New Features in SOCET SET®

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ABSTRACT

SOCET SET is a well established software suite for photogrammetric production, with a history dating back to the 1980s. It stands at a critical point in its development, because its functionality is being encompassed in BAE Systems' recently introduced off-the-shelf software offering, SOCET GXP®. The goal is a single product for all the defense and commercial processes in image analysis, geospatial analysis, mapping and targeting. SOCET SET users will enjoy significant benefits from this confluence, primarily greater ease of use and entirely redesigned user interfaces for the familiar photogrammetric procedures. Pending this major transformation, however, SOCET SET continues to evolve in response to customer requirements. The major change in the latest release is an innovative approach to the generation of terrain models called Next-Generation Automatic Terrain Extraction (NGATE). Also important are sensor modeling and triangulation of imagery from the Leica ADS40 and several new satellite sources. This paper describes these features, together with some lesser, incremental developments, then traces the path of SOCET SET into 2008, focusing on the integration with SOCET GXP.

1. INTRODUCTION

The Geospatial eXploitation Products™ (GXP) business area of BAE Systems has three commercial-off-the-shelf software products, of which the best known in the photogrammetric world is SOCET SET, a comprehensive package for all the main operations of digital photogrammetry. SOCET SET was launched as a commercial product in 1990, but its history goes back to digital photogrammetric workstations developed by Helava and Associates for the United States Defense Mapping Agency in the 1980s (3); indeed, some of the software doubtless originated in the analytical plotters Helava produced in the 1970s. Another offering in the GXP line, VITec®, was launched in 1991 as a commercial product developed in close alignment with VITec graphics cards. These had been purpose-built since 1988 for handling digital images, because digital cameras and scanned film images were becoming prevalent and at that time readily available graphics cards offered insufficient performance for large images. In the ensuing years the VITec product was also sold into the defense image analysis market, primarily in the US. Though still shipped within certain ongoing government contracts, VITec has been eclipsed in functionality by SOCET GXP, which is fast becoming the flagship of the product range. SOCET GXP is currently an image analysis product, freshly written and with a modern, imaginative approach to facilitating the work of the government image analyst. Its goal, however, is much more ambitious. Conceived in 2001 and first shipped in 2005, SOCET GXP was the result of a vision that it would be efficient and convenient to create a single product encompassing the operations of image analysis, geospatial analysis (a US government term for photogrammetric measurement and mapping), commercial photogrammetry and targeting. Thus the plan was for the functionality of SOCET SET to be embraced within the dramatically different architecture and user experience of SOCET GXP. This will be largely accomplished in 2008 and completed in 2009, during which period SOCET SET users will be assisted in making a smooth transition without unwelcome downturns in productivity before the advantages of the new product take effect. The prescience of the vision was underlined in a 2005 editorial in *GPS World* (1), which stated, "When the National Imagery and Mapping Agency (NIMA) changed its name to the National Geospatial-Intelligence Agency (NGA) in 2003, it aimed to reflect the powerful capabilities this young agency was realizing by melding the geospatial and imaging tradecraft into a new discipline. Such convergence was the original intent when NIMA was

created in 1996 – to merge the mapping, charting, and geodesy skill set of the Defense Mapping Agency with the image-analyst capabilities of the National Photographic Interpretation Center." This paper outlines the strengths of SOCET GXP as a vehicle for successful photogrammetry. BAE Systems recognizes, however, that SOCET SET customers must continue to receive updated products and support until the transition to SOCET GXP is complete. The paper, therefore, goes on to describe the new features in the latest release of SOCET SET.

2. THE PRODUCTS

The functionality of VITec was overtaken by SOCET GXP in 2006. SOCET GXP v3.0, scheduled for release in mid-2008, will include most of the photogrammetric functionality of SOCET SET and this product transition will be completed with v3.1 in 2009. In the meantime, another release containing new functionality for image analysts was shipped in July 2007, v2.3. SOCET SET v5.4 was shipped in July 2007 and v5.4.1 is imminent, so the information provided in this paper refers to both v5.4 and v5.4.1, which include major new functionality as well as many minor improvements. SOCET GXP v3.x is discussed first, to provide a glimpse of the future, then SOCET SET v5.4/5.4.1 is described to indicate the innovations reaching users' workstations today.

