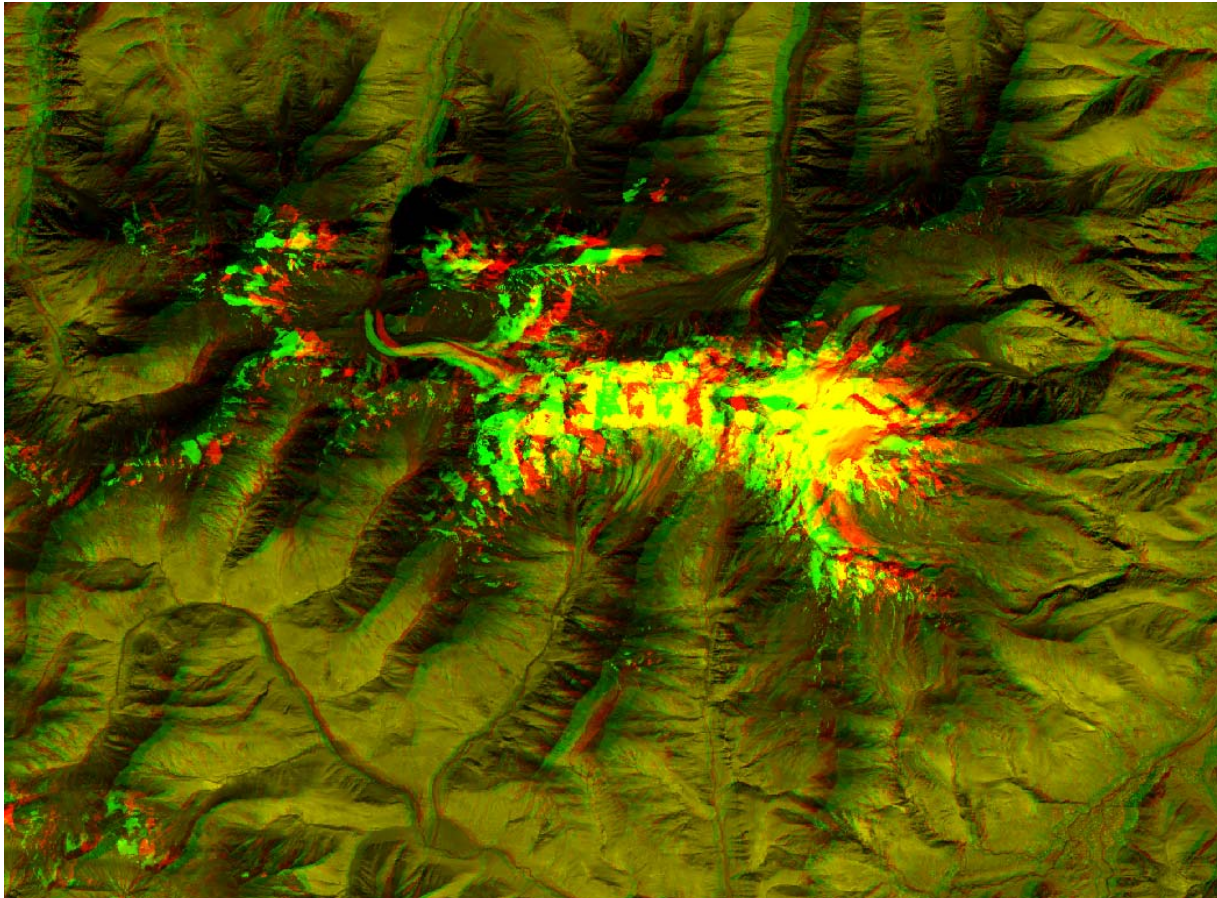


Creation of an Stereo Pair from a Digital Terrain Model (DTM) and (satellite) image in ILWIS

M.C.J. Damen

Dept. of Environmental System Analysis (ESA),
Faculty of Geo-Information Science and Earth Observation (ITC)
University of Twente
P.O. Box 6, 7500 AA Enschede, the Netherlands.
Tel: +31 (0)53 4874266, Fax: +31 (0)53 4874336; e-mail: damen@itc.nl



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Michiel Damen, ESA
Version 5, January 2011- ILWIS ACADEMIC

Introduction

The Stereo pair from DTM operation creates a stereo pair from a single raster image and a Digital Terrain Model (DTM). The (satellite) image will be displayed over the terrain.

