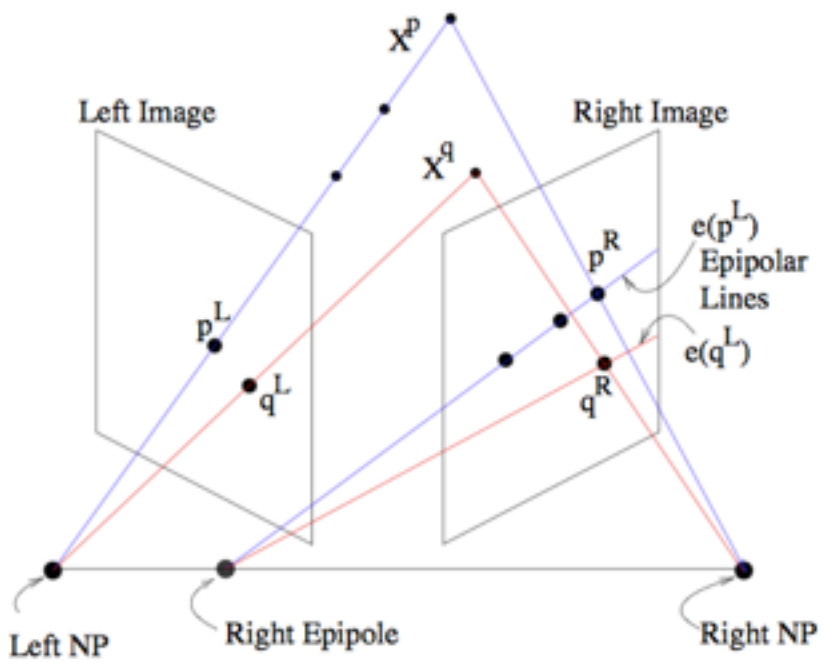
Projection, stereo images

X^p and X^q are the physical location of objects.

NP are the nadir points of the cameras.



http://www.cs.toronto.edu/~jepson/csc420/notes/epiPolarGeom.pdf

The projection of the left nadir, NP is seen as a the right epipole with w.r.t. the right image. The epipoles may or may not be within the border of the images.

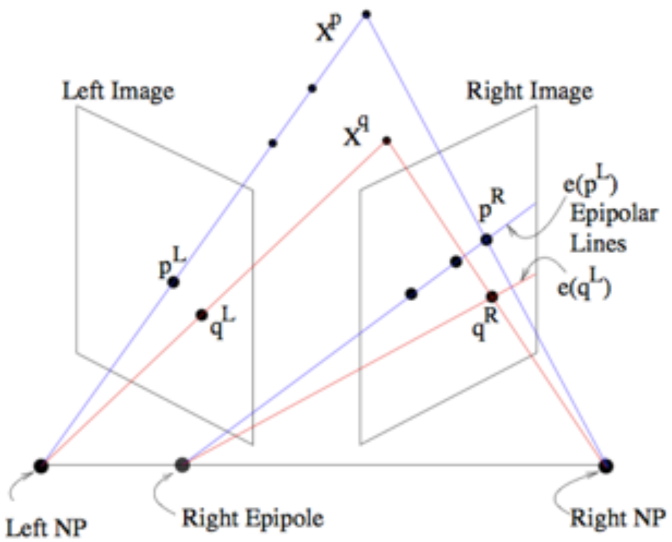
The projection of X^p to left nadir, NP is seen as an epipole line in the right image. If more than one epipole line is present in the right image, they converge at the right epipole (which might not be within the boundaries of the image).

Once the points in the left image, X_L are matched with points in the right image, X_R, if there are at least 7 points, one can determine the “bifocal tensor”,
a.k.a. “fundamental matrix, relating the points in the 2 images using a 3x3 matrix of rank 2.

