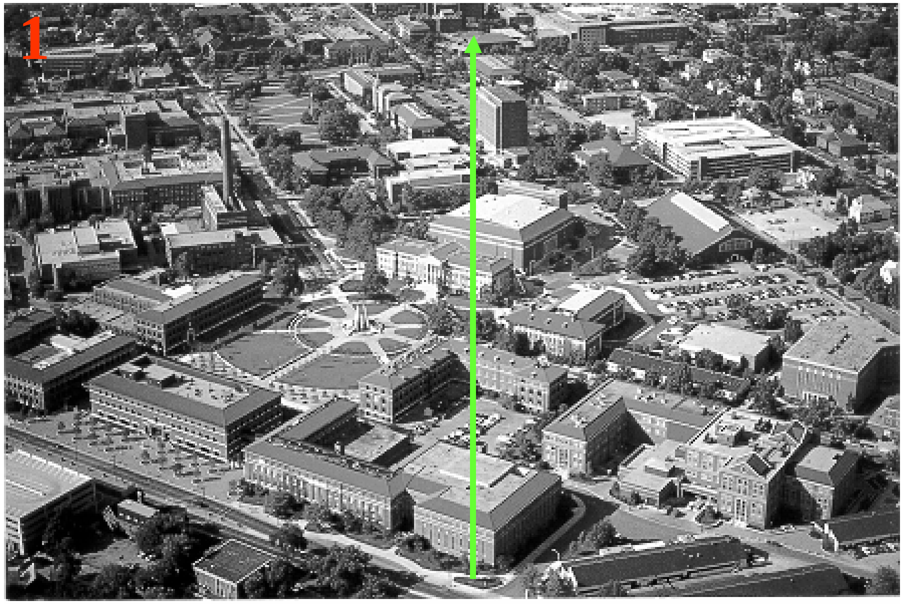
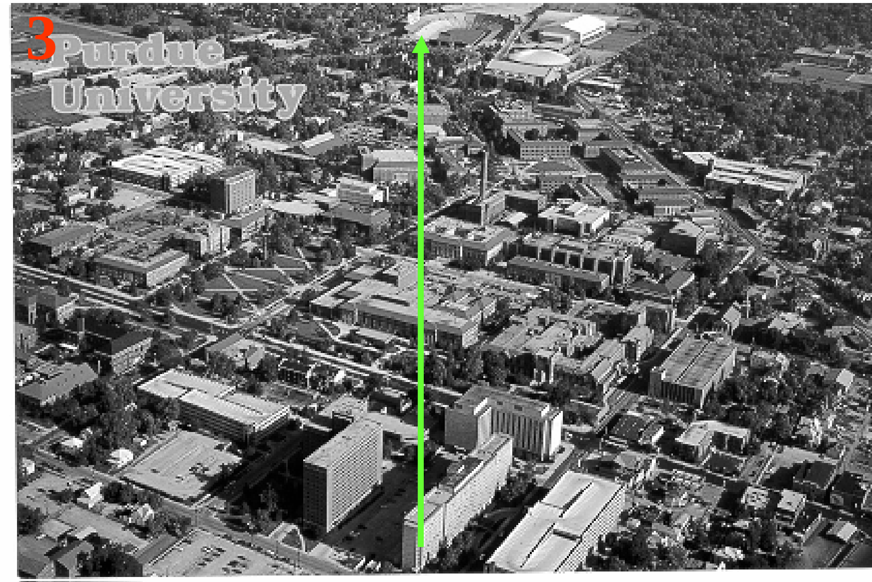
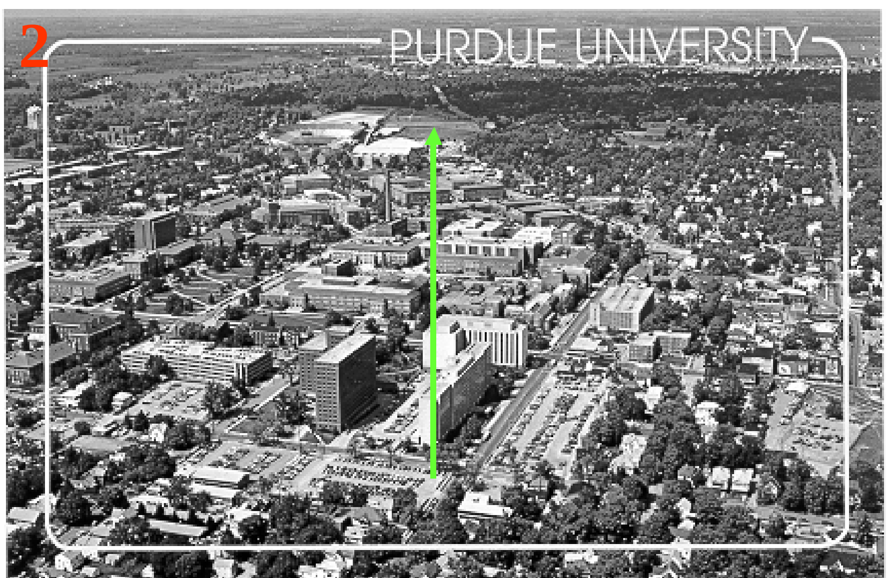
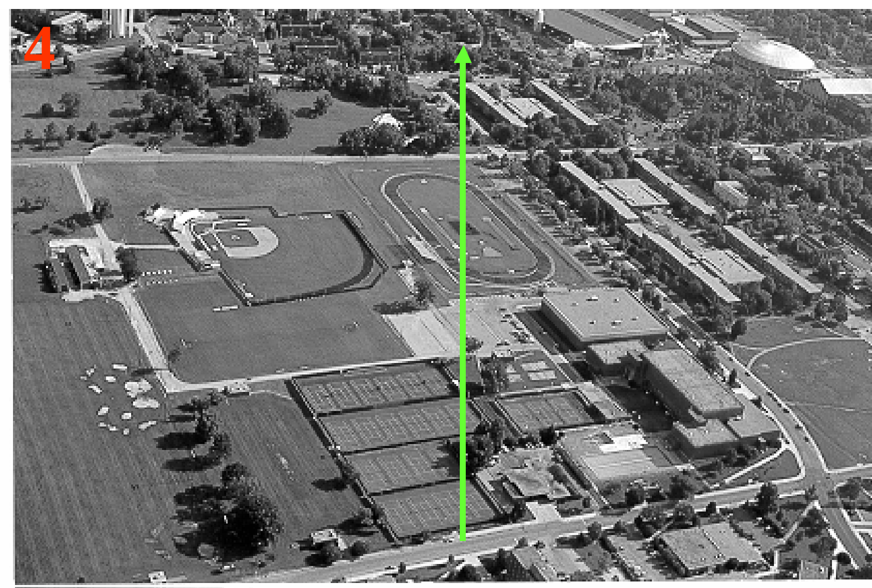
Locate +Y axis in the image and transfer to map

