

Report on the Workshop Design Issues of Softcopy Photogrammetric Workstations

The Workshop - organized by the International Society for Photogrammetry and Remote Sensing Intercommission Working Group II/III, "Design and Algorithmic Aspects of Digital Photogrammetric Systems," and supported by the American Society for Photogrammetry and Remote Sensing - was held at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado on 21 and 22 March 1991. Dr. Heinrich Ebner of the Technical University Munich and Dr. Ian Dowman of University College London were co-chairmen of the Workshop while Dr. Franz Leberl of VEXCEL Corporation in Boulder was the local organizer.

TECHNICAL SESSIONS

The Workshop opened with some introductory thoughts on softcopy photogrammetry by Franz Leberl. He posed the question: "Why worry about softcopy photogrammetric systems?" and went on to note that such systems provided an opportunity to automate, they were less costly because they replace optical-mechanical components with standard computers and software, they allow non-photogrammetrists to employ the technology, and they provide increased opportunity for integration, quality control, and predictability. He then went on to list some 16 vendors of softcopy photogrammetric workstations and indicated some of the formal programs in academia, industry, and government for advancement of the technology. After discussing the elements of a softcopy system-illustrated with a flow chart-he closed by highlighting key questions in the technology, including that of automation (a focus of interest throughout the Workshop).

H. Ebner spoke on the "Goals and Activities of the ISPRS Intercommission Working Group II/III," noting that the group was formed following the ISPRS Kyoto Congress in 1988. The Working Group was to pursue three topics: (1) The definition of functions and performance of digital photogrammetric systems (DPS), to include design and algorithmic aspects; (2) the evaluation of existing systems, including both general purpose and special purpose (i.e., close-range) systems; and (3) proposals for further development. He noted that the working group included 74 members from 14 countries and that meetings had already been held in Stuttgart (September 1989), London (February 1990), Tsukuba (May 1990), Wuhan (May 1990), and Dresden (September 1990). Following the present Workshop, meetings are planned for Munich (3-6 September 1991) and at the ISPRS Congress in Washington, D.C. (2-14 August 1992), to include one session, two joint sessions, and a tutorial.

The opening session closed with a discussion of "European Developments in Digital Photogrammetric Workstations" by I. Dowman (H. Ebner and C. Heipke, coauthors). He began by listing some key historical points in the development of digital photogrammetric workstations (DPWS), noting that special purpose hardware was not required, and that parallel processing and standard architectures were emerging. Governing concepts were the importance of software, elimination of the human op-

erator (eventually), and that the development must be based on sound theory. This was followed by descriptions of both commercial and academic developments in hardware and software, and a discussion of future developments.

In the opening paper of the second morning session, F. C. Paderes of Purdue University (J. Bethel and E. Mikhail, coauthors) spoke on the "Photogrammetric Softcopy Stereo System at Purdue University," including the design, software capabilities, and computer hardware (SUN 4/280, PIXAR II Image Computer, and TEKTRONIX SGS 625 Stereo Display Monitor). Initial efforts included reduction of stereo SPOT imagery and digitized stereo aerial frame photography.

In the final paper of the morning, R. Welch of the University of Georgia described "Three Dimensional Mapping on Personal Computers," with emphasis on the many capabilities and applications of the Desktop Mapping System (DMS), including automatic stereocorrelation and the generation of perspective views.

Opening the first afternoon session, F. Ray Novelle of the U. S. Army Engineer Topographic Laboratories, in his paper, "Stereo Correlation: Options and Parameter Designs," described research carried out to determine methods for determining optimum spacing between correlation windows, window shaping, window size, and search limits; for point prediction and image correlation; and for editing of the automatically produced digital elevation data. A unique method of utilizing orthophotos generated from each image of the stereo pair and the digital elevation data was described.

George Lee of the U. S. Geological Survey (C. Skalet and L. Ladner, coauthors) provided a detailed description of a system developed for monoscopic revision utilizing digital orthophotographs. This included pilot projects carried out for Waukegan, Illinois and Mont Belvieu, Texas. Future investigations include the implementation of softcopy stereo aerotriangulation, autocorrelation for the production of digital elevation models, and softcopy stereo revision.

"Design Considerations for Softcopy Photogrammetry Workstations" was the subject of a paper given by Toni Shenk of The Ohio State University (C. Toth, coauthor). He began with a conceptual flow using a top-down approach which started with raw images, resampled images in epipolar geometry, a skeletal object space, a segmented and labeled object space, and, finally, a geometric and semantic description of object space. Automatic relative orientation, manual absolute orientation, and recovery of surfaces are the bases for the system. He noted that fully automated cartography is years off!

