DAILY ASSESSMENT FORMAT

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Course:	**IIRS**	**USN:**	**4al17ec063**
Topic:	**Photogrammetric products from satellite stereo images (DEM and derivatives & Orthoimage)**	**Semester & Section:**	**6^{th} b**
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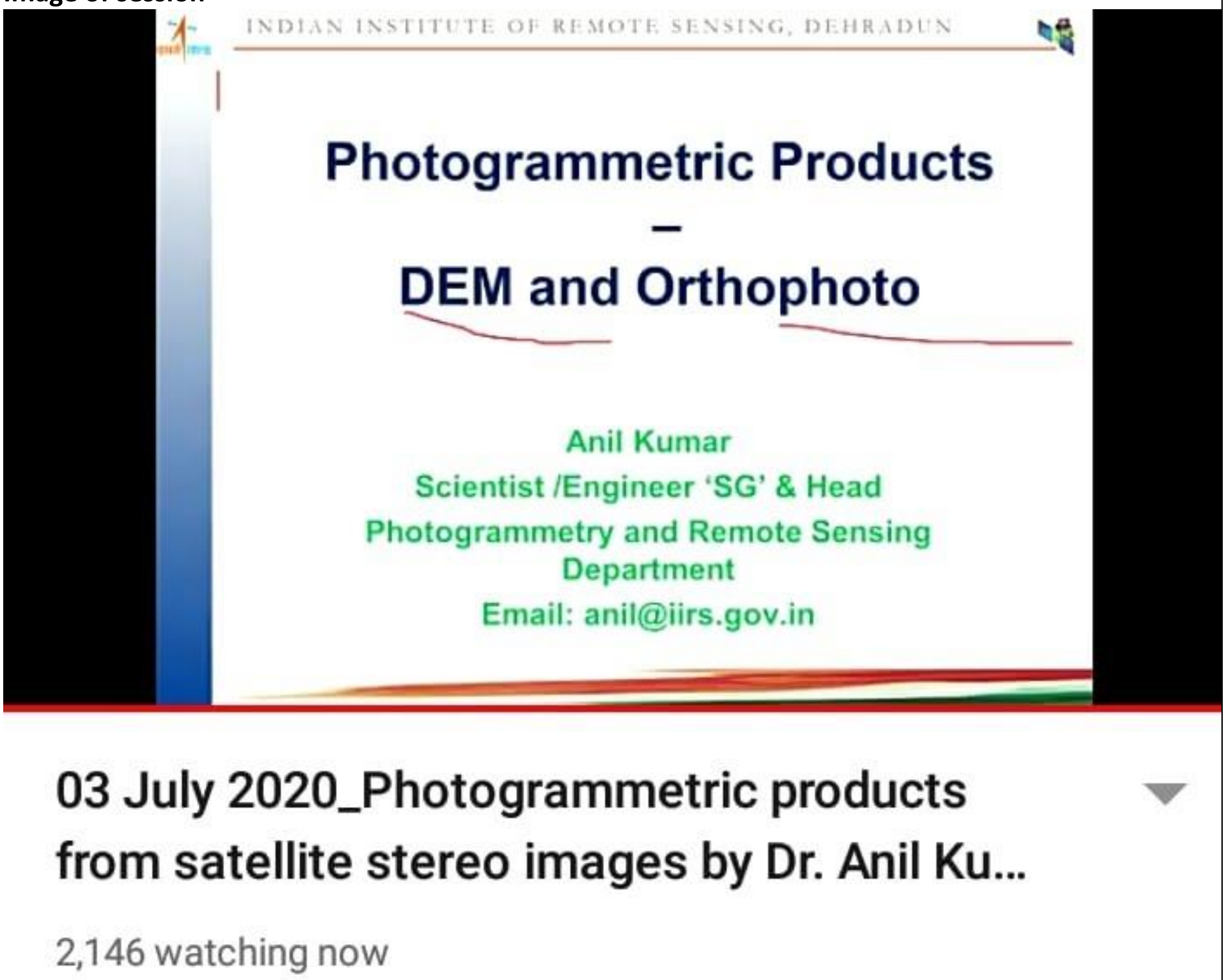
FORENOON SESSION DETAILS

