Autonomous Ground Control Points Detection

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What is Photogrammetry?

Photogrammetry is the science of making measurements from photographs. The input to photogrammetry is photographs, and the output is typically a map, a drawing, a measurement, or a 3D model of some real-world object or scene. Many of the maps we use today are created with photogrammetry and photographs taken from aircraft.

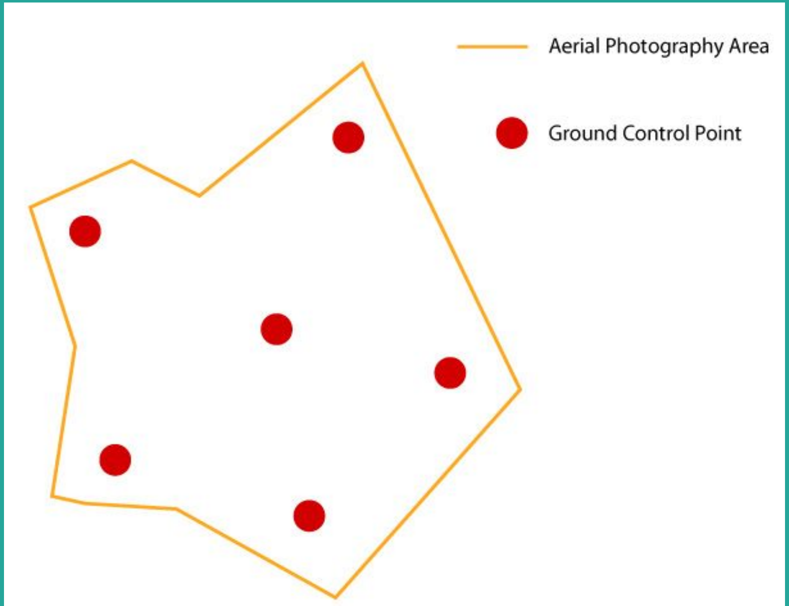
What are Ground Control Points?

Ground Control Points (GCP) are points on the ground with known coordinates in the spatial coordinate system (i.e. both coordinates defining horizontal position and the altitude coordinate). Their coordinates are obtained with traditional surveying methods in the field (tachymetry, GNSS-measurement) or from other available sources.Ground Control Points (GCP) are points on the ground with known coordinates in the spatial coordinate system (i.e. both coordinates defining horizontal position and the altitude coordinate). Their coordinates are obtained with traditional surveying methods in the field (tachymetry, GNSS-measurement) or from other available sources.

Why are GCPs needed in photogrammetry?

The GCP in nature determines the position of its aerial photo mage in the coordinate system. To calculate the coordinates for each point on the aerial photography, several ground control points' coordinates are used and photogrammetric procedures followed.

GCPs are necessary for orientation and placement of aerial photographs in the spatial coordinate system, which is a prerequisite for the production of georeferenced metric and 3D models of the earth's surface (point cloud, DSM, DTM, orthophoto plan). Namely, computer processing and analysis require spatial coordination models – from point cloud to orthophoto mosaics.



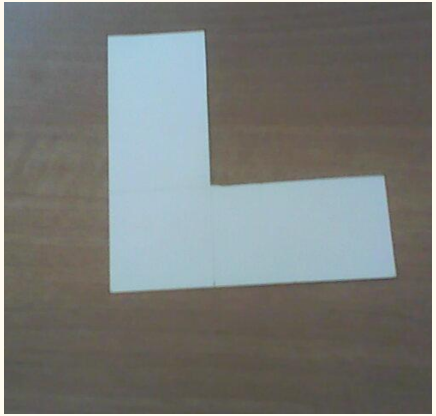
Autonomous GCP detection

Approach

- Segmentation
- GCP Classifier
- Ground control point detection

Procedure

1. Grayscale thresholding
2. Contour detection
3. Filter contours based on convexity and area.
4. Fit Bounding Rectangles on the contours and select bounding rectangles with aspect ratio approximately equal to the square.



