PHOTOGRAMMETRIC RESEARCH PROJECTS AT MICHIGAN TECH INTEGRATED GEOSPATIAL TECHNOLOGY PROGRAM

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EXTENDED ABSTRACT:

Michigan Technological University (Michigan Tech) is a research university located in the Upper Peninsula of Michigan. Michigan Tech is a leader in both undergraduate and graduate science, technological, and engineering education and research. Michigan Tech began as the Michigan Mining School in Houghton in 1885 to train mining engineers to better operate the local copper mines. The university is now organized into two Colleges (Engineering and Science & Arts), and three Schools (Forest Resources & Environmental Science, Business, and Technology). Michigan Tech offers over 120 degree options, including 37 masters and 25 doctoral options. Our university includes 437 faculty, over 6000 undergraduates, and approximately 1000 graduate students.

Michigan Tech is an emerging research institution with approximately $65 million in annual research expenditures in 2011-2012. Over the last five years, Michigan Tech has had the fastest growing research program in the State of Michigan. The National Science Foundation's most recent national research rankings list Michigan Tech 163rd among all research institutions (662) and 118th among public national institutions, 66th among institutions without medical schools. In addition, Michigan Tech has the highest number of licenses and invention disclosures (per $10 million in research) of any Michigan institution. The university is listed as a high research activity, STEM-dominant institution under the current Carnegie classification, and produces 50-60 science and engineering PhDs per year.

Faculty from several areas on campus collaborate on remote sensing and GIS-related research. In the School of Forest Resources and Environmental Science, remote sensing and geographic information science are used to gain a better understanding of how the underlying spatial patterns of vegetation, animals, and natural features are related across landscapes, ultimately leading to more-informed decisions regarding the sustainable use of resources. Our faculty investigates these areas using technologies such as remotely sensed imagery, geographic information systems

(GIS), and the Global Positioning System (GPS), presenting their results on paper and digital maps. Faculty from the School of Technology and Geological and Mining Engineering and Science also collaborates on related research.

Likewise, faculty from across campus collaborate on water-relate research. Our faculty study many areas of water resources, including forest and wetland ecohydrology, vegetation-atmosphere exchange of water, the effect of climate change on hydrological processes, hydrological modeling, water-resource conservation and sustainability, wetland restoration, classification, mapping, aquatic-terrestrial links, and conservation and management of wetland and upland ecosystems. Faculty from biology and civil/environmental engineering are also active in freshwater research. Our success in water-related research recently led the State of Michigan to commit resources to construct at $25 million Great Lakes Research Center(GLRC) on the campus of Michigan Tech. Center already started its operations and many geospatial faculty members, researchers and students are involved in GLRC projects.

Integrated Geospatial Technology graduate program was established in 2010 and currently is heavily involved in the training of the geospatial workforce in the United States and many other countries.

(http://www.mtu.edu/gradschool/programs/degrees/geospatial/) Research performed by Integrated Geospatial Technology graduate students is an important program element bringing a bridge between training and education. Current presentation outlines some preliminary results from two graduate student research projects associated with photogrammetric science and engineering.

The first project is OpenPhotogrammetry and it is associated with the development of the open-source geospatial web-portal challenging photogrammetric processing of remotely sensed imagery. OpenPhotogrammetry geoportal operates objects representing different types of solutions for various geospatial imaging sensors. OpenPhotogrammetry, when fully developed, is foreseen as a useful instrument for the research of sensors deployed in global mapping in the framework of Service-Oriented Programming Architecture (SOPA) as depicted in Figure-1a. Figure-1b is a sample of the current state of Openphotogrammetry geoportal web-implementation.

A second project outlined in current presentation is associated with the development of the collaborative environments based on novel human-computer interaction technologies such as encephalogram of the brain (EEG) and eye-tracking (ET). The establishment of optimal human-computer symbiosis when the computer system is designated to perform operations where computer algorithms are more efficient and humane analyst can perform operations where the human brain is more efficient than a computer is a promising research direction. Figure-2a outlines an operational workflow of such a collaborative geospatial information processing environment.