2.1. SOCET GXP v3.x

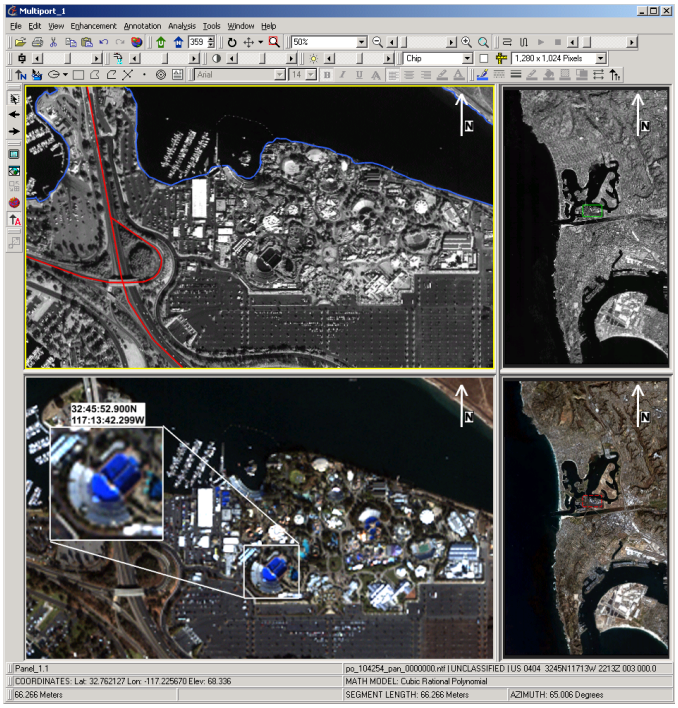

Fig. 1: Multiport in SOCET GXP

The special characteristics of SOCET GXP have been published widely and need little reiteration here. Suffice it to say that at the center of the product is a viewport called a Multiport. The user can open a number of such Multiports and within each of these there can be several panels (fig. 1). Into each panel the user may load an image, a digital map, elevation data or other information. The panels may be geometrically linked, so that when the user changes location in one panel the cursor moves correctly in the other ones. Similarly, more than one data set can be loaded into each panel, either for mosaicking or to superimpose one image on another, or on a map, for easy comparison or change detection. Underlying this functionality is a wide range of image imports and rigorous sensor models for numerous government and commercial image sources. This focus on faithful, mathematical sensor modeling distinguishes SOCET GXP from other image analysis products. Photogrammetrists should remember that, in many practical defense situations, ground control is not available, so images must be orientated or triangulated either using image metadata or by registration to existing controlled imagery. In these circumstances, accurate sensor modeling is critical. SOCET GXP v2.3 includes all the sensor models available in SOCET SET in addition to the ones already provided in SOCET GXP. Accompanying the Multiport is the Workspace Manager, another keystone in the flexibility and productivity of SOCET GXP. The Workspace Manager provides the user with three views of the data and easy methods to navigate amongst it:

the Data view is the familiar listing seen in Windows Explorer; the Windows view shows which Multiports and panels are open and the data they contain; and the Preview pane shows the thumbnail and metadata for a selected image. Indeed, for the photogrammetrist, simple actions, such as double-clicking on an image filename to take a quick look, or making a "virtual mosaic" of a group of images, without the need to define a photogrammetric project in all its complexity, are a boon *per se*. A further strength is the felicity with which products, for example for mission planning, can be created from analyzed images and easily manipulated templates. And new functionality in the mid-2007 v2.3 release includes an online, bidirectional connection to Google Earth™ and a means of recording and updating features and attributes in the ESRI® Geodatabase or SOCET SET Feature Database.