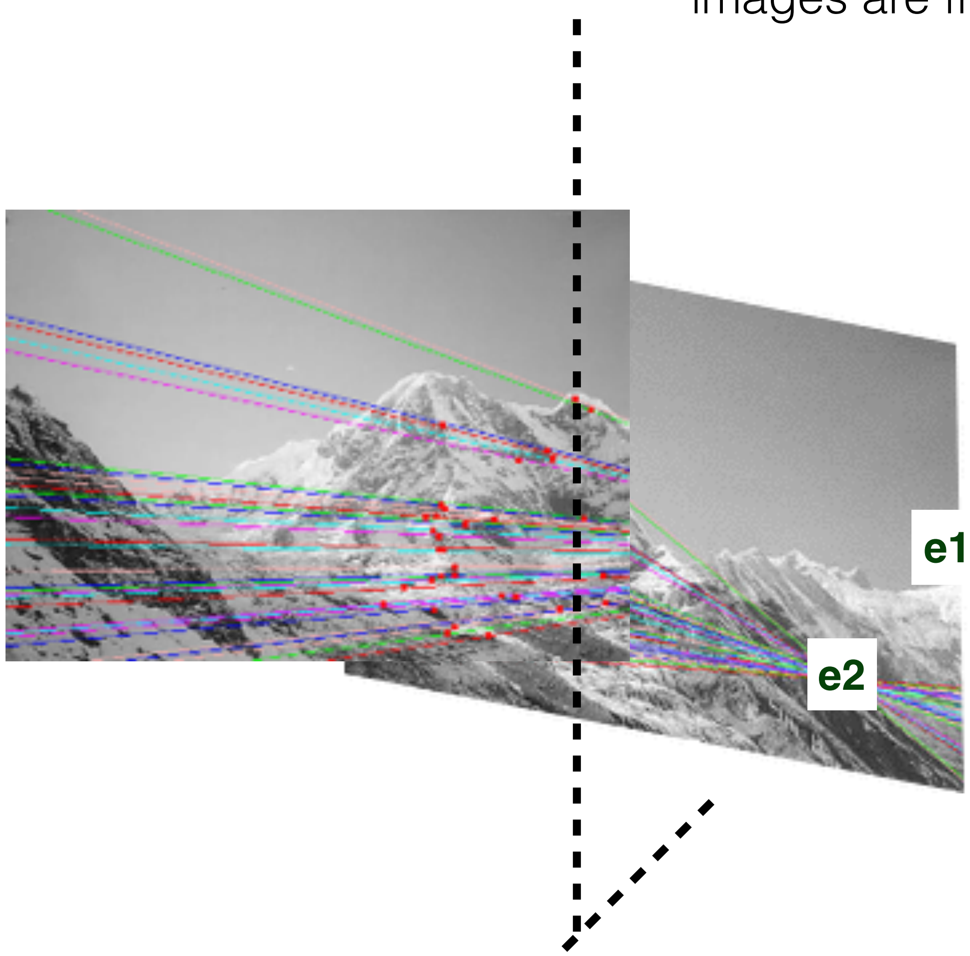
$(X_L)^T * F * X_R = 0$ for any pair or points in the images.

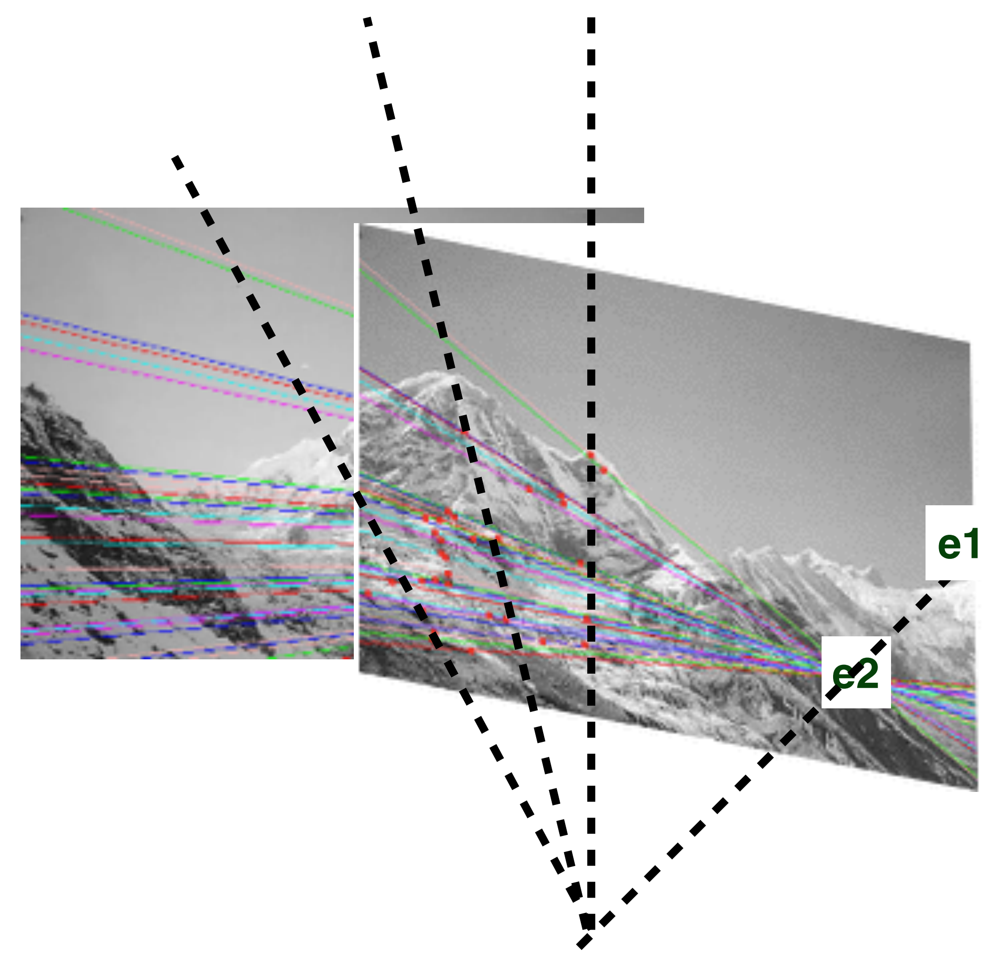
Note: the “Essential matrix” is a matrix used if the camera details are known. the “bifocal tensor”, a.k.a. “fundamental matrix” does not need camera details.