GCP Classifier

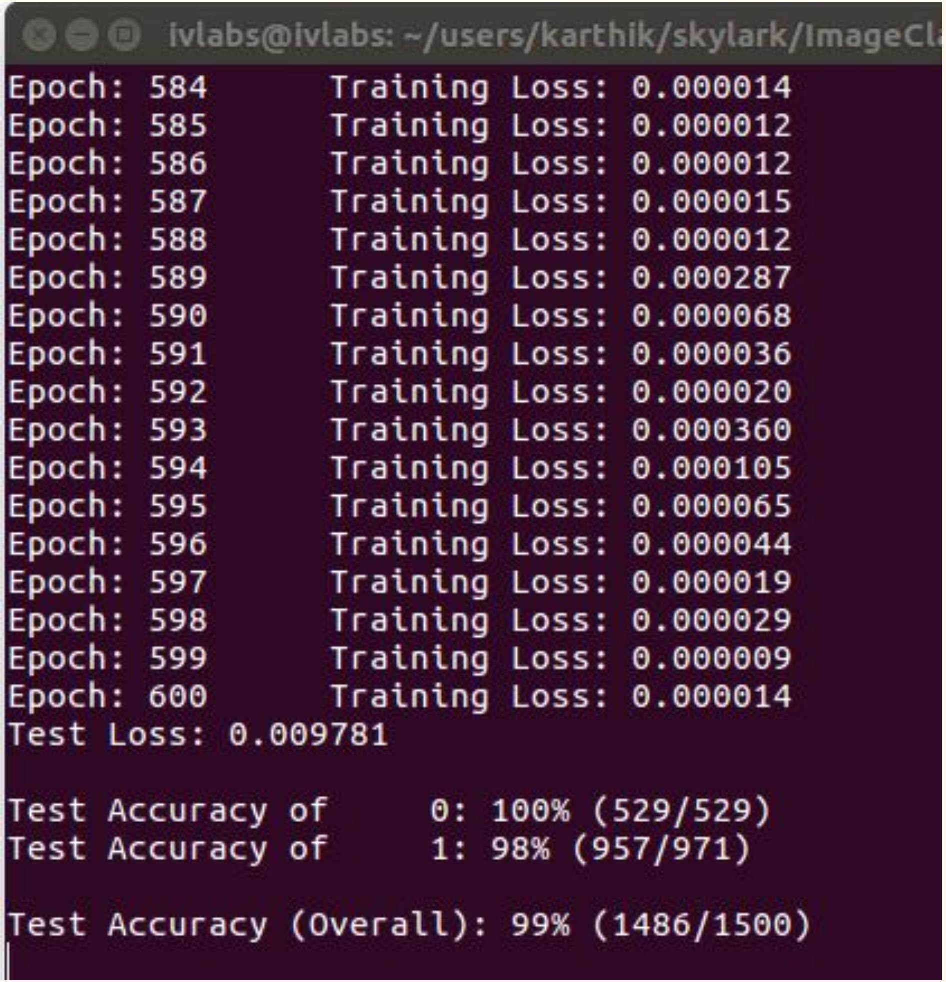
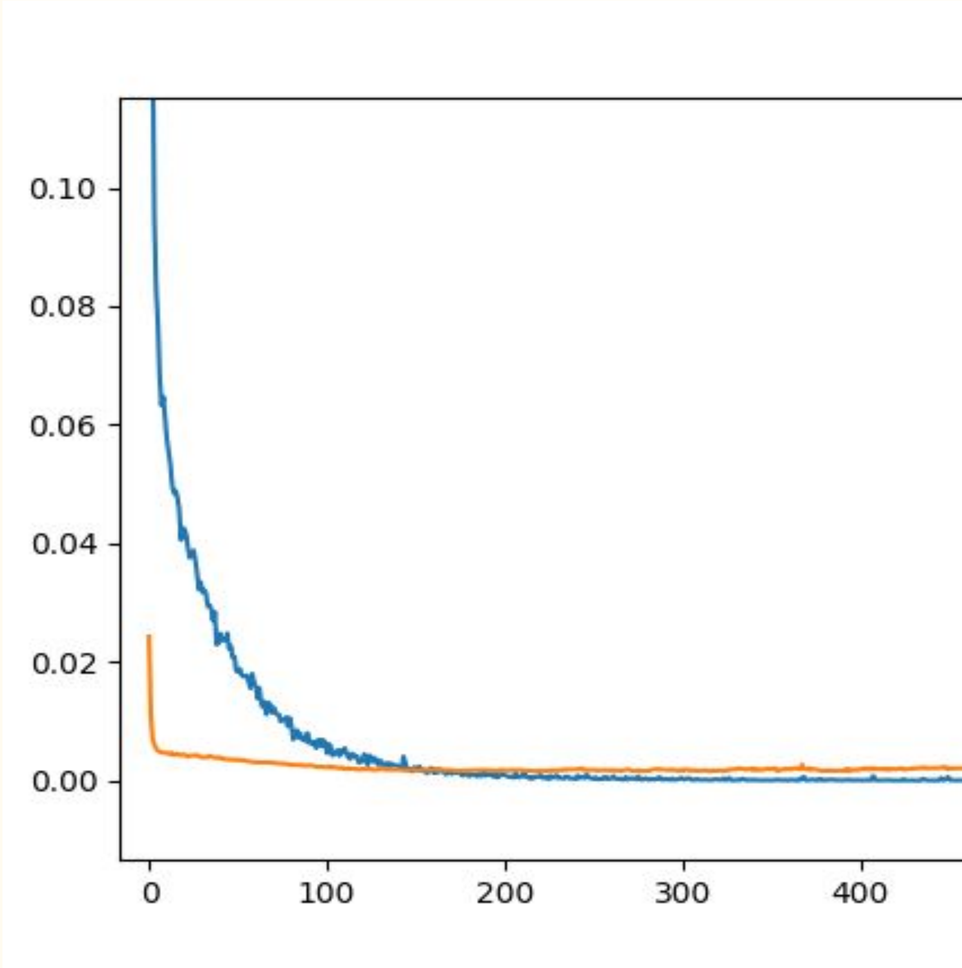
Binary Image Classifier