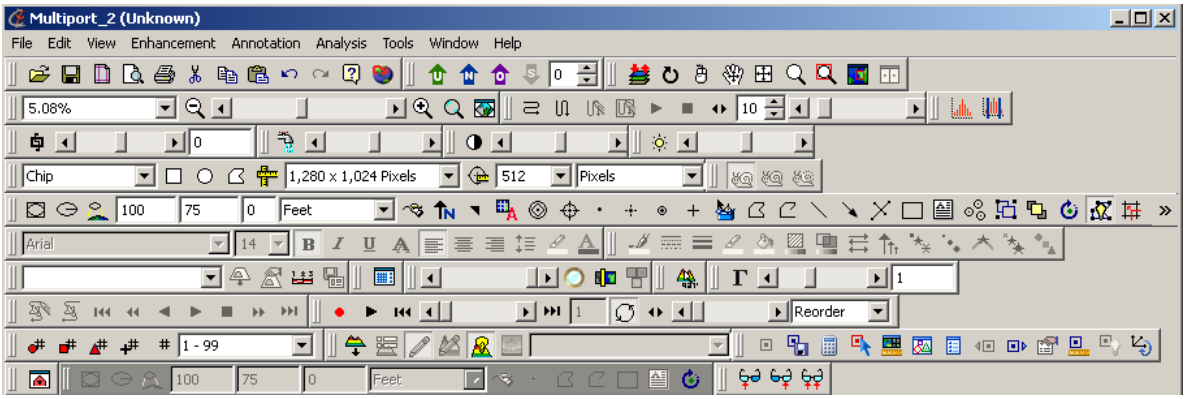

Fig. 2: SOCET GXP toolbars

All this rich functionality has to be managed if the user is to continue to work efficaciously. In addition to the superstructure of Workspace Manager and Multiport, a host of image analysis tools is available, resulting in a preponderance of menus, tools, preferences and toolbars. If all the toolbars were switched on, the result would be as shown in fig. 2! Microsoft® Office has encountered a similar difficulty as it has grown over the years. As a result, SOCET GXP v3.0 will include the Microsoft Office Ribbon user interface, which includes the Ribbon itself, contextual tabs dependent on the object being processed, a quick access toolbar that is always available, and mini toolbars that appear automatically with respect to certain objects. The result is a much better

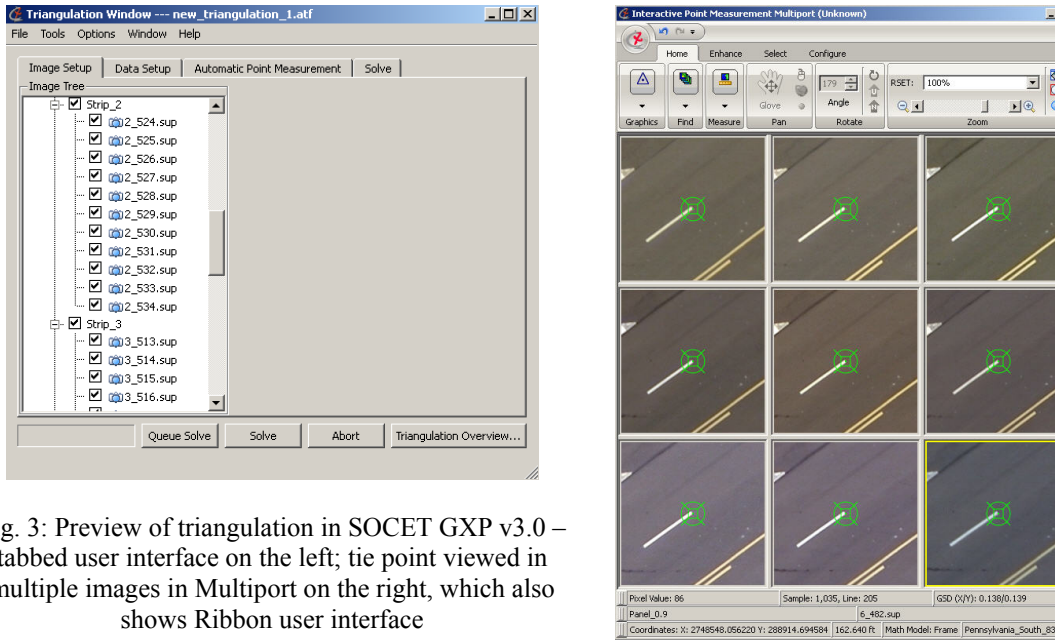

Fig. 3: Preview of triangulation in SOCET GXP v3.0 – tabbed user interface on the left; tie point viewed in multiple images in Multiport on the right, which also shows Ribbon user interface