Projection, stereo images



images are from Brown & Lowe 2003



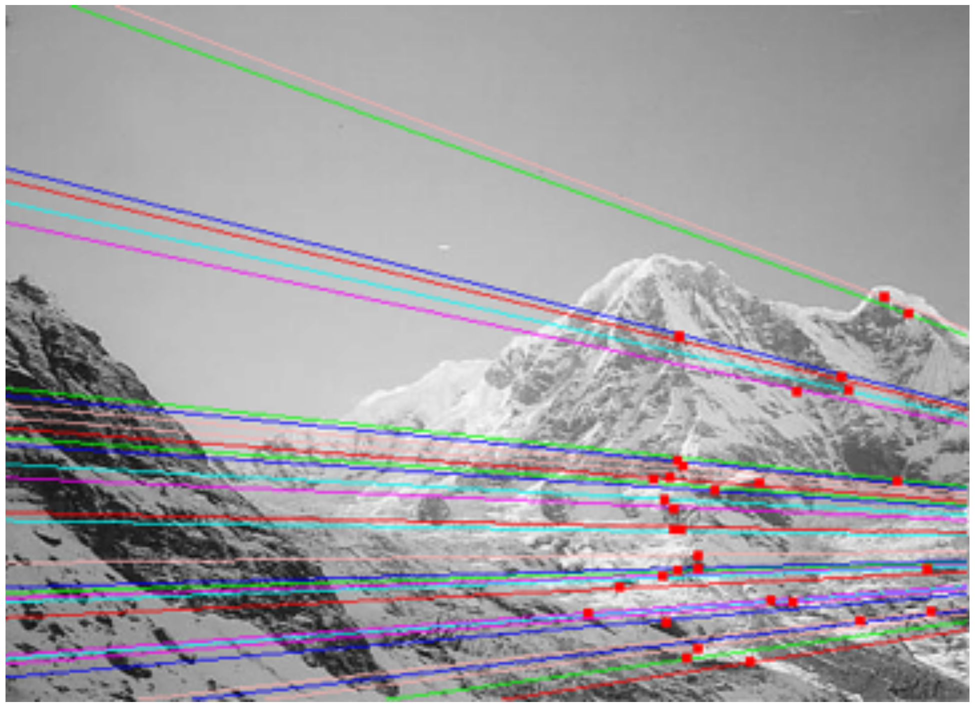


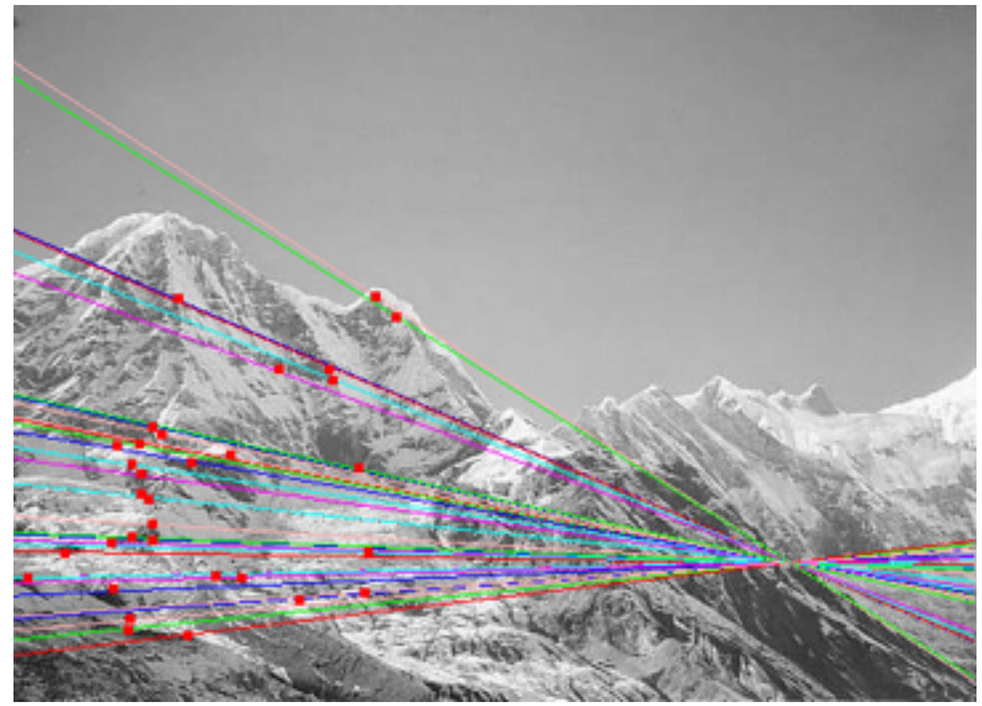
same camera objectives (nadirs), but different orientation for the 2 images (that is, rotated around the same nadir)

```
leftEpipole = (819.7904805976898, 289.2491982985311) = e1
rightEpipole = (-512.6627398191632, 11.894186211572105) = e2
```

Projection, stereo images

manually matching a subset of the corners from the edge extractor used with “outdoor mode”:

