabling technologies (EET) are critical for applying remote sensing data in transportation and are considered fundamental for performing the research in the other functional areas. EET may need to be coordinated among institutions performing research in remote sensing in transportation. Tools that need to be considered in transportation research are classed into six areas: near-real time data reduction, data extraction/data mining, integration, dynamic data fusion, presentation and visualization, and standardization/interoperability.

A multi-sensor approach for analysis of the research topics is necessary. Fundamental preprocessing issues for application to the large amount of remotely sensed data of potential use to transportation studies must be studied. Humans cannot deal with these vast amounts of data, and machines must be the initial users. Useful thematic extraction and data mining tools are therefore necessary. Scaling issues – spatial, temporal, radiometric – need to be considered for remotely sensed data used in transportation. There is a need to determine the kinds of information that can be obtained from hyperspectral sensors that would be useful for transportation issues (for example, the spectral signatures of different types of elements associated with transportation, particularly in urban areas). Referencing systems ranging from 1-D to 4-D are important. Systems of sensors that automatically interact and collect meaningful data are required. Sensor and image understanding are critical for optimal automated data extraction.

There are a number of issues to address in the integration, registration and data modeling of transportation data. Various platforms, such as satellite, aircraft, tethered balloons, and UAVs (unmanned aerial vehicles), need to be investigated for use in acquiring transportation data. Consideration of the capability of a sensor to acquire information that can be processed in real time and obtained in all-weather and all-light conditions is necessary. The fusion of real-time information with existing transportation data and the visualization and presentation of transportation data are extremely important. Current visualization techniques are not fully utilized by transportation experts. Methods for digital holographic representations and 4-D representation of data – for example, portraying the linkages of temporal changes in transportation infrastructure and flow patterns with temporal changes in land use, air quality, and urban heat islands – could lead to novel insights.

Data quality is critical. Archival data standards need to be developed. Implementing efficient state-of-the-art database management techniques is important. Education and public outreach activities and products are important for media attention and public recognition of the broad benefits of the work being done in transportation.

Conclusion of the Workshop

The final session – *The Next Steps* – was moderated by USDOT. Appreciation was extended to the participants for making the two days a successful workshop. Assurance was given that the recommendations generated from the workshop will be used by USDOT to create a framework for research that can be used to develop the technology base for future applications focusing on commercial remote sensing products that can be implemented in transportation practices.

Appendix A. Invitation Letter

Dear Colleague:

You are invited to attend and participate in a workshop, Applications of Remotely Sensed Data to Transportation, to be held on The Ohio State University campus on August 12 and 13, 1999.

Section 5113 of the Transportation Equity Act (TEA-21) of 1998 requires the U.S. Department of Transportation to develop a national policy for use of remote sensing and geospatial information technologies in transportation. In addition, a research program to implement this policy is to be developed. In response to this legislation, the DOT held a National Forum on "Remote Sensing Applications in Transportation" at NASA Headquarters in Washington, D.C., on May 11 and 12, 1999. (A short summary is attached.)

To further respond, The Ohio State University's Center for Mapping was asked by DOT to bring together academic leaders in transportation and remote sensing in a focused workshop. The goal is to develop a consensus on priority research for academic participation and to establish a university consortia approach for performing this research.

The workshop's intent is to provide DOT (Research and Special Programs Administration) with a research agenda which identifies several high priority research clusters of remote sensing applications in transportation that DOT can support in the coming years under the terms of TEA-21. To help us focus the discussions at the workshop, we would request that you forward, by August 5th to the e-mail address below, three or more research thrusts which you think would need to be addressed to facilitate the use of remote sensing and geospatial information technologies in transportation. We plan to begin the workshop with break-out groups who will use these forwarded suggestions as a starting point.

Please let us know by return e-mail to rstransp@cfm.ohio-state.edu your acceptance/unavailability of this invitation and your suggestions for research thrusts. Once we have your intention to attend, we will forward additional information about the workshop, hotel accommodations, a detailed agenda, and other necessary information.