Homework 3. (a) estimate the rotation matrix, and extract omega-phi-kappa, for each of 4 images

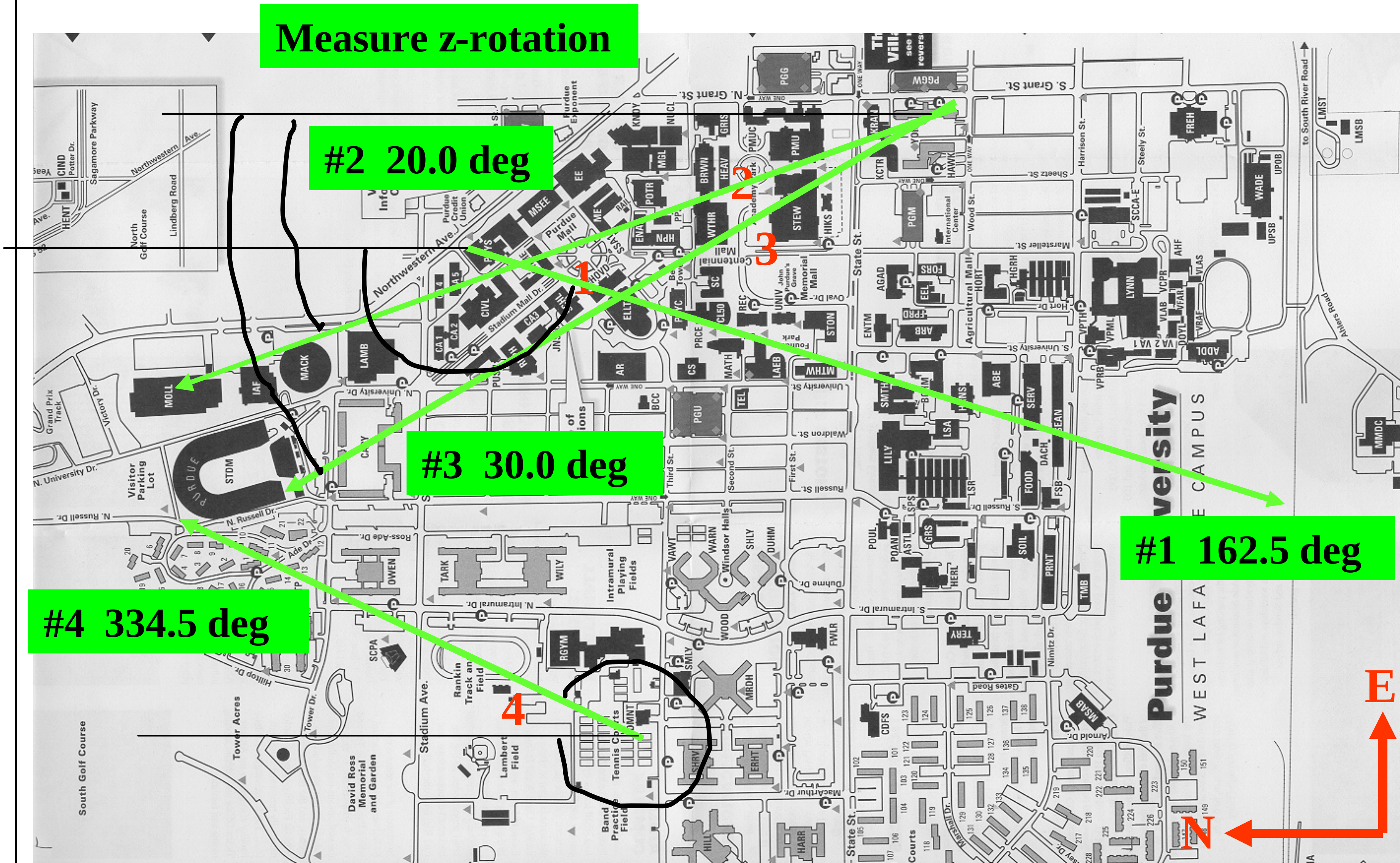