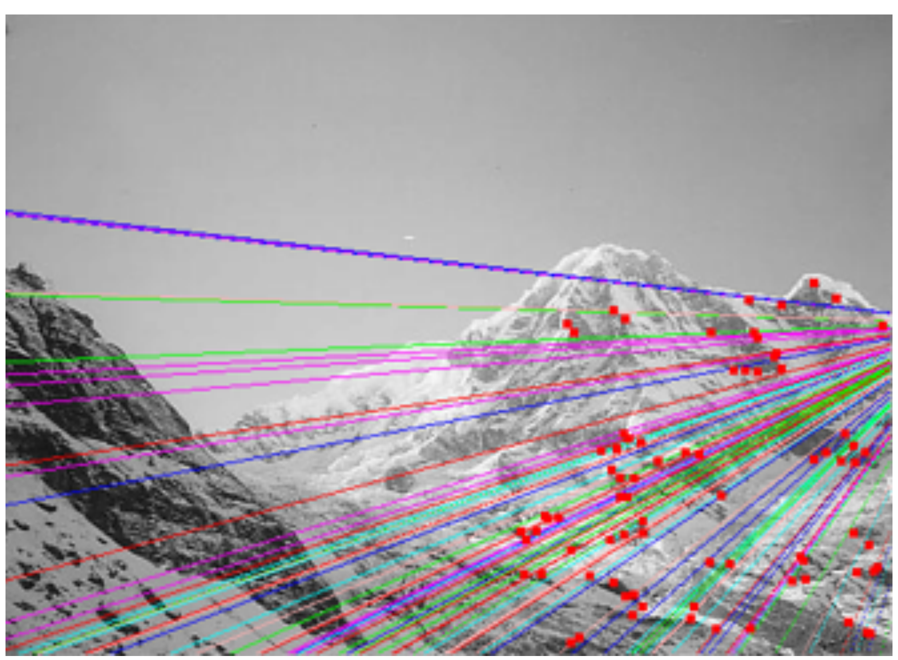


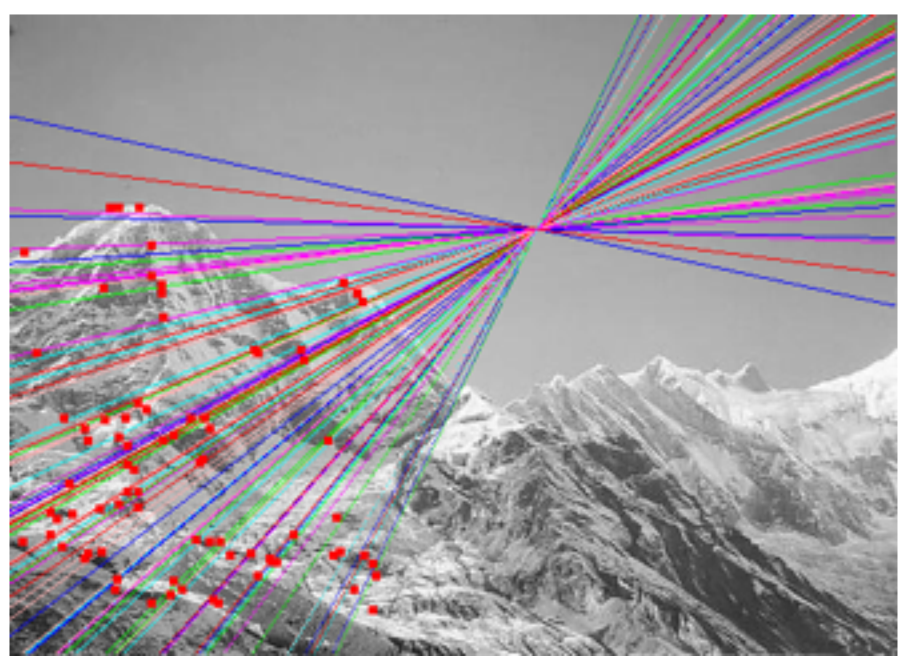


stereo projection fit to 32 points already known to match shows what the epipolar projections should be when the corner find + corner match + stereo projection solve are correctly automated.

```
nMatched=32
avgDist=0.281
stDev=0.508
```

