

Point Cloud Based Change Detection

An Automated Approach for Cloud-based Services



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INTRODUCTION

BACKGROUND A landslide occurred in Malin, Maharashtra, India, on 30 July 2014 and affected an area of approximately 44,000 m².
OBJECTIVES Landslide examination with latest point cloud generation and analysis capabilities. Generation of an automated geospatial workflow for operational applications.
RESOURCES Airbus DS WorldDEM™ (pre-event) and Pléiades stereo image pair (post event), ENVI, ENVI LIDAR, IDL, and ArcGIS*.

POINT CLOUD GENERATION

DATASETS Pléiades 1A (incidence angle 21.6°), Pléiades 1B (incidence angle 1.9°), GSD 0.5 m, 8/9 Feb 2015.
METHODOLOGY The ENVI task "GeneratePointCloudsByDenseImageMatching" was implemented to extract passive point clouds in LAS format from the panchromatic stereo datasets:
 • A dense image-matching algorithm is used to identify corresponding points in the two images.
 • A block adjustment is applied to refine the 3D coordinates that describe the scene geometry.
 • Additionally, the WorldDEM™ was input to constrain the range of heights in the matching area, and subsequently the length of the epipolar line.

POINT CLOUD FEATURE EXTRACTION

DATASETS 158 *.las files extracted from the panchromatic stereo datasets.
METHODOLOGY The "PointCloudFeatureExtraction" task was executed to generate the post-DEM DSM from the photogrammetric point clouds (called post-DSM). The following parameters were set for the DEM extraction:
 • DEM_GRID_RESOLUTION: 1 m (project density 3-4 points / m²)
 • DEM_NEAR_TERRAIN_CLASSIFICATION: 0.5 m
 • DEM_FILTER_LOWER_POINTS: Rural Area Filtering

POST-PROCESSING & CLASSIFICATION

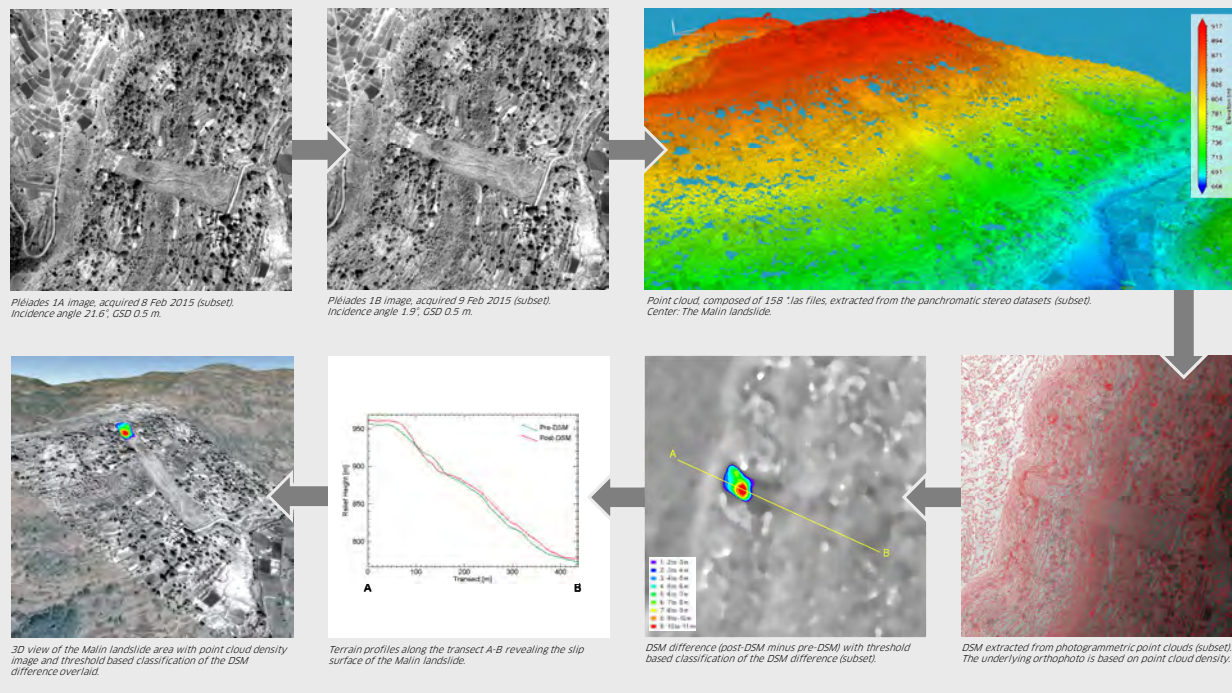
DATASETS Pre-DSM (WorldDEM™) and photogrammetric post-DSM.
METHODOLOGY Post-processing and classification consisted of the following steps:
 • Adding the geoid component (EGM 2008) to the post-DSM.
 • Pre-DEM reprojection to the UTM Zone 43N (WGS-84) coordinate system and resizing.
 • Subtraction of the pre-DSM from the post-DSM.
 • Filtering and threshold based classification of the DSM difference.

AUTOMATION

This automated point cloud generation and analysis can be embedded in virtually any existing geospatial workflow for operational applications.
 Tested integration options are:
 • Deployment within service-based information systems, notably ArcGIS*. This allows to make the application available to organizations through their Portal for ArcGIS* website.
 • Publishing the point cloud processing tasks as web-based services via the ENVI Services Engine (ESE) to existing enterprise infrastructures or cloud solutions.
 • General implementation in geospatial workflows using the IDL bi-directional Python bridge.

CONCLUSION

• Based on stereo satellite imagery, point clouds of high precision and density distribution can be obtained in a few minutes to support the operational monitoring of landslide processes.
 • The simple implementation in online services with the technology of HARRIS and ESRI makes it possible to calculate and retrieve tailored, individual analyses for user-defined areas on-the-fly.



```

PRO generatePointClouds, inStereo1, inStereo2, $
    inDEM, outDIR

COMPILE_OPT IDL2

; Start the application
e = ENVI /HEADLESS

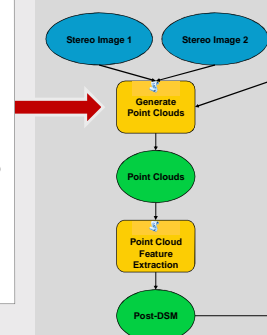
; Open input rasters
rasterStereo1 = e.OpenRaster(inStereo1)
rasterStereo2 = e.OpenRaster(inStereo2)
rasterDEM = e.OpenRaster(inDEM)

; Get the point cloud generation task
; from the catalog of ENVI tasks
Task = ENVITask("GeneratePointCloudsByDenseImageMatching")
Task.INPUT_RASTERS = [rasterStereo1, rasterStereo2]
Task.INPUT_DEM_RASTER = rasterDEM
Task.DO_BLOCK_ADJUSTMENT = 55.00 ; default
Task.MINIMUM_OVERLAP = 55 ; default
Task.MATCHING_THRESHOLD = 15 ; default
Task.EDGE_THRESHOLD = 5 ; default
Task.QUALITY_THRESHOLD = 60 ; default
Task.OUTPUT_DIRECTORY = outDIR
Task.Execute

END
    
```

IDL script (above) for implementation of the point cloud generation in the ArcGIS* ModelBuilder (right) for a point cloud based change detection.

POINT CLOUD GENERATION & FEATURE EXTRACTION



POST-PROCESSING & CLASSIFICATION