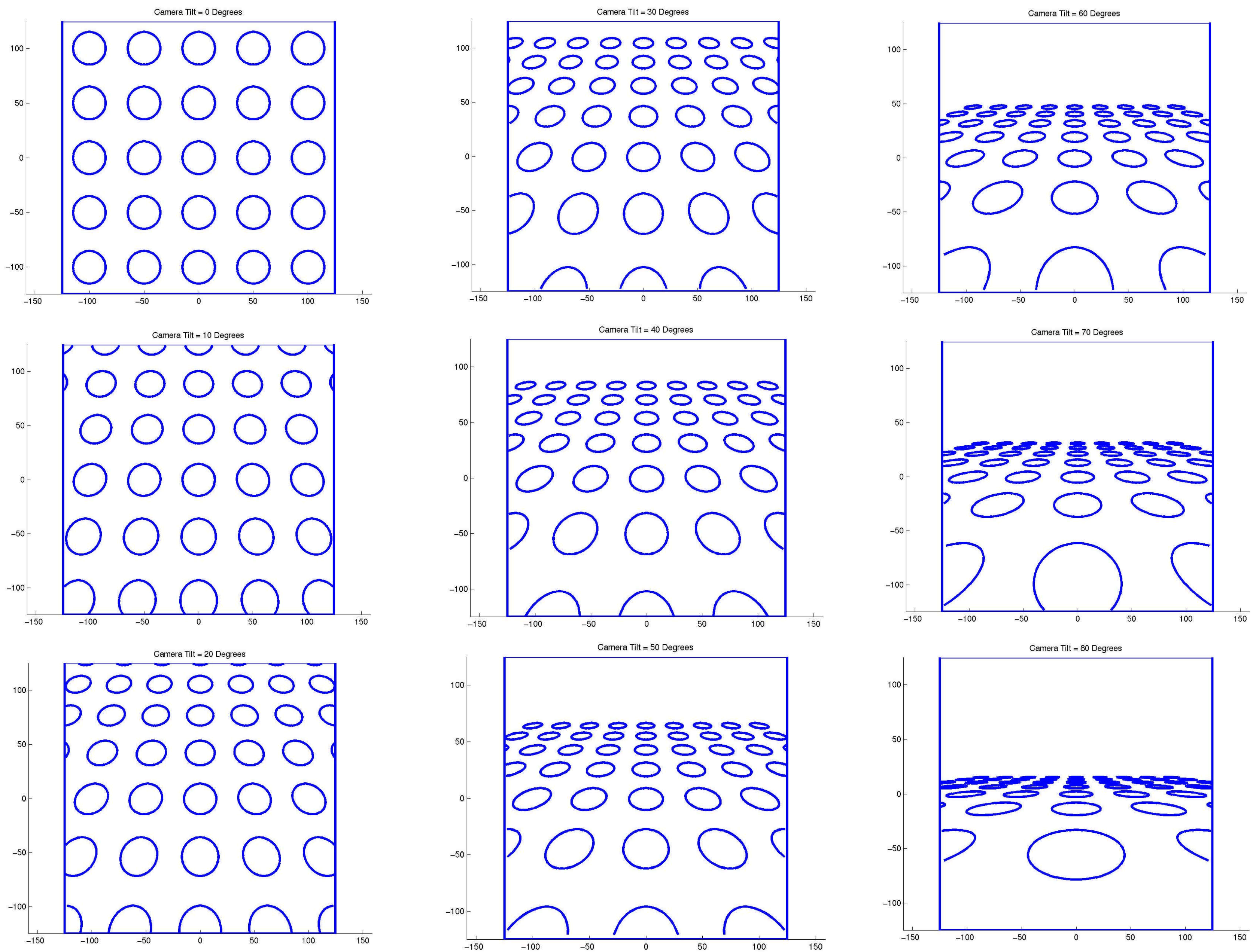
(a) continued, use campus map for reference, approximate center of each image is indicated, approximate E,N axes shown