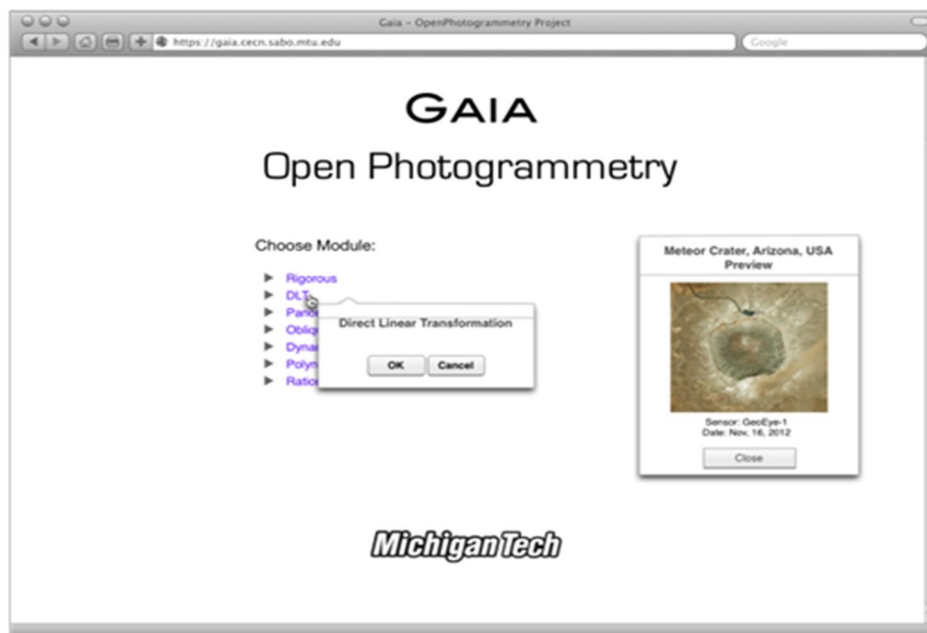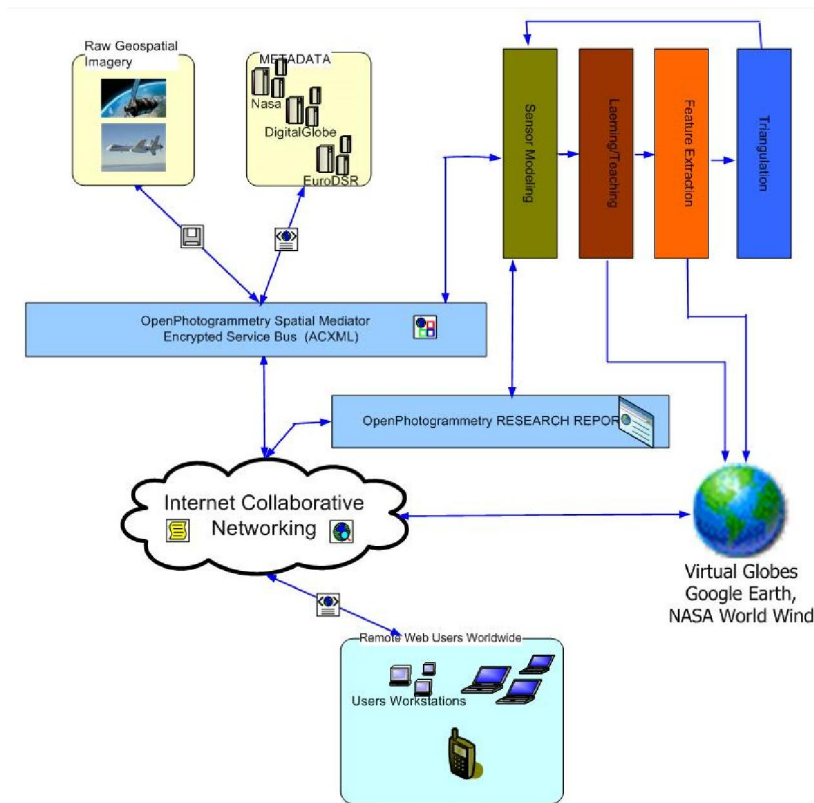Figure-2b shows such a collaborative environment experimental use for teaching Photogrammetry.