We apologize for the short notice, but we are certain that you will agree that the potential impact of this workshop is well worth any time inconvenience that we might experience on a personal basis.

Sincerely yours,

Joel L. Morrison
Professor/Director
Center for Mapping
The Ohio State University

Appendix B. Attendees List

Workshop on Applications of Remotely Sensed Data to Transportation
The Ohio State University, Columbus, Ohio
12-13 August 1999

Attendees	*Affiliation*	*E-Mail Address*
Richard Beck	University of Akron	beckra@alexia.lis.uiuc.edu
Jim Bethel	Purdue University	bethel@ecn.purdue.edu
Andrew Blanchard	University of Missouri	BlanchardA@missouri.edu
John Bossler	Ohio State University	jbossler@aol.com
Ron Boenau	Federal Transit Administration	ronald.boenau@fta.dot.gov
Kim Boyer	Ohio State University	kim@ee.eng.ohio-state.edu
Dorota G. Brzezinska	Ohio State University	dorota@cfm.ohio-state.edu
Bob Brower	Cayuga County, New York	bbrower@co.cayuga.ny.us
Mark Byram	Ohio DOT	mbyram@dot.state.oh.us
Fenton Carey	USDOT	fenton.carey@rspa.dot.gov
William Carter	University of Florida	bcarter@ce.ufl.edu
Sanjay Chawla	University of Minnesota	chawla@cs.umn.edu
Sastry Chilukuri	Ohio State University	chilukuri.1@osu.edu
Shih-Miao Chin	ORNL	hlc@ornl.gov
Kevin Czajkowski	University of Toledo	kczajko@pop3.utoledo.edu
Jerome Dobson	ORNL	jed@ornl.gov
Jerry Everett	University of Tennessee	jeverett@utk.edu
Charles Fleming	Georgia DOT	bird@dot.state.ga.us
Rick Forster	University of Utah	rick.forster@geog.utah.edu
Robert Frohn	University of Cincinnati	robert.frohn@uc.edu
Sasikala Ganesan	Ohio State University	sasi@cfm.ohio-state.edu
David Gardner	Ohio ODOT	dgardner@dot.state.oh.us
Alan Gertler	Desert Research Institute	alang@dri.edu
Tom Glancy	Minnesota DOT	tom.glancy@dot.state.mn.us
Robert Glass	NASA Jet Propulsion Lab	robert.r.glass@jpl.nasa.gov
Prem Goel	Ohio State University	goel.1@osu.edu
Kathleen Hancock	University of Massachusetts-Amherst	hancock@kirk.ecs.umass.edu
Lawrence J. Harman	Bridgewater State College	lharman@bridgew.edu
George Hepner	University of Utah	george.hepner@geog.utah.edu
Mushtaq Hussain	California State University-Fresno	mushtaqh@engr.csufresno.edu
Mei-po Kwan	Ohio State University	Kwan.8@osu.edu
Ron Li	Ohio State University	li.282@osu.edu
Don Light	Litton	dllight@emerge.wsicorp.com
Tony Manch	Ohio DOT	tmanch@dot.state.oh.us
Duane Marble	Ohio State University	marble.1@osu.edu
Tom Marchessault	USDOT	Tom.Marchessault@ost.dot.gov
Mark McCord	Ohio State University	mccord.2@osu.edu
Linda Meadows	Ohio State University	meadows.1@osu.edu