The stereo pair can be viewed on the computer screen (split screen mode) with a stereoscope (screen-scope), or as an anaglyph using red-green or red-blue glasses. In short, the process is as follows:

First import the (satellite) image in ILWIS and create a geo-reference (if not yet there). Also import the DTM, which must have the same geo-reference as the image. The DTM can be created from (digitized) contour lines by interpolation. It is also possible to use an existing DEM, such as an SRTM DEM Aster DEM, Cartosat DEM, Lidar derived DEM.

Remark: The best quality you will get if the image and the DTM have approximately the same spatial resolution.

In ILWIS we use the “**Stereo Pair from DEM**” option for the operations. Rotation differences and possible scale differences between the image and the DTM will be removed.

Step 1: Selection of input data

- a. Select the image to be used. This can be a geo-referenced “Google Earth” image, a (color) hill-shaded Dem (for instance from Lidar) or a medium to high resolution satellite image.
- b. Select the DTM of the same area as the image. It is important that image and DTM have (approx.) the same resolution. Some examples:
 - Combination of a (color) hill-shaded Lidar DEM with (the same) DTM with elevation data.
 - Combination of a high res. image (Quickbird, IKONOS or even Google Earth) with a

resolution of approx. 1 meter with a DEM from contour lines 1:10.000 or larger.

- An Aster DEM (res. 30 m.) with a VNIR Aster image (res. 15 m.) or
 - An Aster DEM (res. 30 m.) with a pan-sharpened ETM Landsat image.
 - An SRTM DEM (res. 90 m.) with a Landsat ETM (re.30 m.).
 - A Cartosat derived DEM with a Cartosat or other high res. Optical image.
- c. Give all the imported files clear file names, in which is indicated type and date of the image or DTM. Copy all files to a working directory.

Step 2: Import of DEM's and image's

- a. UNZip the data if needed; check the file format (for instance GeoTiff, ERDAS Img or HDF)

Remark: Check with the supervising staff which images to be used

- b. Start the ILWIS program and move with the ILWIS Navigator (left pane) to the working directory with the data.

Remark: the image files are not yet displayed in the Catalog of the ILWIS ‘Main’ window, because they do not have yet the ILWIS format.

- c. Select in the ‘Main’ window: *File > Import > Via GDAL*. Select in the Import window the files to be imported one-by-one in the correct Import Format. After this type the Output Filename. Include in the filename the type and date of acquisition. Select *OK*.
- d. Click in the Catalog the Raster icon of the optical images (or individual image bands) or contour line or DEM; check the result by displaying the data on the computer screen..

Step 3: Domain change: picture to image

To display an image with the “Stereo Pair from DEM” module it must have an ILWIS “image domain”. First check the Domain: Right mouse-click the Map icon in the Catalog and select *Properties*.

Remark: Step 3 applies only for scanned images, not for satellite images which have already an image domain. In this case you can skip this step.

a. Display as color-composite

For display as Color Composite you first have to change the Domain from Picture to Image. In ILWIS, the Picture Domain has three Bands (Raster maps).

Right mouse-click the Map icon of Band_1 in the Catalog and select: *Properties*. In the 'Properties of Raster Map' window you select for Domain: Image and after this: *Apply, OK*. Do the same for Band_2 and Band_3.

Select: *Operations > Image Processing > Color Composite*. Select in the 'Color Composite' window the correct Red Band, Green Band and Blue Band. Specify an Output Map Name and use default values for display. Select: *Show* to display the Color Composite.

Remark: For some scanned images and "Google Images" you have to use for Red Green and Blue the bands 1, 2 and 3 (so opposite to satellite images)

b. Display as black / white

For anaglyph creation you can only use a black and white image. In case you have already the Red Green and Blue bands of the image, you can use for instance the Red band as the black and white image. Otherwise you have to carry out color separation.

To carry out a color separation: Select: *Operations > Image Processing > Color Separation*.

In the 'Color Separation' Window select the input image, choose the option Intensity and specify an Output Map Name. The output map will have Image domain.