The final paper of the first-days session, "DVP-The Digital Videoplotter Developed by Laval University," was presented by P. A. Gagnon of Laval University (C. Nolette and J. P. Agnard, coauthors). The DVP, originally developed as an educational tool but now being marketed commercially, is a PC-based system utilizing a moving cursor and mirror stereoscope viewing of a split screen CRT monitor. It provides all the capabilities of an analytical plotter utilizing digitized photographs.

The second-days technical session opened with the paper, "Shading and Stereo Yield Shape and Reflectance," by B. Horn of the Massachusetts Institute of Technology. He began with a history of shape from shading, going on to basic image formation (perspective projection and scene radiance or brightness), and noting simplifying assumptions such as distant light source (providing constant illumination) and distant viewer (providing an orthographic projection). He further noted that machine vision is hard and that one must use sensor fusion, and combine shape from shading with stereo, because stereo, though it gives absolute height, provides sparse information while shape from shading gives detail.

D. McKeown of Carnegie Mellon University spoke on "Photogrammetric Support for Image Understanding: Issues for Softcopy Workstations." Workstation issues included utilization of off-the-shelf hardware, specialized hardware for image display processing and manipulation and for stereo matching, software environment for manual and semi-automated model construction and to support automated scene analyses, and database support. Rigorous camera models, a database system with ample/accurate three-dimensional ground control, flexibility, and modular implementation are desirable. Photogrammetric support should include stereo registration, perceptual grouping, object modeling, cartographic feature extraction, monocular and stereo fusion, stereo refinement, and sensor fusion.

S. Miller of Helava Associates (U. Helava and K. Devenecia, coauthors), in speaking about "Implementation of Softcopy Photogrammetric Workstations," began with the historical development of softcopy systems by General Dynamics, including the Digital Stereo Comparator/Compiler (DSCC) for the Defense Mapping Agency, later developments for that same agency, and recent developments of lower cost commercial systems.

In the next paper, "Consideration in the Design of a System for the Rapid Acquisition of Geographic Information," A. Ahac of MacDonald Dettwiler, Vancouver, Canada (R. Defoe, Canada Centre for Remote Sensing, Ottawa, and M. van Wijk, National Research Council, Ottawa, coauthors) described their development of the Topographic Database Revision System (TDBRS). The TDBRS will provide interactive support in the form of a high resolution stereoscopic display and edit, a control point marker/geometric modeler, and a transform editor. Automated transforms include geocorrection, radiometric correction, orthoimage generation, epipolar pair generation, image enhancement, DEM

extraction, planimetric feature extraction (i.e., a semi-automatic "road follower," and automatic linear feature extraction based on shape heuristics, spectral characteristics, etc.), and change detection.

P. Boniface of IS described "PRISM-Softcopy Production of Orthophotos and DEM," a photogrammetric workstation under development which will be used for the production of digital orthophotographs and DEMs from aerial photographs and SPOT imagery.

The final paper in the Workshop, "Image Processing on Open System" by C. Greve of Autometric (C. Molander and D. Gordon, coauthors), described several softcopy workstations developed by Autometric, including PEGASUS and WINGS. He then went on to discuss some of the remaining problems in softcopy stereoplotting, including data storage, availability of digital data, roaming and overview, lack of image processing software standards, and lack of hardware platforms that provide necessary features.

The Workshop closed with a summary of the papers, given by H. Ebner; closing comments by I. Dowman, noting that there had been no PC-based developments in Europe but two in the U.S., that the U.S. military had put a lot of support into development, and that most European activity was in the universities while most U.S. activity was in commercial firms; and final remarks by F. Leberl.

OTHER ACTIVITIES

The National Center for Atmospheric Research and the City of Boulder, Colorado, both with beautiful views of the Rockies immediately to the West, were an excellent venue for the Workshop. Between the mid-morning and mid-afternoon coffee breaks, a dinner at the Boulderado Hotel the first evening of the Workshop, and a social evening spent at the Leberl home, the participants had ample opportunity to renew old acquaintanceships and discuss technical matters. On the Saturday following the Workshop, a number of the participants joined in a ski trip to Breckenridge.

Papers from the Workshop are being refereed and will be published in the January 1992 issue of *Photogrammetric Engineering & Remote Sensing*.

-Jim Case
Cedar City, Utah

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