organized arrangement, enabling the user to access and take advantage of a significantly larger proportion of the functionality than before and use the product in a pleasing, less fatiguing way.
Even more important to many users, however, will be the extensive photogrammetric functionality. In principle, this will involve operations currently available in SOCET SET, such as triangulation, terrain model generation, orthorectification, mosaicking and feature collection. But these are not being ported, they are being rewritten, with deep thought and sophisticated redesign reflecting current user experiences and the increasing need for greater productivity and faster turnaround. A central component of this approach is brand new users interfaces: fig. 3 gives an impression of how triangulation will be presented to the user – the familiar operations are there but the tabbed user interface is more intuitive and more effective than that in SOCET SET; the right hand image in fig. 3 shows a tie point measured in multiple images displayed in the panels of a Multiport, within the Ribbon user interface. Finally, the SOCET GXP APIs are being extended so that users of the SOCET SET DevKit will be able to port their customized applications: these will include third party packages currently available for SOCET SET, such as Cardinal Systems' VrOne.

2.2. SOCET SET v5.4/5.4.1

SOCET SET v5.4/5.4.1 contains numerous features introduced in response to customer demand and several major innovations. These are most conveniently described in the context of the workflow. The structure of SOCET SET is retained, with the addition of one new module (NGATE). The following modules are available (for brevity this list omits certain modules provided for specific defense applications only):

- CORE – basic functionality and image manipulation; data imports and exports; sensor models for film and digital frame cameras, Leica ADS40, IKONOS and QuickBird RPC imagery, and orthorectified image products
- Stereo – presentation of images for stereoscopic viewing with readily available viewing hardware and graphics cards
- ASM – Advanced Sensor Models, i.e. sensor models not included in Core
- APM, IPM – Automatic and Interactive Point Measurement for triangulation
- MST – Multi-Sensor Triangulation, bundle adjustment of multiple image types simultaneously
- ATE, NGATE, ITE – Automatic Terrain Extraction, Next-Generation Automatic Terrain Extraction, Interactive Terrain Editing, generation and editing of digital terrain models
- Ortho – orthorectification, mosaicking, true orthos, stereomates
- Dodger – image balancing and dodging
- Feature Extraction –collection and update of features and attributes; perspective scenes and fly-throughs
- SOCET for ArcGIS® –collection and update of features and attributes in the ESRI Geodatabase using ArcMap®
- ClearFlite® – identification and measurement of obstructions round airfields with respect to standard definitions of obstruction identification surfaces
- DevKit – libraries and documentation to enable users to customize SOCET SET, integrate it with their own applications, etc.

New sensor models introduced in v5.4 are ALOS PRISM, ASTER, FORMOSAT-2, GeoEye™-1, SPOT 5 DIMAP sub-scene processed images, and WorldView-1. The product is therefore ready for the NextView imaging program, for which satellite launches are scheduled in autumn 2007. The wealth of sensor models is a distinguishing characteristic of SOCET SET, together with the capability of combining imagery from different sensors all within the one project, including rigorous triangulation. The current range of sensor models is provided in table 1.

The major innovation in v5.4 is NGATE. This is a brand new module for automatic generation of digital terrain models. NGATE is based on a hybrid of area-matching and edge-matching, using each approach to guide the other and thus reduce blunders. Performance is further improved by allowing the terrain elevation to change within the search window and by computing an elevation for every pixel. There is a wealth of evidence that NGATE provides a more accurate, detailed and authentic representation of the terrain surface than its predecessors and as a result can engender major cost savings by reducing human editing time by more than 30%. It is fully described elsewhere in these proceedings (2).

