Remote Sensing & GIS

Spring Semester 2010
Lab 1

**Introduction**

IKONOS images covering the area around Thun will be used to conduct the whole workflow from image preprocessing, orientation, DSM generation to a photorealistic 3D visualization for the covered area. For most of the purposes, ERDAS Imagine including the Leica Photogrammetry Suite (LPS) will be used. For special tasks, other software will be deployed, e.g. for preprocessing and DSM generation including quality control. Before the start of each main part of the lab, there will be a short introduction to the data and software used as well as to the workflow.

Computers and software are available in HIL C71.1, please refer to the list at the door for computer occupation.

Login and password for the RS & GIS labs are:

user: rsgis
password: SS_007

**Image preprocessing**

Satellite images often are affected by various effects which decrease image quality. For further processing steps, especially if high accuracy is required, image preprocessing has to be performed in advance. Preprocessing can include functions which enhance contrast, resampling of single channels, composition of channels to new combinations of channels, filtering and removal or reduction of image errors, e.g. spilling, and transformation from 10/11/12 bit to 8 bit due to software capabilities. During
Lab 1, IKONOS images will be preprocessed by means of different software. First, the available images will be analyzed and meaningful preprocessing steps discussed. Only the panchromatic images will be processed and will be optimized especially for subsequent image matching and automated DSM generation.

In order to reduce processing time, from the IKONOS images an image subset will be cut out to test different program parameters. After the optimal parameters have been determined, the whole images will be processed. The different processing steps include: a) strong contrast enhancement of the WHOLE image to visually check noise, artifacts etc., b) estimation of image noise in homogeneous but unsaturated area(s), c) noise reduction, d) contrast enhancement with Wallis, e) reduction of 11-bit to 8-bit.

**Georeferencing**

In this part of the lab different algorithms and ground control point (GCP) configurations for image georeferencing will be investigated. In order to cover enough GCPs the whole images will be used, 50 GCPs are available in the area of investigation. The task can be divided to two main topics: In the first part, the georeferencing tool of ERDAS IMAGINE (Data Preparation – Image Geometric Correction) will be used for manual georeferencing. Here, GCPs will have to be measured manually in the images according to the additional information provided (maps, GCP sketches, coordinates). The following implemented algorithms for georeferencing will be computed:

- IKONOS RPCs (Rational Polynomial Coefficients)
- Polynomial of orders 1 and 2

Additionally, all versions will be calculated using 6, 10 and 20 well-distributed GCPs. The results have to be analysed and discussed. GCPs with large residuals must be remeasured in the images or excluded from the georeferencing. The remaining GCPs not used for georeferencing will be used as check
points. A second measure of quality are the residuals given in the GUI after computation of the transformation parameters. As a result, the best suited method should be proposed. Residuals will be plotted and analyzed in MS Excel.

The second option for georeferencing implemented in ERDAS IMAGINE (AutoSync) allows for referencing an image with respect to another, already referenced image, which can be a map or an orthoimage etc. For this task, the already manually measured GCPs will be adopted in one image and transferred to the other image by means of image matching. Again, the result has to be evaluated. First, the automatically measured points should be checked for blunders and edited if required. Again, the remaining GCPs serve as check points in order to assess the accuracy of the referencing. Before starting the georeferencing, the correct coordinate systems have to be chosen and assigned to all used data!

If the above two measurement processes, if needed, tie points, without known ground coordinates, will be used.

Stereo Image orientation
This step is similar to the above but in this case we perform stereo pair (panchromatic and RGB channels) in ERDAS IMAGINE (LPS). The best version of the georeferencing (sensor model, number of GCPs and image measurement method) should be selected for orientation.

DSM generation and quality control and orthoimage generation
After Stereo Image Orientation, in ERDAS IMAGINE (LPS) a Digital Surface Model (DSM) will be generated. For this purpose, based on different landcover, image matching parameters will be adapted to achieve a possibly high accuracy for the resulting DSM. The resulting DSM will be compared by means of Least Squares 3D Surface Matching (LS3D) with the P+F inhouse software (D. Akca) to a DSM derived from the same images using the P+F software SAT-PP in order to evaluate the impact of different image matching algorithms on DSM accuracy. Furthermore, a comparison of both image-
based DSMs to the Swisstopo LIDAR DOM-AV using LS3D will be computed. The results of the comparison will be evaluated and discussed by the students. Finally, an orthoimage will be generated in LPS from the RGB channels (of one of the Ikonos images) as well as from one panchromatic channel using one of the above three DSMs, preferably the one generated in LPS if the result is of sufficient quality.

Pan-sharpening and visualization

The last part in the processing chain consists of pan-sharpening of the IKONOS RGB channels by means of the panchromatic channel to improve the ground sampling distance of the RGB orthoimage. The required function is available in ERDAS IMAGINE (Image Interpreter – Spatial Enhancement). From the 5 different methods for pan-sharpening available in ERDAS IMAGINE, 2 will be used:

- Resolution Merge
- Wavelet Resolution Merge

After computation of the pan-sharpened orthoimages the results should be compared by transferring the GCPs from the raw images to the orthoimages and checking the resulting planimetric ground coordinates with the original ones.

The best result will be selected for 3D visualization in ERDAS IMAGINE (VirtualGIS) in combination with the DSM used for orthoimage generation.

**Landuse Classification**

In the last part of lab 1, the task is to use an ASTER scene of the Thun area with image channels covering the visible and near, short wave and thermal infrared parts of the electromagnetic spectrum in order to produce a landuse classification. Before starting the practical exercise, we will discuss the level of detail of the classification which is expected to be derived in a meaningful way from the images. Then, using training areas that have to be identified, a supervised classification will be conducted and the results compared.
Report

Each student has to write a report on Lab 1, deadline for submitting the report is Friday, 23th of April.

The report has to contain:

- description of the workflow for each task
- description of the achieved results for each task
- critical discussion, comparison and assessment of the applied methods and results for each task
- critical discussion concerning the experience with the deployed software

The reports have to be delivered within the deadlines and accepted for examination admittance.

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