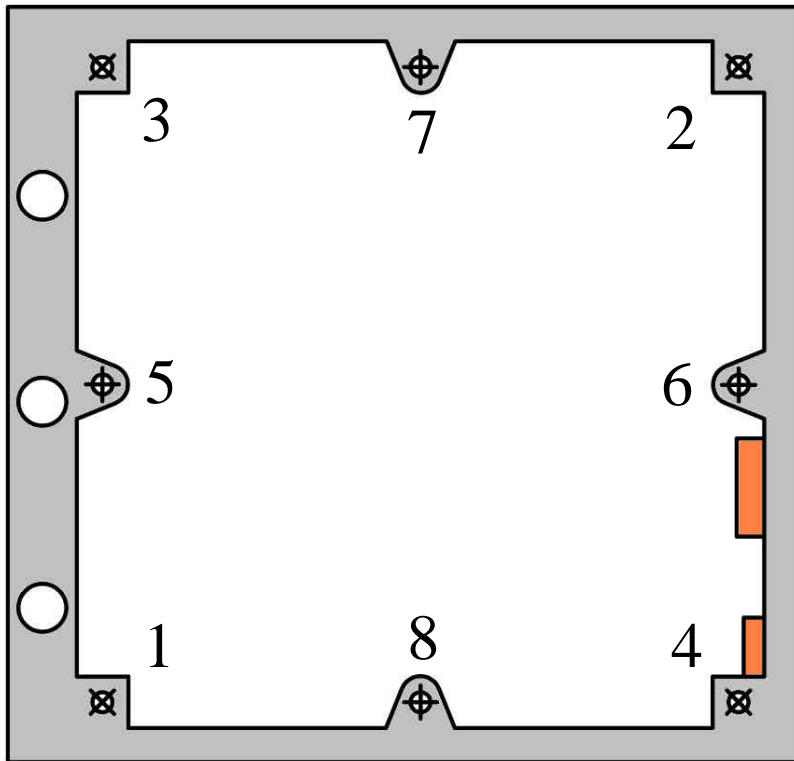
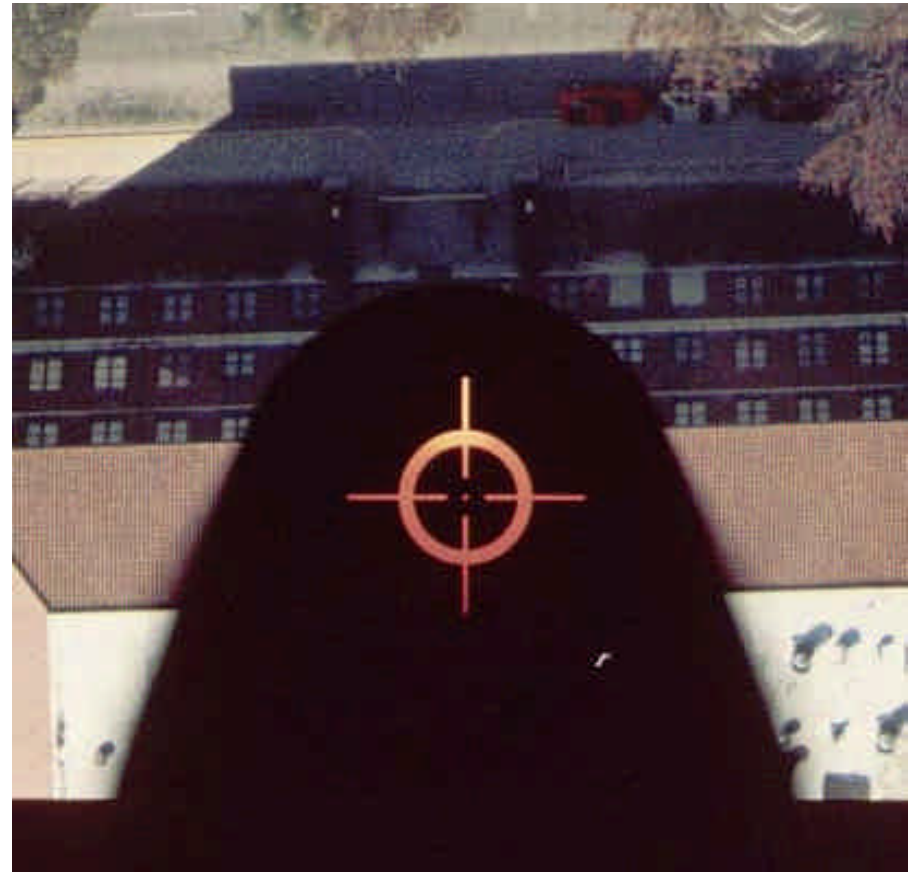