Figure-1 a) Structure of the OpenPhtogrammetry as a SOPA b) Sensor model selection screen of the current version OpenPhotogrammetry geoportal.
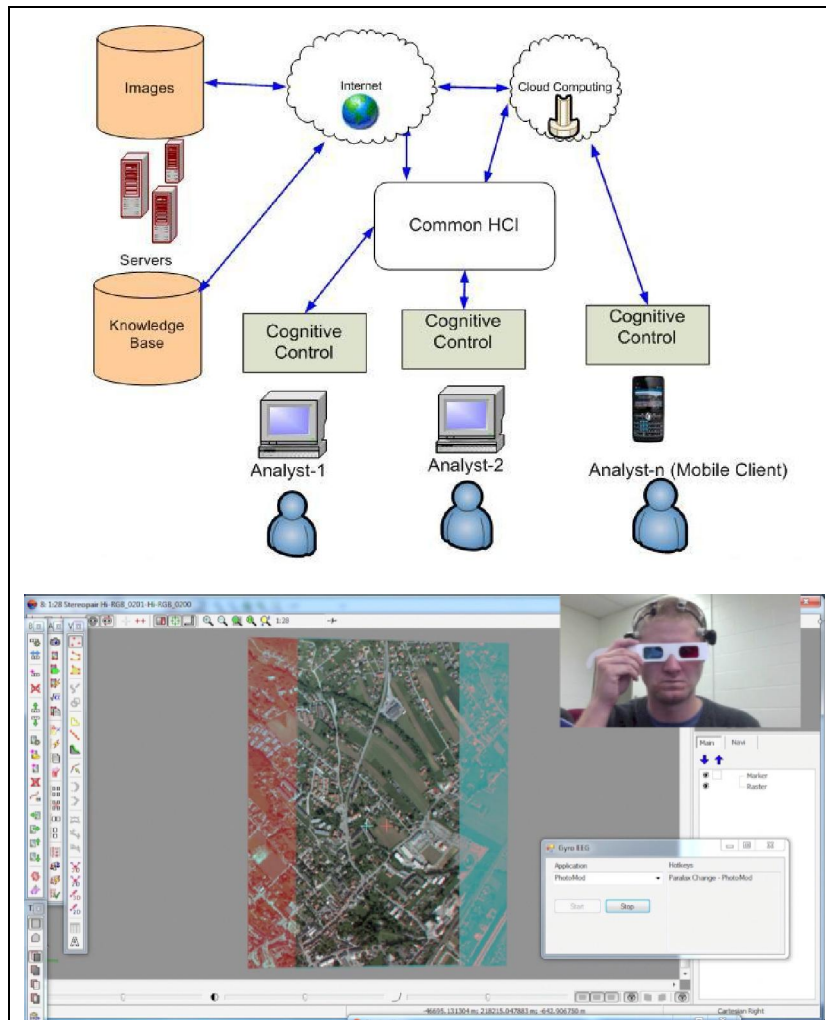
Figure 2 a) Collaborative geospatial environment system architecture b) Experiment of cognitive control of softcopy photogrammetric workstation in application for Photogrammetry teaching.

Both projects can be termed as a "knowledge fusion" because are associated with integration of geospatial disciplines (photogrametry, geodesy, cartography, GIS) and non-geospatial disciplines such as computer sciences, data mining, human-computer interactions and cognitive sciences. Such a research projects are very important elements of training modern geospatial workforce for the global mapping and other modern world challenges. Presentation outlines the current state of research projects in more details.

BIOGRAPHICAL NOTES

Dr. Eugene Levin, CP, Program Chair of Surveying Engineering and Assistant Professor at School of Technology at Michigan Tech University. Dr. Levin also directing Integrated Geospatial Technology graduate program. He received M.S. degree in astrogeodesy from Siberian State Academy of Geodesy in 1982 and Ph.D in photogrammetry from Moscow State Land Organization University in 1989. He is UP Michigan regional director for of American Society of Photogrammetry and Remote Sensing (ASPRS). Dr. Eugene Levin is

an ASPRS Certified Photogrammetrist. Dr. Levin intensively involved in the Michigan Tech Geospatial Initiative development, and is a geospatial technology expert in the fields of photogrammetry, aerial and satellite imagery, remote sensing, GIS, 3-D terrain modeling visualization automated feature extraction, and digital cartography. He has 25+ years of experience in US, Israeli and Russian academy and geospatial industry. He held research and managing positions with several Russian, Israeli and US research, academic institutions and high-tech companies, including: Research Institute of Applied Geodesy, Omsk Agricultural Academy, Rosnitc "Zemlya", Ness Technologies, Physical Optics Corporation, Digital Map Products, American GNC, and Future Concepts. He has served as a Principal Investigator and Project Manager in multiple award-winning government programs.

Kevin Takala is a graduate student at Integrated Geospatial Technology graduate program. He obtained a B.Sc. in Surveying Engineering from Michigan Tech University in 2011. His research is concentrated in 3D Visualization and use of EEG systems for geospatial application control.

Ioakeim Tellidis is a graduate student at Integrated Geospatial Technology graduate program. He obtained a B.Sc. degree in Structural Engineering from the Technical University of West Macedonia (Greece) in 1996. His interests and past projects related to photogrammetric processing of the UAV imagery bring him to work on his graduate degree with Michigan Tech.