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3.5 REPORT OF THE SUBPANEL ON REMAPPING PROCEDURES

The remapping procedures subpanel met for two sessions to define research needs in remapping for earth resources observational systems. The panel consisted of:

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Victor Conocchioli EROS Data Center	M. Naraghi JPL
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3.5.1 State of Knowledge

Remapping is done by government data centers, private industry, and users. Systems developed by government data centers (e.g., MDP) deliver a few types of products which do not meet the range of needs of users. The need for subsets and mosaics of frames, map quadrangles, various map projections, etc. were documented at the 1977 Santa Maria Conference on Geobase Information System Impacts on Space Image Formats. A value-added private industry service has not developed because there is little available software and it is not profitable for a company to fund remapping software efforts. Users typically develop bits and pieces of remapping software as needed. All three types of organizations would benefit from a fundamental research effort on remapping software and systems which achieve a range of products and are modular and transportable. Related research is needed in areas of platform modeling and calibration and photogrammetric methodology for current and proposed sensors including spaceborne and airborne. Table I summarizes key problems facing the space image data user community today.

It was noted by the panel that the remapping/rectification process could be significantly aided through engineering systems improvements in attitude control, with subsequent improvement in spacecraft ephemeris modeling accuracy. Attitude/alignment error is the largest source of image rectificaton error. Thermally induced relative alignment error between the image instrument and the spacecraft must be measured or actively compensated for. An alternative is to place the attitude sensors in close proximity to the image instrument to minimize misalignment effects. It was noted that attitude error can be controlled to 36 seconds with current generation star trackers and hydro. A star tracker/hydro package capable of 3 seconds accuracy could be developed. Furthermore, an ephemeris accuracy of 10 meters is possible with the NAVSTAR/GPS system. With the GPS system it would appear we will achieve 150-400 meter accuracy in the absence of ground control points. This can be contrasted with

TABLE I. Problems in Remapping

- MANY USERS DESIRE PRODUCTS IN MAP PROJECTED FORM AND USUALLY IN QUADRANGLES ORIENTED NORTH
- REMAPPING SOFTWARE IS NOT TRANSPORTABLE/EFFICIENT
- GCP LIBRARY NOT DISTRIBUTED
- QUALITY CONTROL ON STANDARD PRODUCTS (E.G., MDP) NOT SUFFICIENT
- SENSOR/PLATFORM MODELS ARE NOT COMPLETELY UNDERSTOOD OR UTILIZED
- PHOTOGRAMMETRIC RECTIFICATION MODELS FOR SINGLE AND MULTIPLE IMAGES NOT WELL DEVELOPED
- MODEL CALIBRATION DATA ARE INADEQUATE
- RECTIFICATION ACCURACY LIMITED BY INADEQUATE KNOWLEDGE/AVAILABILITY OF TERRAIN RELIEF DATA

the 10-15 meter accuracy possible without GCPs but using advanced attitude sensors and misalighment compensation and measurement on the next generation spacecraft.

3.5.2 Recommended Research

The research tasks recommended are summarized in Table II.

There is a need for state-of-the-art technology assessments prior to initiation of major programs, and the high potential return from well formulated testing of algorithms on selected data sets of actual and synthetic imagery. In addition, there is a need for SRT tasks that incorporate standard photogrammetric methodology and formulas and that more fully utilize platform and calibration data from current and proposed sensors to reproject digital imagery. The impact of improved platform stability and integration of GPS measurements on reduced ground segment processing needs to be critically assessed. The group also highlighted the need for a substantial effort in the development of remapping software and systems that are modular and transportable. This need stems from the fact that previous and current ground segment image data rectification tasks are faced with external forces difficult to resolve, namely users wanting a wide variety of map projections and data processing capabilities which private industry has not yet cost-effectively developed nor has an individual government facility efficiently supplied.

TABLE II.
RECOMMENDED RESEARCH TASKS

- IMAGE WARPING AND ROTATION SOFTWARE AND HARDWARE SYSTEM DESIGN
- GROUND CONTROL POINT FILES
  - MULTISENSOR APPLICABILITY
  - ALTERNATIVE CONTROL DATA SETS
  - UPDATE AND REVIEW POLICY
  - PACKAGING, FORMATS, AND ANCILLARY DATA/DISTRIBUTION METHODS
  - SPATIAL DISTRIBUTION NEEDED
- TRANSPORTABLE SOFTWARE STANDARDS AND TOOLS
- GENERATE SIMULATED AND STANDARD DATA SETS FOR AIRCRAFT AND SPACECRAFT IMAGERIES
- DESIGN SIMULATION STUDY ALGORITHMS FOR RECTIFICATION OF SINGLE AND MULTIPLE IMAGES

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TABLE II (CONTINUED)

- MODEL INFLUENCE OF SENSOR/PLATFORM PARAMETERS AND TERRAIN RELIEF ON RECTIFICATION ACCURACY
- DEVELOP AND IMPLEMENT PHOTOGRAMMETRIC RECTIFICATION AND BLOCK ADJUSTMENT FOR OVERLAPPING IMAGES
- DEVELOP SUITABLE TECHNIQUES FOR MOSAICKING
- RESOLVE THE REGISTRATION/RECTIFICATION SEQUENCE PROBLEMS FOR MULTITEMPORAL OVERLAYS
- DEVELOP ADVANCED ATTITUDE SENSORS
- DEVELOP TECHNIQUES FOR COMPENSATION OF RELATIVE MISALIGNMENT OF IMAGE SENSOR WITH PLATFORM SENSOR
- DEVELOP CAPABILITY TO SYSTEMATICALLY CORRECT AIRCRAFT SCANNER DATA FROM ON-BOARD ATTITUDE SENSORS

TABLE II (CONTINUED)

- USE OF MULTIPASS IMAGERY TO PRODUCE ELEVATION MODELS
- DEVELOP PLATFORM MODEL AND DTM-DRIVEN RECTIFICATION MODELS
- DEVELOP CORRESPONDENCE MEASURES FOR FINDING CONTROL POINTS BETWEEN IMAGES FROM DIFFERENT SENSORS
- ESTABLISH OPTIMIZED AIRCRAFT MISSION DESIGN ALTERNATIVES.