# Fiducial Measurement



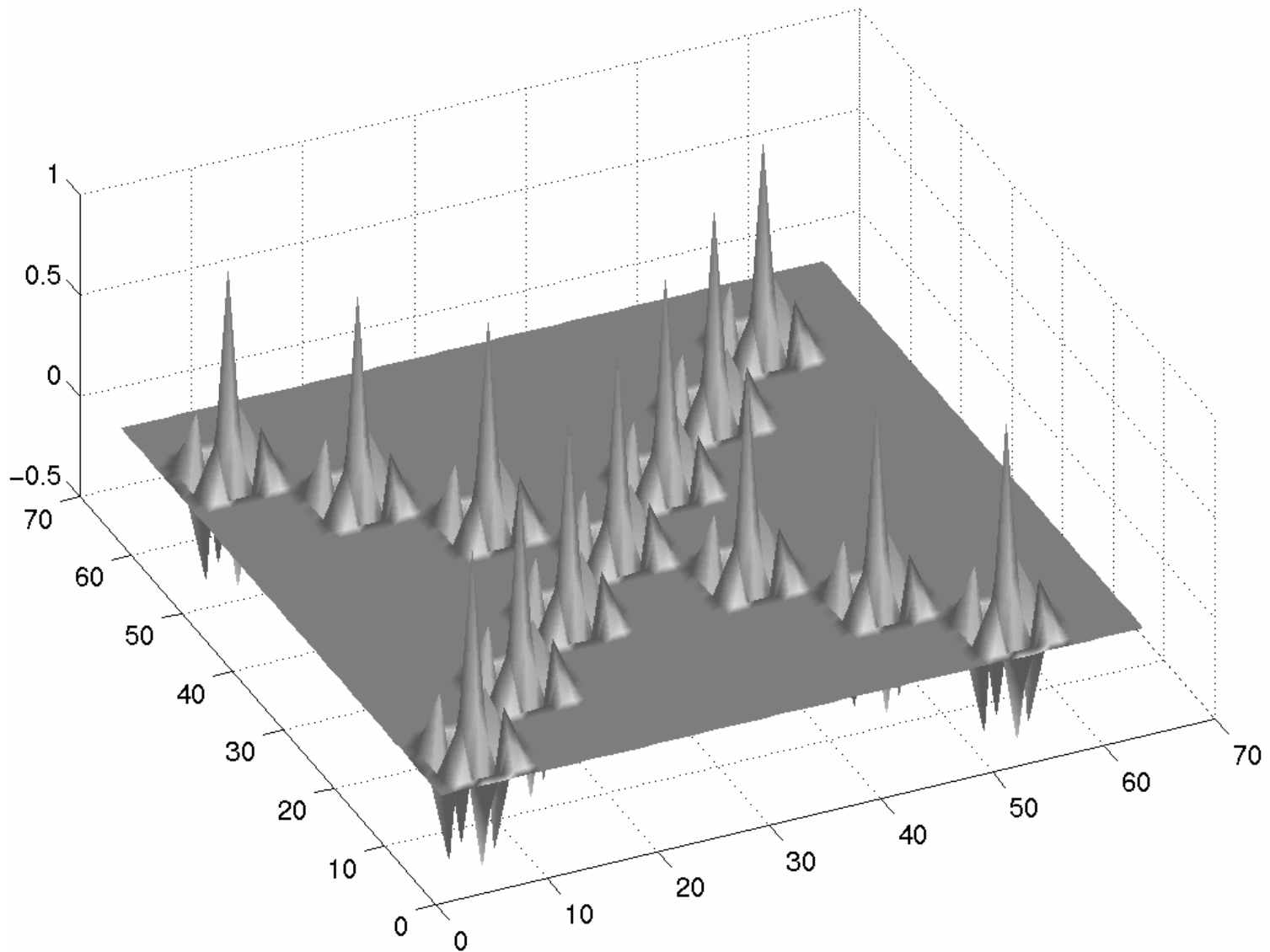
Get the correct correspondence between what you measure and its coordinates