Estimation of tilt (x-rotation) by visual estimation and by aspect ratio of objects near the principal point

photo	Tilt (x-rot) from visual est.	Tilt (x-rot) from aspect ratio
1	50 deg	65 deg (2.4)
2	65 deg	70 deg (3.0)
3	50 deg	65 deg (2.5)
4	60 deg	60 deg (2.0)

Best way to obtain angles: get 6-10 control points (XYZ), obtain L's from the DLT, compute angles from the L's.


Camera Tilt = 0 Degrees
Camera Tilt = 30 Degrees
Camera Tilt = 60 Degrees
Camera Tilt = 10 Degrees
Camera Tilt = 40 Degrees
Camera Tilt = 70 Degrees
Camera Tilt = 20 Degrees
Camera Tilt = 50 Degrees
Camera Tilt = 80 Degrees

Look at the aspect ratio of the circle in the center of the image (at the principal point) to make better estimate of tilt – in practice use feature visible in the image

at principal point, $y = 0$

$t = \text{tilt}$, $H = \text{flying height}$, $f = \text{focal length}$

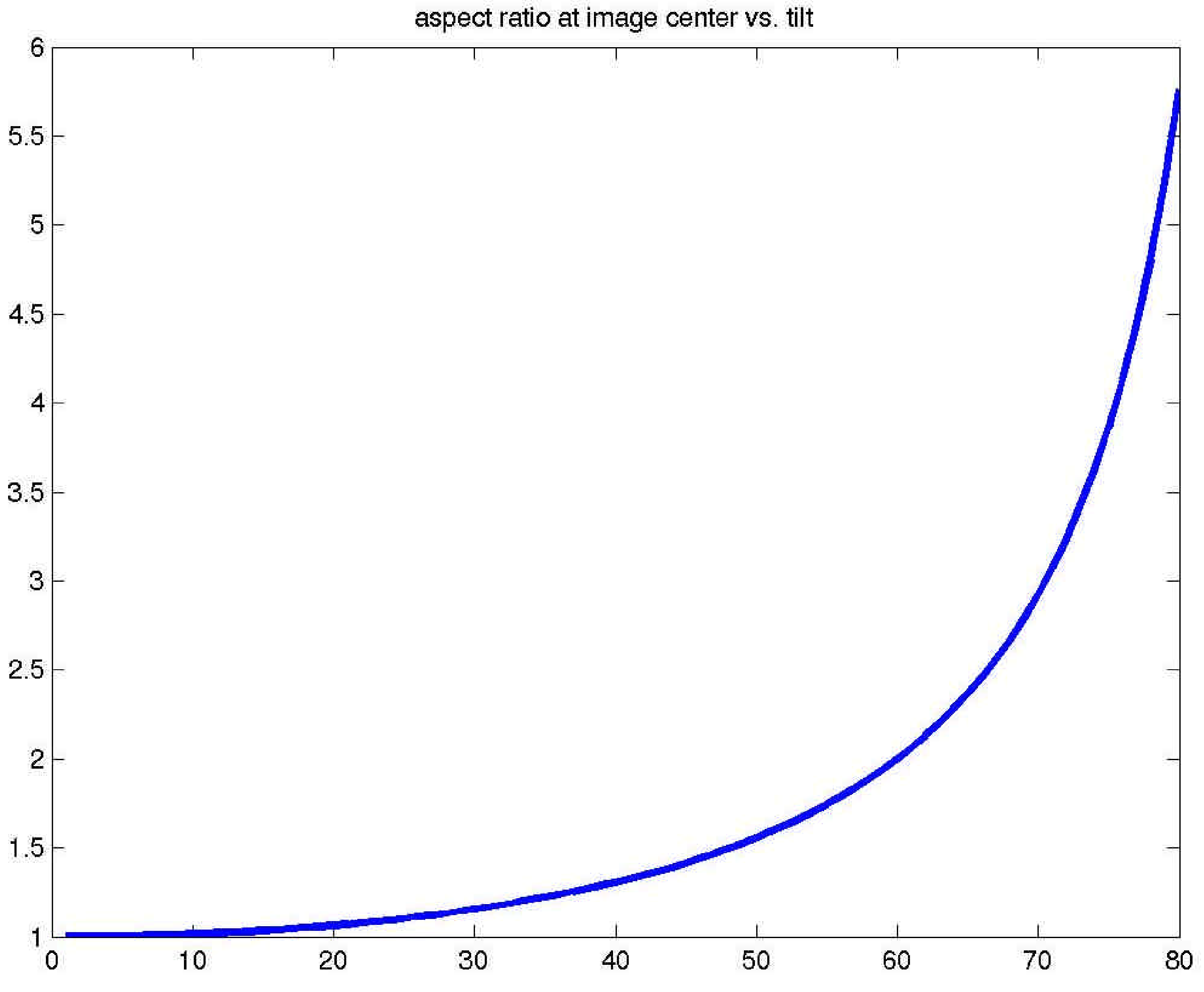
$$e = \frac{f}{\tan t} - y$$

$$S_x = \text{Scale(x)} = \frac{e \sin t}{H}$$

$$S_y = \text{Scale(y)} = \frac{e^2 \sin^2 t}{Hf}$$

$$\text{aspect ratio} = \frac{S_x}{S_y}$$

Tilt (deg)	Aspect ratio
0	1.000
10	1.015
20	1.064
30	1.155
40	1.305