Dataset Creation

1. Positive and Negative examples are collected based on the labeled dataset.
2. All examples are resized to a uniform size.
3. Positive examples are augmented(Mirrored, rescaled, rotated) to balance the ratio between negative and positive examples.

Training

1. Train (60%), Valid(10%), Test(30%)
2. Convolution neural network architecture with 2 Conv layers and 3 fully connected layers.
3. Dropout layer with 80% keep probability are being added for better generalisation.
4. Cross Entropy Loss is used as a training loss


ivlabs@ivlabs: ~/users/karthik/skylark/ImageCl
Epoch: 584 Training Loss: 0.000014
Epoch: 585 Training Loss: 0.000012
Epoch: 586 Training Loss: 0.000012
Epoch: 587 Training Loss: 0.000015
Epoch: 588 Training Loss: 0.000012
Epoch: 589 Training Loss: 0.000287
Epoch: 590 Training Loss: 0.000068
Epoch: 591 Training Loss: 0.000036
Epoch: 592 Training Loss: 0.000020
Epoch: 593 Training Loss: 0.000360
Epoch: 594 Training Loss: 0.000105
Epoch: 595 Training Loss: 0.000065
Epoch: 596 Training Loss: 0.000044
Epoch: 597 Training Loss: 0.000019
Epoch: 598 Training Loss: 0.000029
Epoch: 599 Training Loss: 0.000009
Epoch: 600 Training Loss: 0.000014
Test Loss: 0.009781
Test Accuracy of 0: 100% (529/529)
Test Accuracy of 1: 98% (957/971)
Test Accuracy (Overall): 99% (1486/1500)

0.10
0.08
0.06
0.04
0.02
0.00
0
100
200
300
400

Conclusion

This autonomous GCP detection using Computer vision and machine learning techniques saves a lot of manual time of identifying and marking multiple GCPs in the aerial images shot from the drones for photogrammetry.