Carolyn Merry	Ohio State University	merry.1@osu.edu
Harvey Miller	University of Utah	harvey.miller@geog.utah.edu
Wayne Mooneyhan	NASA Headquarters	mooney@usra.edu
Stanley Morain	University of New Mexico	smorain@spock.unm.edu
Joel Morrison	Ohio State University	morrison@cfm.ohio-state.edu
Terri Mulhern	University of Toledo	theresa_mulhern@hotmail.com
Val Noronha	VITAL/NCGIA	noronha@ncgia.ucsb.edu
John Nystuen	University of Michigan	nystuen@umich.edu
Morton O'Kelly	Ohio State University	okelly+@osu.edu
Umit Ozguner	Ohio State University	ozguner.1@osu.edu
Tom Palmerlee	NAS/NRC TRB	tpalmerl@nas.edu
Steve Perone	Portland MPO	perones@metro.dst.or.us
John Phillips	TRC, Inc.	phillij@trcpg.com
Dale Quattrochi	NASA Marshall Space Center	dale.quattrochi@msfc.nasa.gov
Forrest Robson	North Carolina DOT	frobson@dot.state.nc.us
Michael Rodgers	Georgia Institute of Technology	michael.rodgers@ce.gatech.edu
Herman Rodrigo	FHWA Ohio	herman.rodrigo@fhwa.dot.gov
Jie Shan	Purdue University	jshan@ecn.purdue.edu
Ed Sheffner	NASA Ames Research Center	esheffner@mail.arc.nasa.gov
Reginald Souleyrette	Iowa State University	reg@iastate.edu
Herbert Tesser	Marshall University	tesser@marshall.edu
K. Thirumalai	US DOT	K.Thirumalai@rspa.dot.gov
Carolyn Thornton	Mississippi DOT	cthornton@mdot.state.ms.us
John Usher	Mississippi State University	usher@engr.msstate.edu
Robert Vincent	Bowling Green State University	rvincen@bgnet.bgsu.edu
Alan Vonderohe	University of Wisconsin	apvonder@facstaff.wisc.edu
Michelle Von-Ville	Ohio State University	von-ville.1@osu.edu
Kelvin Wang	University of Arkansas	kcw@engr.uark.edu
Fredrick Wilson	Morgan State University	fwilson@eng.morgan.edu
Demin Xiong	ORNL	xiongd@ornl.gov
Pany Zafiropoulos	Ohio State University	pany@cfm.ohio-state.edu

Other participants from The Ohio State University who helped in the organization of the workshop and should be thanked include:

David Ashley	Dean, College of Engineering	ashley.33@osu.edu
Keith Bedford	Chair, Dept. of Civil & Environmental Engineering & Geodetic Science	bedford.1@osu.edu
Cheena Srinivasan	Associate Dean for Research, College of Engineering	srinivasan.3@osu.edu
Sally Krause	Center for Mapping	krause@cfm.ohio-state.edu
Diane Rano	Center for Mapping	rano@cfm.ohio-state.edu

Proposed Research Thrusts for Remote Sensing in Transportation Workshop

Use of remote sensing imagery for modeling activities

Use of remote sensing to measure activities at nodes in networks, not just on links; particularly relevant at transportation intermodal ports – remote sensing would allow the *big picture* on the total level of interaction

Imagery for use in determining driving behavior by understanding vehicle trajectories

Ocean routing modeling

Use of images in disaster planning to update and provide new routing patterns during loss of links (*i.e.*, water-covered roads, rail or low flow in river) to provide rapid re-routing plans and for use in evacuation modeling

Use of remote sensing data to calibrate/validate microsimulation planning models (TRANSIMS)

Use of remote sensing data to calibrate/validate traditional, sequential planning models

Use of remote sensing to monitor/plan parking and downtown circulation/special events

Corridor planning

Change detection and correlation (*e.g.*, leading towards integrated land use planning and transportation planning models)

Is it possible for remote sensing of transport flows to completely change the way that we do transport planning

What are the best ways of forecasting flows if we have link volume data available for a long time series

Emerging need for real-time traffic data to support online advanced traffic management systems (ATMS) and advanced traveler information systems (ATIS) applications

Use of remote sensing for infrastructure management

Inventory of traffic signs using real time mapping

Infrastructure management and assessment – cracks, potholes

Mobile mapping (GPS/INS/camera) for automatic traffic objects recognition (signs, lights, centerline, surface damages)

Integrating digital imagery, pattern recognition software, inertia measurement systems and GPS in a mobile platform for asset management

Use of GPS to improve traffic measures

Sensitivity issues when GPS in moving vehicles

Use of airborne and ground-based ranging applications and GPS to model three-dimensional surfaces