50	1.556
60	2.000
70	2.924
80	5.759


aspect ratio at image center vs. tilt
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0
10
20
30
40
50
60
70
80

1. $M = M_x(65^\circ)M_z(162.5^\circ)$

$$M = \begin{bmatrix} -0.9537 & 0.3007 & 0 \\ -0.1271 & -0.4031 & 0.9063 \\ 0.2725 & 0.8644 & 0.4226 \end{bmatrix}$$

$w = -63.94^\circ$

$f = 15.81^\circ$

$k = 172.4^\circ$

2. $M = M_x(70^\circ)M_z(20^\circ)$

$$M = \begin{bmatrix} 0.9397 & 0.3420 & 0 \\ -0.1170 & 0.3214 & 0.9397 \\ 0.3214 & -0.8830 & 0.3420 \end{bmatrix}$$

$w = 68.82^\circ$

$f = 18.74^\circ$

$k = 7.09^\circ$

3. $M = M_x(65^\circ)M_z(30^\circ)$

$$M = \begin{bmatrix} 0.8660 & 0.5000 & 0 \\ -0.2113 & 0.3660 & 0.9063 \\ 0.4532 & -0.7849 & 0.4226 \end{bmatrix}$$

$w = 61.70^\circ$

$f = 26.94^\circ$

$k = 13.71^\circ$

4. $M = M_x(60^\circ)M_z(334.5^\circ)$

$$M = \begin{bmatrix} 0.9026 & -0.4305 & 0 \\ 0.2153 & 0.4513 & 0.8660 \\ -0.3728 & -0.7817 & 0.5000 \end{bmatrix}$$

$w = 57.39^\circ$

$f = -21.89^\circ$

$k = -13.41^\circ$

Graphical Resection of TIN rendering

$$\begin{bmatrix} X_L \\ Y_L \\ Z_L \end{bmatrix} = \begin{bmatrix} 471380 \\ 4493800 \\ 34641 \end{bmatrix}$$

