MEETING DEM AND ORTHO-IMAGERY SPECIFICATIONS

An IFSAR Quality Management System

Interferometric Synthetic Aperture Radar (IFSAR) is emerging as a highly cost-effective 3D mapping technology. Digital elevation models and ortho-rectified radar imagery are core commercial Intermap Technologies products using its airborne IFSAR based STAR technology, the list of applications for which is continually growing. Quality control and assurance ensure consistent data quality.

Data quality has become a matter of escalating interest amongst the geospatial community. Data providers must thus ensure their data products meet specifications; quality must be built into the production process so that data consistently and predictably meets expectations. A rigorous Quality Management System (QMS) needs to be designed and implemented in the â€˜data factoryâ€™, implying that a series of Quality Control and Quality Assurance (QC/QA) be conducted along the whole production chain. A QMS tactically integrates various QC/ QA tasks to facilitate production whilst maintaining productivity. As a producer of geospatial data, Intermap has been paying ever-increasing attention to the quality of its data products and the customers who use this data. A QMS has been established and dedicated to facilitating quality handling and continuous process and quality improvement at Intermap.

Airborne Terrain Mapping
STAR mapping is an effective 3D terrain mapping solution in terms of speed, cost, quality and weather-independence. It is a process of recording and processing raw radar data to generate 3D geospatial data products. Height information is obtained using the relative phase difference between two coherent SAR images simultaneously obtained by two antennae separated by an across-track baseline in a single-pass mode. These systems collect raw radar data based on a pre-determined mission plan. An onboard-integrated Global Positioning System (GPS) and Initial Navigation System (INS) record sensor position and orientation information, together with one or more ground GPS stations for subsequent differential GPS correction. After data collection a series of automated processes are conducted to derive Digital Surface Models (DSMs), Digital Terrain Models (DTMs) and Ortho-rectified Radar Images (ORIs), core products from STAR mapping. Value-added products can also be generated based solely or in part on the DSM, DTM and ORI components.

The Spirit of Quality
Intermap has recently established a Customer Care Division headed by a company vice-president. This gesture has raised the importance of product quality to a very high level in the company. The mandates of the new division are to enhance the skills of company staff and the processes they follow through a defined, robust QMS. The end goal is to create a continuous and proactive environment of learning and skill development and to carry out independent validation and verification of data products, resulting in continuous and active quality improvement.

Quality Management
The QMS aims to facilitate production in order to achieve on-time delivery, consistent customer satisfaction, higher efficiency and increased profitability.
QMS conducts a series of quality-related activities involving goal setting, planning, implementation, documentation, assessment, reporting and improvement to ensure that a process, item or service is of the type and quality expected. Our QMS is designed around the following policies.

- To implement recognised quality systems to support production processes, meet client requirements and enable growth into new markets.
- To create and maintain a quality-conscious working environment.
- To build quality into all production processes.
- To establish a concept of â€˜next process is customerâ€™.
- To train staff and equip them with the tools to measure, maintain and enhance quality.
- To foster a culture of continuous improvement in all quality-related areas.
- To hold client needs in the highest regard.

Quality Components of STAR Mapping
Spatial accuracy is the most important quality component, which includes relative and absolute accuracy as well as the accuracy uniformity

of the products across the mission area. Another component is completeness. Datasets shall cover to mission boundary, with missing objects and data voids being properly handled. Logical consistency is crucial; multiple products DSM, DTM, ORI etc. for the same area shall be logically consistent, including co-registration, edge matching between adjacent map sheets, reasonably flattened water bodies, drainage monotonicity and continuity, DTM lower than or the same as DSM, etc. Cleanliness of artefacts pays close attention to antenna patterns and range effects, spikes and wells, de-correlation, seam lines, and motion ripples, which might be caused by the nature of the radar sensor, environmental influences or interaction of radar and ground features. And concerning the physical format, intermediate and final products delivered to clients shall have the required format.

Adaption to Practice

Our QMS requires that all processes be documented so that everyone involved in the process follows the same instructions. Quality means producing the same product the same way all the time. If the process is found not to be contiguous with practice, designated personnel are tasked to determine which is right. If the practice is found not to be correct then retraining is required. If the practice proves a new and better way, then the process document is rewritten and improved to take advantage of the new process. A net benefit of this scheme is continuous process improvement. Further, the concept of process ownership has greatly increased staff quality awareness in both technical and management aspects. The commitment of process ownership has also improved non-conformance resolution with the goal of enhanced productivity through reduced rework.

Treating the next process as an internal customer helps ensure that data going to the next process meets the particular specifications of that stage. This will re-sult in an early catching of potential quality problems and their early elimination, thus reducing amounts of rework.To ensure a product meets its specifications, QC/QA shall be strategically integrated into the production process, facilitated by a QMS and supported by a set of consistent standards. In the context of this article, QC refers to a series of technical activities for in-process detection and correction of defects at each transformational step of the production chain. QA includes the inspection and testing of data products, both intermediate and final, with respect to the specifications to ensure they are met.

QC/QA Tasks

The mission planning QC/QA ensures correct and efficient planning of the mission. Usually, a certain number of redundant across and overlapping flight strips are also planned and acquired for the subsequent QC/ QA. Data acquisition QC/QA signifies that rigorous system maintenance and calibration are regularly conducted to ensure stability and functionality of the radar system. The quality of all collected data is checked and assured. Data processing QC/QA includes the following three sub-tasks. First, the Navigation QC/ QA is meant to control the performance of the navigation system. Secondly, the Motion QC/QA is to provide a first-order prediction of artefacts; and thirdly the Auxiliary QC/QA is to evaluate consistency and accuracy of available auxiliary data. The interactive editing QC/QA is to detect and correct potential blunders inherent to the datasets and is comprehensively conducted for every single mapsheet. Value-adding QC/QA is application dependent and is tailored to meet specific user requirements. And finally, at the end of all processes, there is the Delivery QC/QA.

Independent Assessment

At Intermap, a series of Independent Verification and Validation (IV&V) steps are also conducted. Whilst the process-QC/QA steps are focused on specific points within a process, i.e. looking at the â€˜treesâ€™, IV&V tasks look at overall data quality, the â€˜forestâ€™, through tools and processes different from those used in production. IV&V employ a combination of full-inspection and data-sampling techniques to ensure quality. IV&V is designed and implemented to ensure that a particular dataset, product and process are performing as expected. IV&V do not replace the above-described process-QC/QA, that takes immediate responsibility and is conducted in a more comprehensive way for the whole dataset.

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