Image of session



Very high-resolution satellite stereo images play an important role in cartographical and geomorphological applications, provided that all the processing steps follow strict procedures and the result of each step is carefully assessed. We outline a general process for assessing a reliable analysis of terrain morphometry starting from a GeoEye-1 stereo-pair acquired on an area with different morphological features. The key steps were critically analyzed to evaluate the uncertainty of the results. A number of maps of morphometric features were extracted from the digital elevation models in order to characterize a landslide; on the basis of the contour line and feature maps, we were able to accurately delimit the boundaries of the various landslide bodies

Methods

If the aim of the survey is landscape characterization in order to monitor changes over time, the outcome of any image elaboration step – georeferencing, image matching, DEM extraction and morphometrical feature extraction – should be subjected to critical analysis.

Georeferencing

For geomorphological purposes, the image georeferencing phase is of primary importance. The georeferencing accuracy of high-resolution satellite imagery is not a function of spatial resolution alone, as it is also dependent upon radiometric image quality, satellite platform attitude and the precision of the GCPs survey. The most frequently used georeferencing algorithms are based on rigorous models or on use of RPFs.

In this work, we have tested the physical model embedded within the software Geomatica (called "Toutin's model"), the physical one embedded in Socet Set (called "rigorous simultaneous") and the RPF model embedded in Geomatica (called "Rational Function").

The software user's guides suggest using only a few points (from 6 to 10 for Geomatica, even less for Socet) to geo-reference the image if the rigorous model is used. This is why we used only a small number of points as GCPs. The remaining were used as check points (CPs) for testing the accuracy of the output (e.g. to evaluate the difference between the value measured on the terrain and that measured on the georeferenced image).

In order to georeference the image, we run a NRTK GPS surveying campaign. To obtain a homogeneous distribution of well-"matched" points, control points were chosen in close proximity to the nodes of a regular grid; grid spacing was fixed while bearing in mind the number of points required for image georeferencing, which depends on the type of mathematical transformation used. The grid was overlaid onto the image and the GCPs position was selected nearby these nodes taking care of choosing "stable" details clearly visible on the image, such as artifacts or natural objects (Figure 2, left panel). Due to the presence of many mountainous districts, devoid of any stable points that can be easily identified on the image, in some areas, there are no points in correspondence of the grid nodes.

Figure 2. Regular grids have been drawn on the image to obtain a homogeneous distribution of well"matched" points. Control points have been chosen in close proximity of the nodes of the grid. Green circles indicate areas on the images that are close to visible control points, yellow triangles indicate "bad" points with issue of collimation (since they are located in shady areas of the image), red squares are on the location of grid nodes where it was not possible to find a point to collimate (mountain areas and/or without artifacts). Left panel: GGCPs; right panel: MGCPs. DATUM is ETRS89, frame ETRF00.

DEM extraction

In this phase, we studied the accuracy of the DEMs extracted using stereo-matching techniques from the stereo images. Two commercial software packages – Geomatica and SocetSet – were used for the image processing phases, including DEM extraction.

In both cases, the DEM extraction process makes use of image correlation to find matching features on the two images of a stereo pair, adopting strategies specific to the software used.

Geomatica used a feature-based matching model called normalized cross-correlation matching. This method finds the relative shift between two images by finding the shift that produces the maximum cross-correlation coefficient of the gray values in the images (Geomatics, 2010; Lewis, 1995).

The software requires epipolar images to extract the DEM, in order to reduce the time necessary to find corresponding points in image matching (Deilami & Hashim, 2011). At this stage, it is helpful to add some tie points to improve the digital matching in a few “critical” zones, mainly in the shadowed areas of the mountain slopes. A hierarchical approach using a pyramid of reduced resolution images was the method adopted in order to find these matching features.

In this phase, two parameters need to be chosen: “DEM resolution” (the size of the pixel in the final DEM) and “DEM detail”. Specifically, the latter determines how precisely to represent the terrain in the DEM. Selecting “very high”, “high”, “medium” or “low” determines the time at which to stop the correlation process. In the case of failed correlation, in order to enhance the continuity of the DEM surface, we set the “fill holes” option so as to automatically filter the elevation values by interpolating