$$M = M_x(30^\circ) M_z(-120^\circ)$$

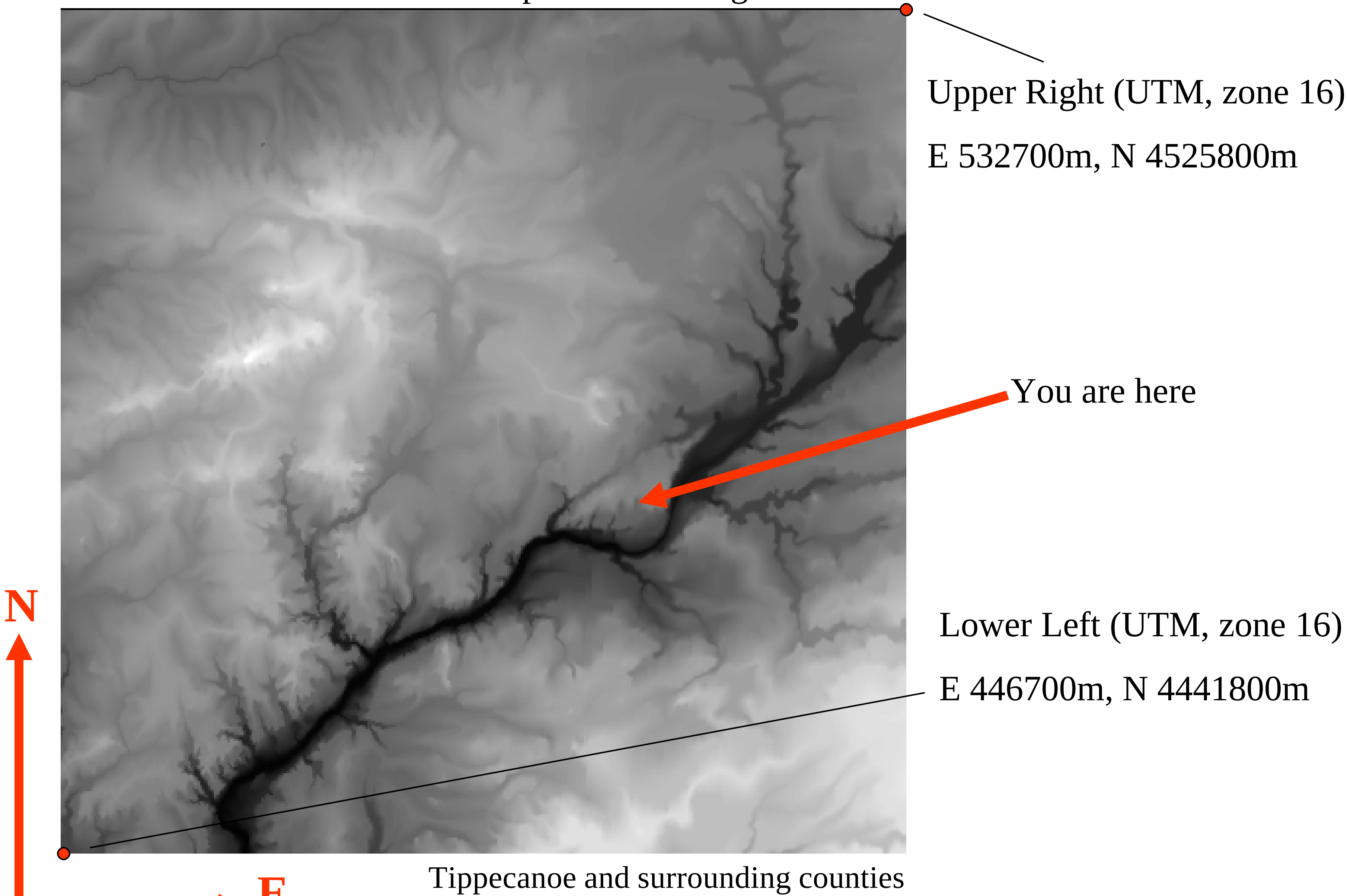
$$M = \begin{bmatrix} -0.5000 & -0.8660 & 0 \\ 0.7500 & -0.4330 & 0.5000 \\ -0.4330 & 0.2500 & 0.8660 \end{bmatrix}$$