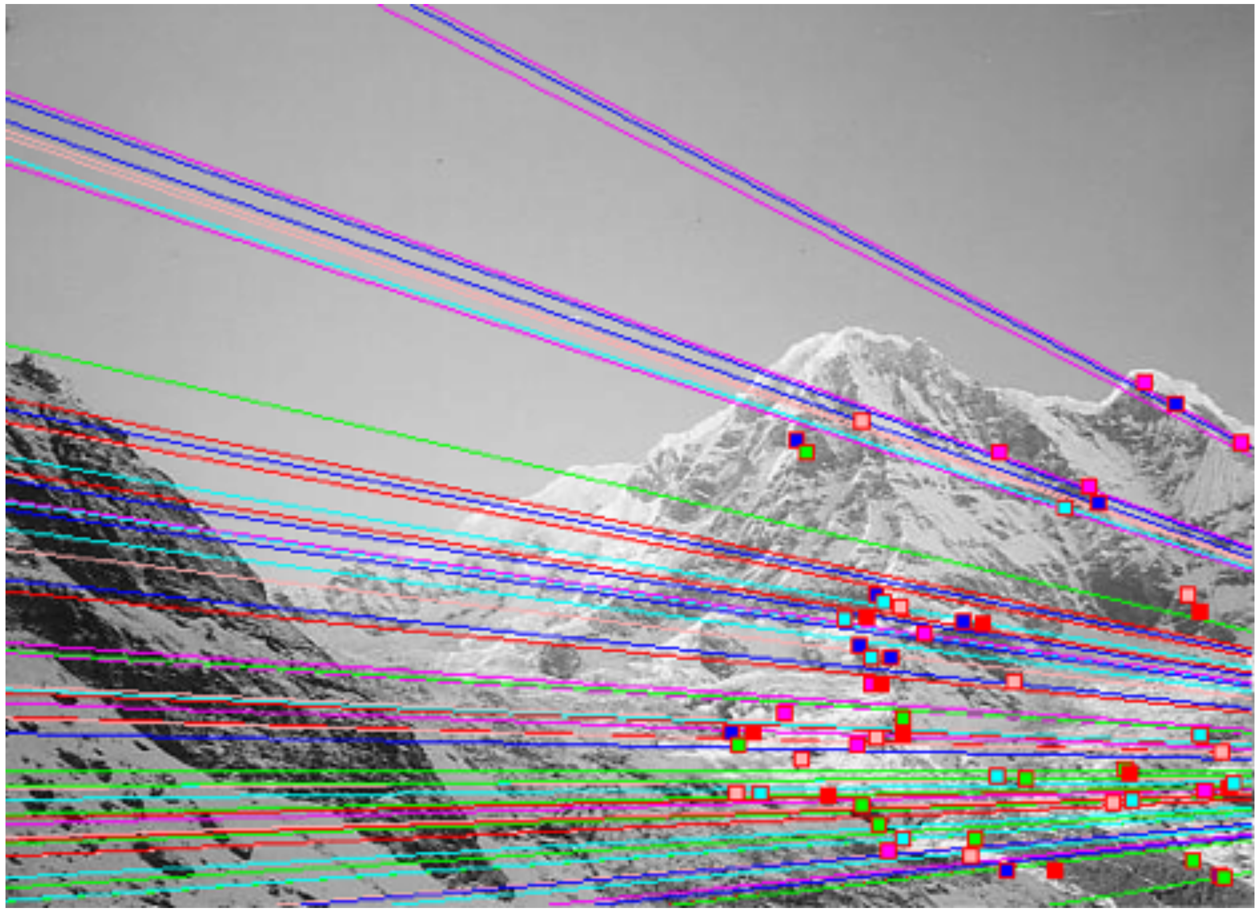
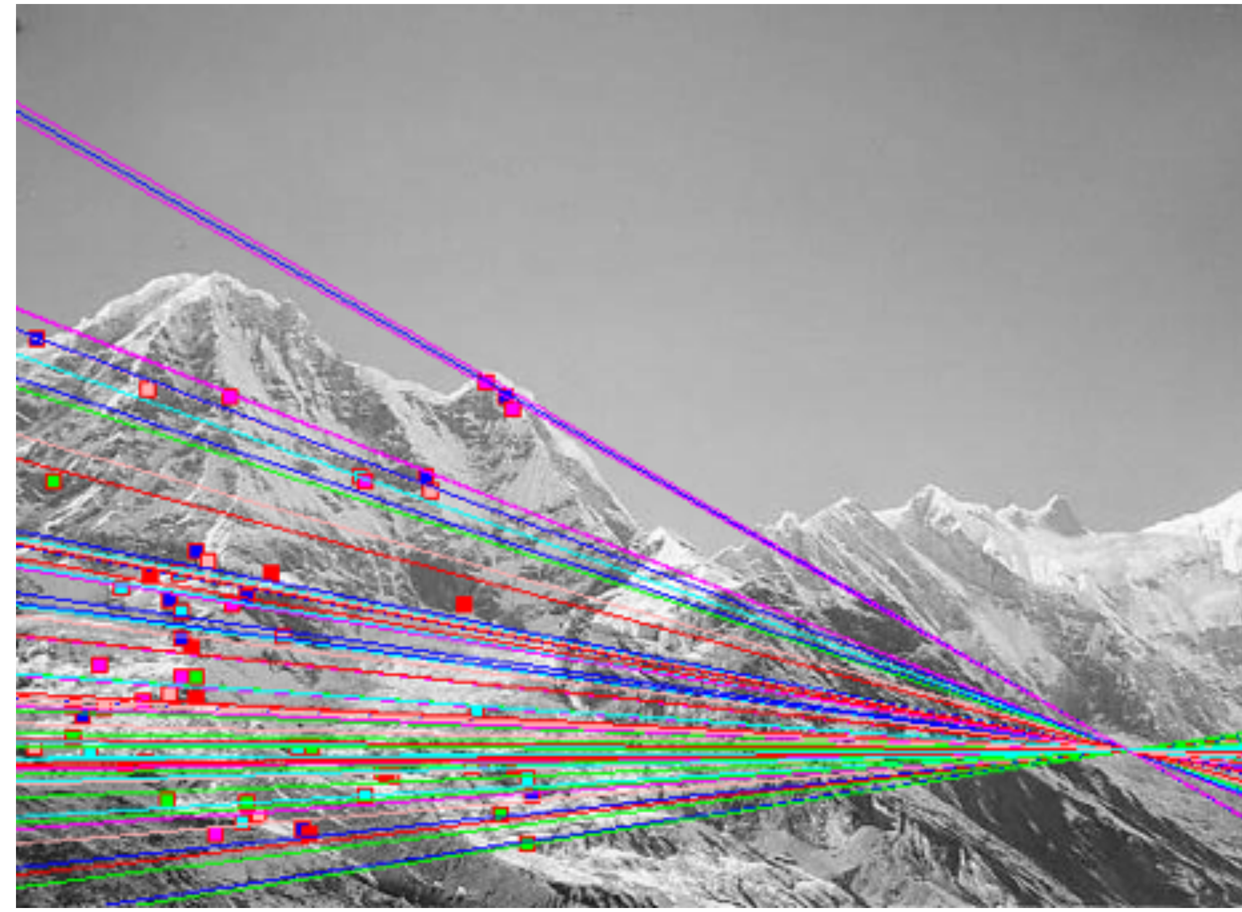
all corners from the edge extractor used with “outdoor mode”:





best of stereo projection iterations of pairings in the 78 un-matched points as a matrix, shows one cannot follow this w/ outlier removal from these epipolar line and point differences because the top points from the 2nd tallest mountain would be removed and those are 2 of the most important in an accurate fit (see above). So will use euclidean point matching first (same for inflection points).