Well defined camera fiducial marks suggest that matching/automation could be used to locate



# Correlation Matching of Signalized Points

Result of Cross Correlation of Image and Target Kernel



Transform Calibrated XY to row, column

$$r = a_0 + a_1X + a_2Y$$

$$c = b_0 + b_1X + b_2Y$$

Rearrange with unknown vector

$$\begin{bmatrix} r \\ c \end{bmatrix} = \begin{bmatrix} 1 & X & Y & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & X & Y \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ b_0 \\ b_1 \\ b_2 \end{bmatrix}$$

Six Parameter Transformation

but we must apply in the OTHER direction

so, invert

$$\begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} a_1 & a_2 \\ b_1 & b_2 \end{bmatrix}^{-1} \left[ \begin{bmatrix} r \\ c \end{bmatrix} - \begin{bmatrix} a_0 \\ b_0 \end{bmatrix} \right]$$

Q. Why not write & solve directly in the form we want to use?

for example,

$$X = a_0 + a_1 r + a_2 c$$

$$Y = b_0 + b_1 r + b_2 c$$

in matrix form,

$$\begin{bmatrix} \mathbf{X} \\ \mathbf{Y} \end{bmatrix} = \begin{bmatrix} 1 & r & c & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & r & c \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ b_0 \\ b_1 \\ b_2 \end{bmatrix}$$

Don't we save the inversion step by this approach?

# MATLAB GUI to Compute & Apply 2D Coordinate Transformation

Inner Orientation Transformation

Get Fiducial Coordinate File: E:\classes\ce603\_03\dkfid.dat

Get Measurement File: E:\classes\ce603\_03\ph1\_4.mea

Get Output File: E:\classes\ce603\_03\o.2

Transformation Model

Four Parameter

Six Parameter

Objective Function

L1 Norm

L2 Norm

Run Graph Write & Quit

Fid. ID	vX	vY
1	0.003	-0.018
2	-0.003	0.014
3	0.007	0.010
4	0.002	-0.007
5	0.008	-0.002
6	-0.025	0.005
7	0.016	-0.003
8	-0.008	0.002