Ground control point chip library for important road intersections; chip data used to check geometric accuracy of satellite data

Development of improved GPS hardware and algorithms to achieve reliable, real-time sub-decimeter positioning and navigation for transportation applications

Design of a real-time GPS signal augmentation system to support sub-decimeter accuracy transportation applications

Traffic measures from remote sensing imagery

Updating maps used on CD-ROMs for use in vehicles

Change detection between images to track traffic dynamics and change

Where are vehicles during snow removal operations

Collection of street and road centerlines for vehicle navigation and emergency dispatch applications; collection of other transportation facility extents, land use and land use change, capacity analysis

Vehicle detection/location and precise highway/freeway mapping and GIS

Automatic extraction of road networks from high-altitude imagery

Automated delineation and classification (*e.g.*, pavement type) of transportation infrastructure

Automated inventory and classification of traffic

Use of remote sensing for speeding up the bridge and toll road booth bottleneck problems, as well as monitoring the location and operating conditions of vehicle fleet units, not only locally, but also internationally.

Application to congestion management solutions in terms of traffic flow, signalization variation - real-time electronic signage information is important

Use of remote sensing for rural transportation activities

Transportation surveillance applications of the network-based wireless geolocation technologies envisioned for E-911 solutions

Digital holographic database of selected transportation corridors, such that a 3-D simulated drive could be made along the highway. Stereo digital camera would be flown to create a high-resolution DEM (digital elevation model) and DOP (digital ortho photo) file.

Real-time applications of remote sensing data

Real time helicopter-borne traffic stall and accident mapping

Traffic management

Precise lane width (to ~10 cm level) for use with semi-automated vehicles

Use of the vehicle as a probe to send road friction data back to a Traffic Center

Machine vision techniques for automatic vehicle maneuvering and vehicle tracking

Method for extracting lateral vehicle deviations from videolog images for establishing over-the ground *truth* for mobile roadway inventory systems

Frequent update of road traffic counts, especially from a regional system perspective, and with special emphasis on detecting recurring patterns in congestion

If we have the universe of flows in real time, it would be possible to develop dynamic models of arrivals at intersections, malls, and special events – transport questions that have never been asked before because of the lack of real time data

Misc. topics

Imagery for determining atmospheric constituents

Investigation into precise determination of terrain elevation using stereoscopic imagery

Subsidence measurements of coal mines from old and new stereo aerial photographs at 1-ft resolution. Also, SAR interferometric radar data could be collected to compare with aerial photo measurements.

An integrated aerial data acquisition system for engineering design in heavily vegetated and rugged terrain

Legal and technical considerations for the certification, maintenance and distribution of digital engineering assets

Creation of a standard format for data preservation during network exchange of large engineering data files

Air and water transport monitoring and guidance

Better prediction of the close of navigation channels due to ice freeze-up in the Great Lakes, St. Lawrence Seaway and Alaska

WORKSHOP

On

Applications of Remotely Sensed Data to Transportation

Agenda

Thursday, August 12, 1999

Setting the Stage

7:30 - 8:30 Registration and Continental Breakfast

8:30 – 8:45 Welcome by Dean David Ashley, College of Engineering, The Ohio State University

Logistics - Joel L. Morrison, Director, Center for Mapping, The Ohio State University

8:45 - 10:15 Remarks from Department of Transportation

Department of Transportation Overview – Fenton Cary, Associate Administrator, Research and Special Programs Administration, USDOT

Setting the Stage for the Workshop – K. Thirumalai, Chief Engineer, Research and Special Programs Administration, USDOT

Transportation Policy Development – Thomas Marchessault, Office of Transportation Policy Development, USDOT

Questions and Answers Period

10:15 – 10:45 Break

10:45 – 12:15 Remarks from National Aeronautics and Space Administration

NASA Video

NASA Overview – Wayne Mooneyhan, Senior Scientist, Earth Sciences Program, Universities Space Research Association

NASA Interests and Ideas – Dale Quattrochi, Earth Science and Applications Division, Marshall Space Flight Center