Frame (film and digital)	RADARSAT
Aerial film cameras	ALOS PRISM
DMC, UltraCam, DSS, Buckeye, etc.	ASTER
Close range imagery	FORMOSAT-2
GPS/IMU or triangulation metadata	Panoramic
Leica ADS40	Various US DoD
Landsat	RSS 9K
SPOT	NITF
ERS	Polynomials
IRS	Quadratic, rational, DLT, cubic etc.
JERS	RSM (Replacement Sensor Model
EROS-B	Orthophotos
IKONOS	DOQ, ArcWorld®, GeoTIFF
OrbView-3	IfSAR
GeoEye-1	LIDAR
QuickBird	Digitized maps in various projections
WorldView-1	Customized

Table 1: Sensor models in SOCET SET v5.4/5.4.1

Smaller additions in v5.4 and v5.4.1 include: validation with Microsoft® Vista; Geoid 2006 project coordinate system; exterior orientation data import into non-LSR project; creation of NITF RPC00B image chips on output; computation of estimates of precision for individual points in a terrain model; enhanced shapefile export to allow features to be exported that are closed polylines instead of polygons; improvements to automatic assignment of attributes in SOCET for ArcGIS and improved synchronization with ArcMap; new intensity filter to handle hotspots better; thinning of terrain model information during mosaicking; generation of seamlines for mapsheets; distributed processing using Condor for two specific operations – TFRD decompression for Digital Point Positioning Data Base Format production (MIL-PRF-89034, March 1999 format specifications) and VQ compression for Controlled Image Base® (CIB) Format production (MIL-PRF-89041, 15 May 1995 format specifications).

2.3. The near future

SOCET GXP, therefore, is in the final stages of development to the point that it encompasses extensive photogrammetric functionality and can meet the needs of the typical SOCET SET customer. This will be achieved by mid-2008 and those photogrammetric functions not incorporated by this deadline will be included in v3.1 in 2009. There will be some limited new functionality for the image analyst in the meantime, for example catering for new image sources that become available during the development period, such as UAV-borne tactical sensors or sensors carried by new government surveillance satellites. Doubtless there will be additional output formats, including products conforming to emerging military standards. Perhaps more exciting to the GIS audience will be a connection to Microsoft Virtual Earth to parallel the one to Google Earth first introduced in v2.3. Efforts are being made also to add “remote sensing” functionality to interpret and classify

multispectral, hyperspectral and radar imagery. Beyond that, some of the capabilities will become accessible in a service-oriented architecture framework.

Advances in SOCET SET will not slow down during the transition to SOCET GXP v3.0. Planned features include yet more sensor models, as new earth observation satellites continue to be launched at an increasing rate. On the airborne side, functionality will be added to use ADS40 Level 0 imagery, with novel algorithms to handle the jumbled scanlines of the unrectified images to permit image matching, and additional parameters sets will be extended to accommodate the characteristics of the Intergraph DMC and Microsoft UltraCam cameras, as analyzed in so many recent papers, for example (4). The range of satellite sensor models has not yet been finalized, but the shortlist includes Cartosat-1 and TerraSAR-X. Efforts will also be made to add tools to optimize workflows for exploiting today's widely available oblique imagery, for example Pictometry®, MultiVision and Track'Air MIDAS. Finally, enormous improvements in productivity will result from the extension of Condor distributed processing to many more stages of the workflow, for example generation of digital terrain models, orthorectification and mosaicking.

3. CONCLUSIONS

New features in the current release of SOCET SET include the NGATE module for generation terrain elevation data, several additional sensor modules and a number of smaller developments. This paper has described these in the context of the transition of SOCET SET's capabilities into its companion product, SOCET GXP, focusing on plans for major new releases in 2008 and 2009. The goal has been to demonstrate that BAE Systems is not simply porting the photogrammetric functionality of SOCET SET into the other product, but is rethinking it and rewriting it to reflect modern workflows and the endless search for higher productivity.

4. REFERENCES

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