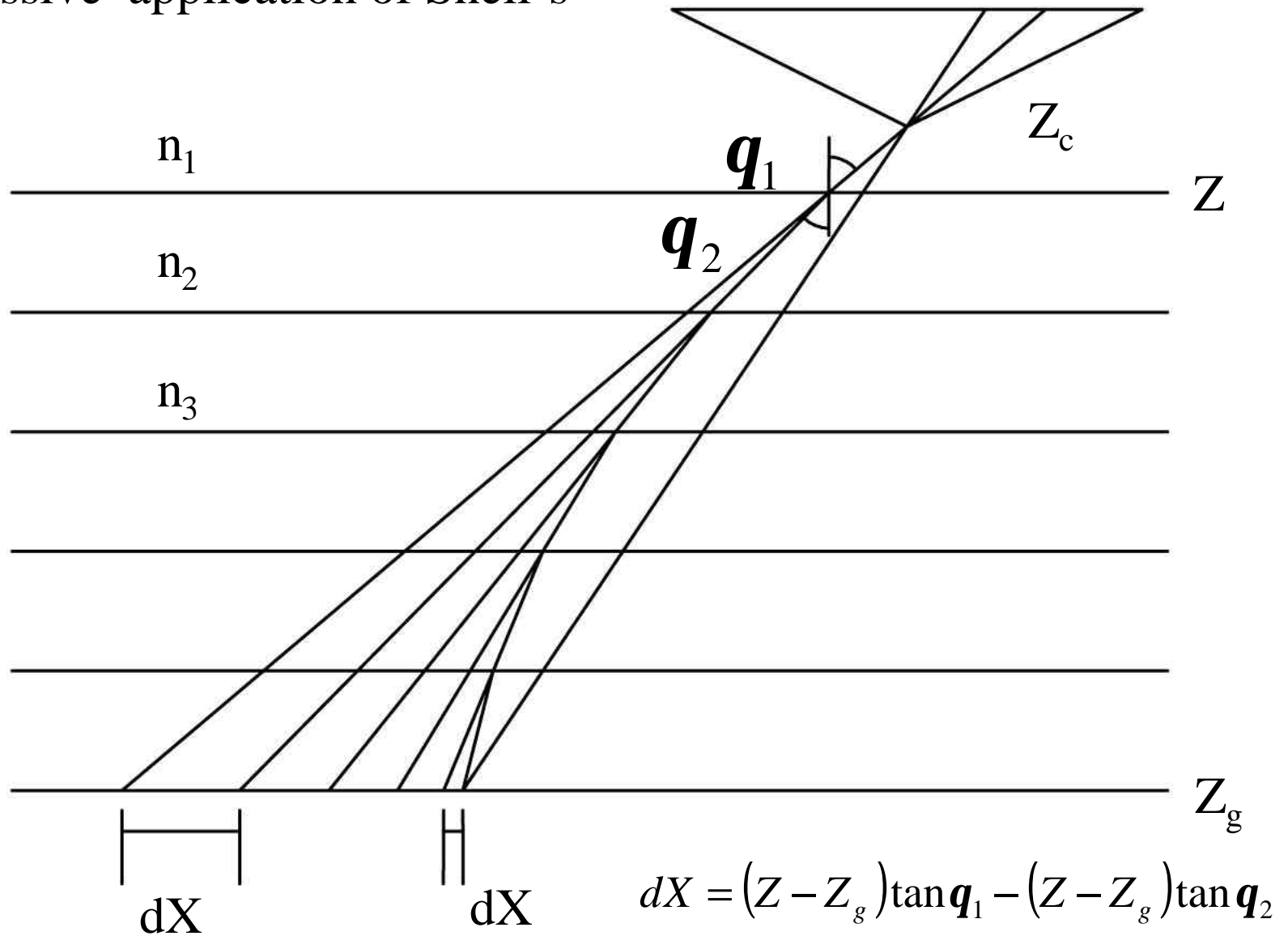
Figure No. 1: Residual Vectors

Plot showing Residual Vectors (vX, vY) for fiducial points 1 through 8. The plot is a 2D coordinate system with axes ranging from -100 to 100. The residual vectors are represented by small blue arrows originating from the origin (0,0) and pointing towards the points labeled 1 through 8.

Windows: Untitled, MATLAB Help, Figure No. 1

Taskbar: Start, CMD, MATLAB, Untitled, Figure No. 1, 12:19 PM

# Atmospheric Refraction from the successive application of Snell's Law



chme8

chme1

ChemEngr. Roof Points for  
Terrestrial block



chme2

chme3

chme5

Outer corner of gutter



chme7

chme6