Intelligent Transportation Systems – Robert Glass, Intelligent Transportation Systems, Project Manager, Jet Propulsion Laboratory

Future Sensors and Satellites – Ed Sheffner, Senior Research Scientist, Earth Systems Science and Policy, Ames Research Center

Questions and Answers Period

12:15 – 1:15 Luncheon

1:15 – 1:30 Logistics of the Break-out Sessions

Defining the Research Clusters

1:30 – 3:30 Break-out Sessions for participants to define and prioritize research cluster topics

3:30 – 4:00 Break

4:00 – 5:30 Reports from Break-out Sessions to Workshop

(The reports of the breakout sessions will be distilled into four cluster topics on Thursday evening. Topics will be posted Thursday night for Friday's breakout sessions. Participants are free to select which cluster topic they will attend on Friday morning.)

6:30 – 8:00 Reception sponsored by the Department of Civil and Environmental Engineering and Geodetic Science (Keith Bedford, Chair), and the Center for Intelligent Transportation Research (Umit Ozguner, Director) – Math Tower (map on back of invitation)

Friday, August 13, 1999

7:30 - 8:30 Continental Breakfast

Defining the Research Cluster Agendas

8:30 – 11:30 Break-out Sessions (one per each cluster topic)
(break between 10:00 and 11:00 AM at the discretion of session chair)

11:30 – 1:00 Buffet luncheon

1:00 – 3:00 Reports from break-out sessions

3:00 - 3:30 Break

The Next Steps

3:30 – 4:15 Discussion of "What's Next": Fenton Carey and K. Thirumalai, USDOT

4:15 – 4:30 Closing Remarks and Adjournment

Appendix E. Research Topics Identified by the Groups

Gold Break-out Session – Group Leader, John Bossler

This breakout session assumed that a system of remote sensors would serve as a framework for sensor systems and planning. A suite of remote sensing sensors would be a set of assets to derive information on the infrastructure. The four topic areas identified included:

1. Impact of transportation on the environment (for example, air quality *vs.* land use/land cover).
2. Flow analysis and modeling. Several data sources would need to be integrated.
3. Infrastructure assessment and management.
4. Impact of the environment on transportation and the assessment of driving hazards.

An aside was mentioned that DOT and NASA should develop a joint research outreach effort to foster the teaching and use of the capabilities of remote sensing and related technologies, as applied to transportation.

Green Break-out Session – Group Leader, Stan Morain

This breakout group considered the tools necessary for assessing and advancing the role of transportation. They addressed issues that considered what remote sensing could do that they could not do with existing methods. Topics developed included:

1. Extraction – automated image extraction, image understanding, urban sprawl.
2. Integration in space and time.
3. Registration, conflation, geocoding and attribution.
4. Education
5. Presentation and visualization using man-machine interfaces.
6. Standardization, interoperability, datum standardization processes, with no loss of information.

The group focused more on the tools necessary to achieve advancement with remote sensing data. The group listed four areas for focus: planning and environment, emergency response (E911), infrastructure management, and operations.

Red Break-out Session – Group Leader, Jerry Dobson

Four research thrust topics were developed. These include:

1. Decision support for transportation systems, including development, rural transportation and corridor planning.
2. Transportation efficiency, considering dynamics, nontopological effects and infrastructure updating.
3. Environmental assessment and monitoring, to include detecting emissions and archeological and cultural resources.

4. Hazard/disaster/emergency management, to include incident management in real time.

Blue Break-out Session – Group Leader, Umit Ozguner

There were 14 thrust topics developed. The top seven topics generated by this group is listed below in priority:

1. Fusion of sensor data for dynamic situations (aircraft, satellite and ground).
2. Performance assessment and asset management through integration of remote sensing and GIS.
3. Real-time visualization and virtual environments for transportation.
4. Environmental assessment.
5. Integration of modeling, value-added data and geospatial data sets for traffic flow.
6. Automated data mining, extraction of value-added information, pattern discovery.
7. Evaluation of new sensors for transportation requirements.