$$w = -16.10^\circ$$

$$f = -25.65^\circ$$

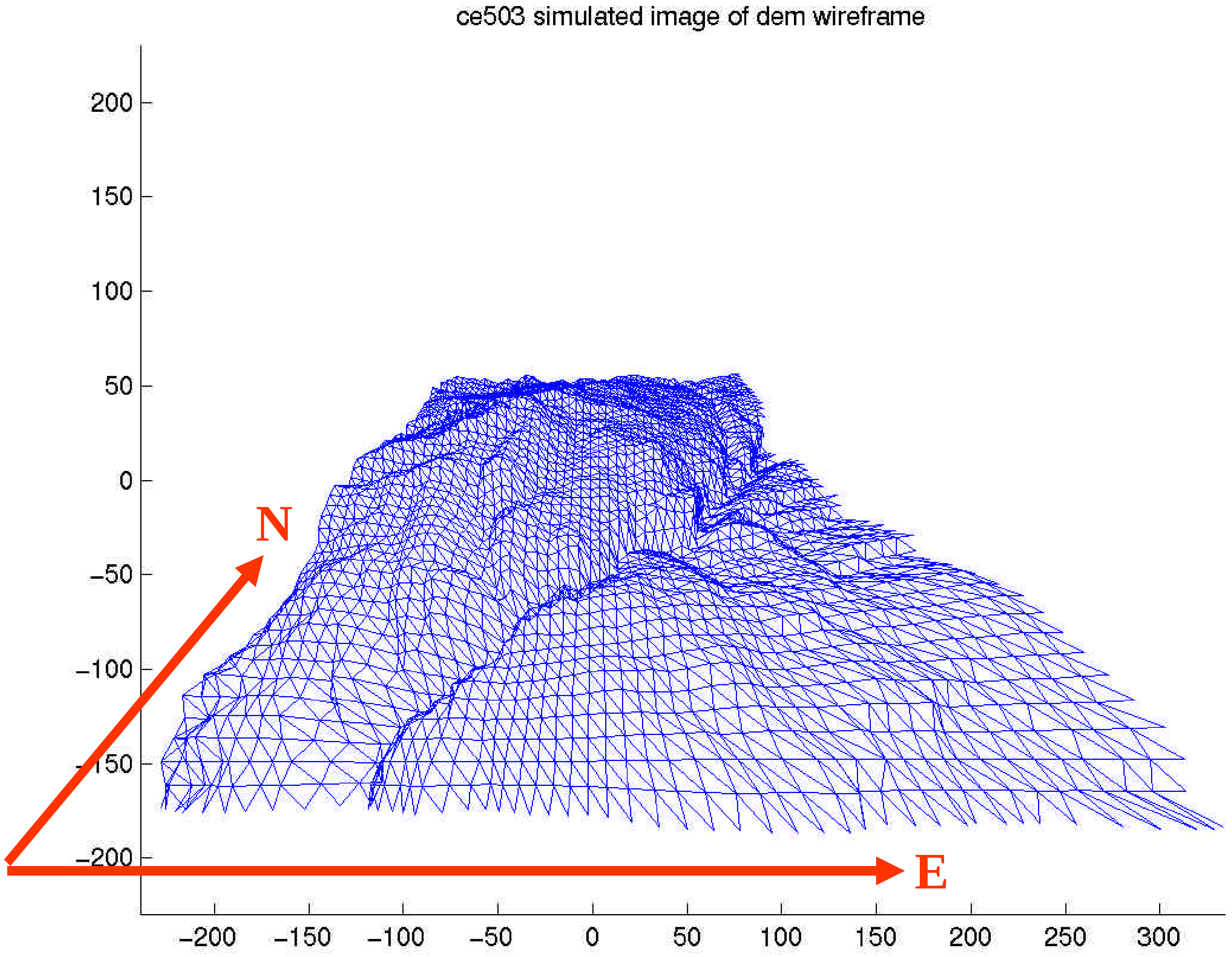
$$k = -123.69^\circ$$

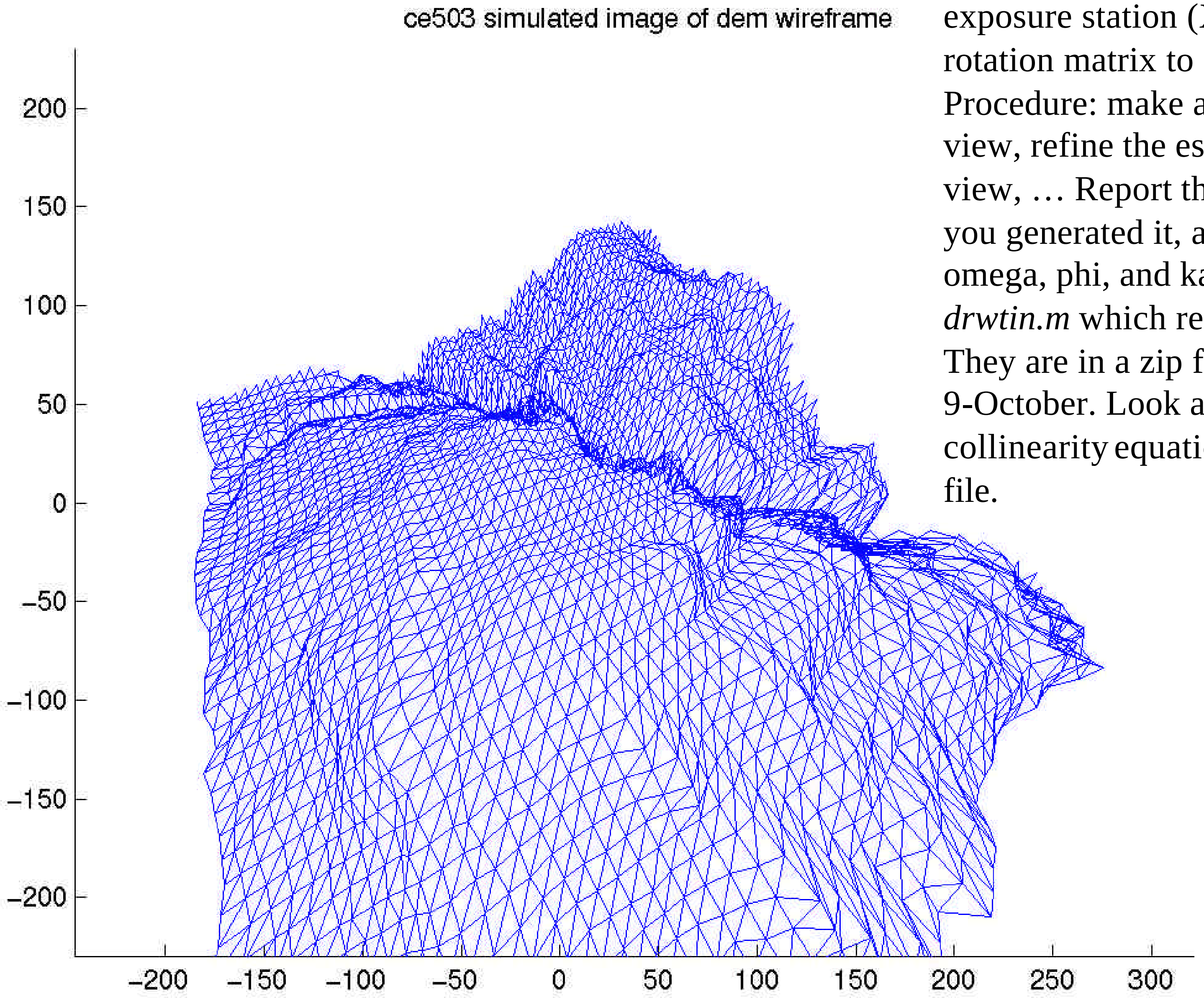
(b) Gray Shaded Elevation Map: Light=High, Dark=Low, this is reference for the next part of the assignment



Tippecanoe and surrounding counties

DEM wireframe, view from the south, parameters in “drwtin.m”, TIN: “tippco8.tin”





(b) Graphical Resection – Estimate exposure station (X_L,Y_L,Z_L) and rotation matrix to generate this view. Procedure: make a guess, generate the view, refine the estimate, make another view, … Report the matrix, the way you generated it, and the conventional omega, phi, and kappa. Modify *drwtin.m* which reads from *tippco8.tin*. They are in a zip file. Due Wednesday, 9-October. Look at application of collinearity equations in the matlab file.

Listing of drwtin.m with parameters to generate the first view – modify this file to generate the second view.