Projection, stereo images

points of interest: **corners** calculated using extremes of curvature from edges created with “outdoor mode”.

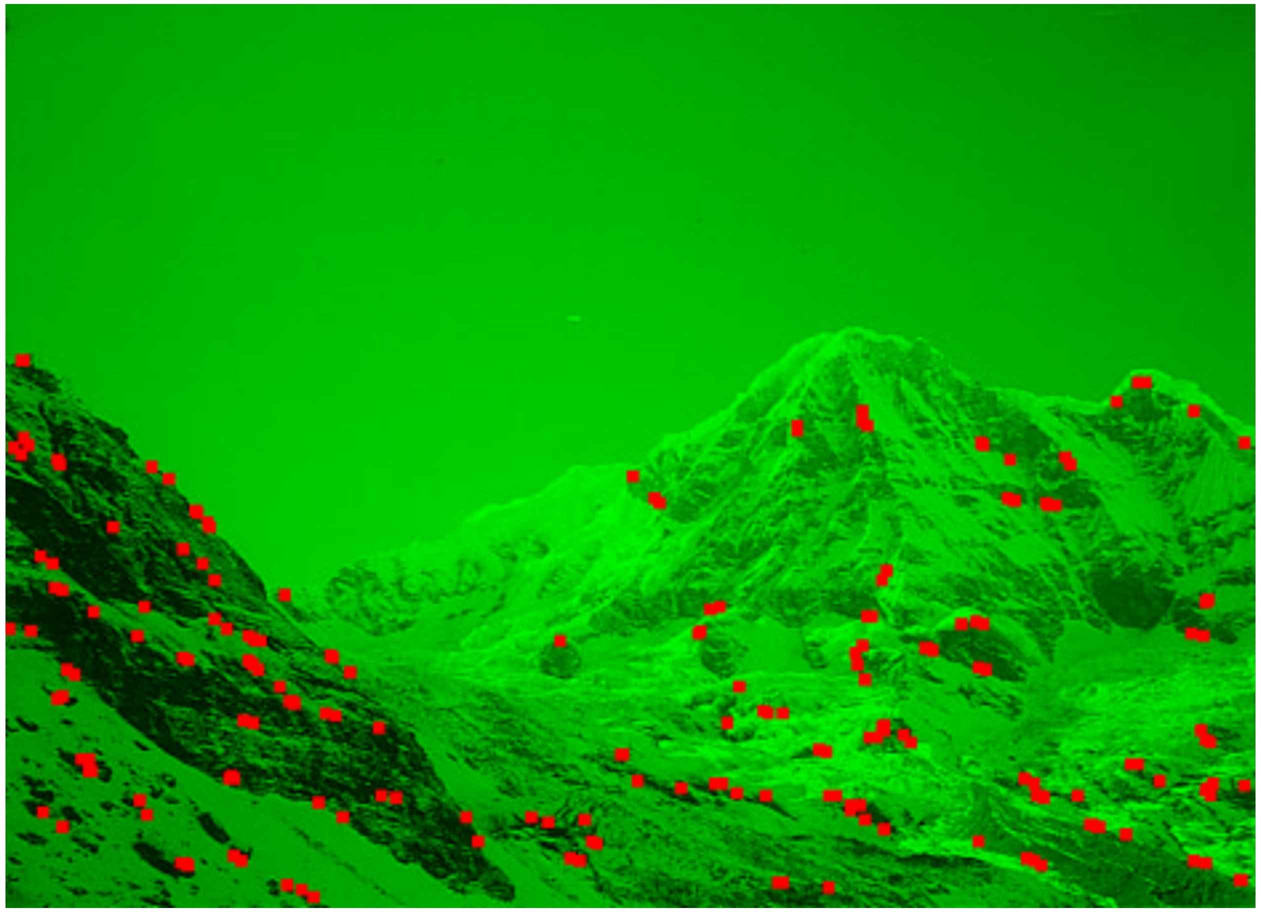
point matcher: find rough euclidean transformation, then rough match of sets, then improved euclidean transformation, followed with removal of points with residuals > avg dist + 0.5*standard deviation.