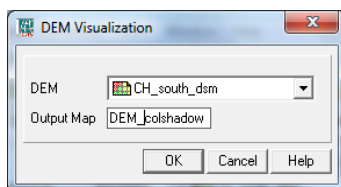
c. Display of DEM as a (color) hill-shade

In case that no high resolution image is available to drape over the DEM, a second option can be to use a (color) hill-shade image of the DEM instead. In ILWIS this can be relatively easy made in the Hydro-Processing module.

Select: *Operations > DEM Hydro-Processing > DEM Visualization*.

Select for DEM: the high resolution DEM

Output Map: DEM_Colshadow



Step 4: Interpolation of contour lines

Remark: You can skip Step 4 if there is already a suitable DEM available. But in case you have 'only' (digitized) contour lines, you first have to interpolate these lines to create a DTM.

In case the contour lines are not yet in ILWIS format, you first have to import them. Below example is for the import of contour lines with an ARC GIS Shapefile format.

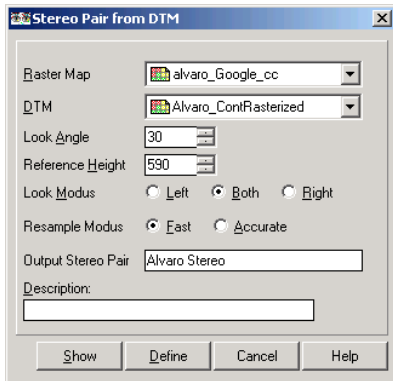
- a. Check the contour lines in ARC-GIS. Make sure that they have the same georeference as the raster image you want to use for 3-D visualization. The area should also be more or less the same.
- b. Import the shape-files in ILWIS by selecting in the 'Main' window: *Operations > Import/Export > Import*. Select in the Import window: ArcView SHP Shape file. After this type the Output Filename. Select : *OK*.
- c. It is essential that before interpolation starts, the contour lines have an ILWIS Value domain. In case you have imported the contour lines from ArcView a table is imported too. To check the Domain open the Table with the same name as the contour lines. Click at the top of the column with the elevation values to find out the Domain type; this should be a Value Domain. Change the Value Range if needed. Make the Precision: 1.
- d. To give the contour lines the same Value Domain as the corresponding column of the Table, do the following: Open in the Main ILWIS Menu: *Operations > Vector Operations > Segments > Attribute map*. Select in the Attribute Map of Segment Map window (1) the Segment map of the contour lines, (2) the Table belonging to the contour line map, and (3) as Attribute the column with the elevation data. Fill-in a name for the Output Segment Map. Select: *OK*.
- e. Right mouse-click in the Catalog the segment contour map and select: *Contour Interpolation*
- f. Select in the 'Contour Interpolation' window the same GeoReference as the Raster Image. Give the name for the Output Raster Map and select Precision: 1


Remark: The interpolation may take some time with large datasets

- g. Select: *Show* to display the DTM. Check the result.




Step 5: Creation Stereopair from DTM




- a. Select in the 'Main' window: *Operations > Image Processing > Stereo Pair from DTM*



- b. Select in the 'Stereopair from DTM' window the Raster Map and the DTM. Select: *Show* to display the Stereo Image.
- c. Now, both the DTM and the image will be re-sampled to output maps, i.e. the stereo pair is calculated. Rotation differences and possible scale differences will be removed and the stereo-pair will appear on the screen.
- d. To show the stereo pair a next time on the computer screen, right mouse-click the stereo pair icon in the Catalog: . After this select: *visualization, with Stereoscope*
- e. To create an Anaglyph image you have to repeat Step 5 by selecting a black & white image in stead of a color image. See for this Step 3 part b.: Display as Black and White. To show the stereo pair select: *visualization . as Anaglyph..*,

Stereo viewing - Tips and hints

-  To properly view the stereo pair, you have to resize the Stereoscope window so that the horizontal distance between the left-hand and the right-hand photograph fits your eye base.
-  Make sure that the splitter between the left-hand pane and the right-hand pane in the Stereoscope window is in the middle of your stereoscope.
-  Make the Stereoscope window larger /smaller, by dragging a corner of the window.

-  When you use Zooming, Panning, Entire map or Redraw or when you scroll in one of the displayed images, this will be applied to both panes.
-  To move one or both images a little to the left or to the right, in order to improve stereo vision, you may unlock  the left pane and right pane from each other.