```
% drwtin.m 26-sep-02
% draw a tin wireframe

XL=488700;
YL=4444541;
ZL=39259;

ax=45/57.29577951;
m=[1 0 0;0 cos(ax) sin(ax);0 -sin(ax) cos(ax)];

f=152.400;

fid=fopen('tippco8.tin','rt');
figure(1);
axis([-230 230 -230 230]);
axis equal;
hold on

x=zeros(3,1);
y=zeros(3,1);

while 1
  fline=fgetl(fid);
  if ~ischar(fline)
    break
    end
  n= sscanf(fline,'%f %f %f',3);
  fline=fgetl(fid);
  p1=sscanf(fline,'%f %f %f',3);
  fline=fgetl(fid);
  p2=sscanf(fline,'%f %f %f',3);
  fline=fgetl(fid);
  p3=sscanf(fline,'%f %f %f',3);
  dx=p1(1)-XL;
  dy=p1(2)-YL;
  dz=p1(3)-ZL;
  u=m*[dx;dy;dz];
  x(1)=-f*u(1)/u(3);
  y(1)=-f*u(2)/u(3);
  dx=p2(1)-XL;
  dy=p2(2)-YL;
  dz=p2(3)-ZL;
  u=m*[dx;dy;dz];
  x(2)=-f*u(1)/u(3);
  y(2)=-f*u(2)/u(3);
  dx=p3(1)-XL;
  dy=p3(2)-YL;
  dz=p3(3)-ZL;
  u=m*[dx;dy;dz];
  x(3)=-f*u(1)/u(3);
  y(3)=-f*u(2)/u(3);
  line(x,y);
  end
fclose(fid);
title('ce503 simulated image of dem wireframe');
```