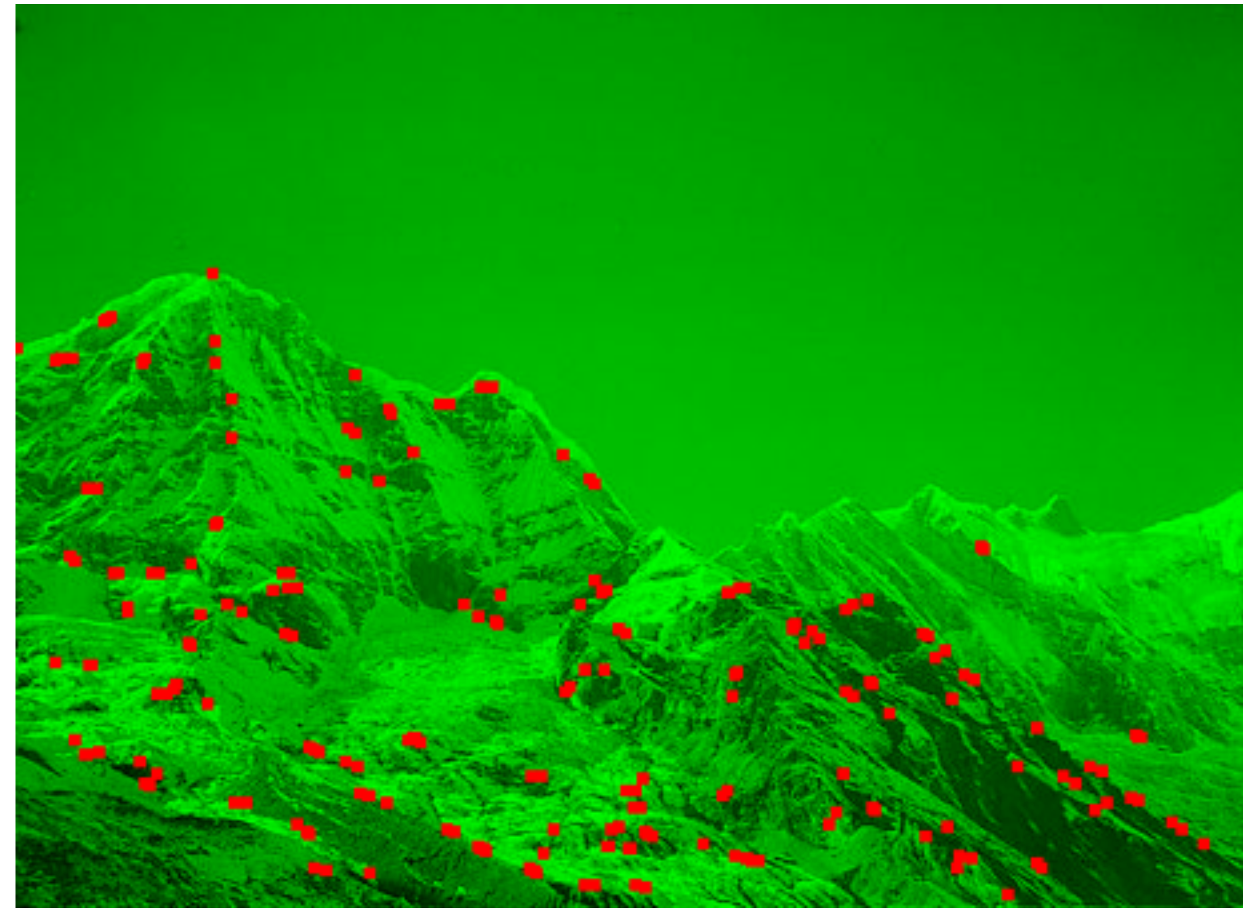
stereo projection: the above is one invocation of the stereo projection calculation (no further outlier removal).

```
nMatchedPoints=60
meanDistFromModel=5.683 (compared to the manually chosen result 0.281)
stDevFromMean=6.138 (compared to the manually chosen result 0.508)
```

corner sets have few common members (even from the specially tailored “outdoor mode” edges) so the sets are difficult to match. Trying inflection points next.

Projection, stereo images





points of interest: **inflection points** calculated using the peaks from the contours extracted from scale space images looks promising. The edges used to create the scale space images were created with “outdoor mode”.

point matcher:

stereo projection:

Not Finished… in progress