Image Registration

CMPUT 615
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What is Image Registration?

To bring to or more images to a common frame of coordinates

Far view

Affine transformation

Near view

Red-yellow-pink points are corresponding points related by affine transformation

Chicken-egg problem?
Geometric Transformations

• Translation
• Rotation
• Euclidean or rigid body transformation
• Similarity transformation
• Affine transformation
• Projective transformation or homography
• Diffeomorphism
• …
Affine Transformation

A point \((x, y)\) is mapped to another point \((X, Y)\) by affine transformation:

\[
\begin{bmatrix}
X \\
Y
\end{bmatrix} = \begin{bmatrix}
a & b \\
c & d
\end{bmatrix} \begin{bmatrix}
x \\
y
\end{bmatrix} + \begin{bmatrix}
e \\
f
\end{bmatrix}
\]

\((a, b, c, d, e, f)\) are called affine transformation parameters.

How many pairs of corresponding points do we need to compute an unknown affine transformation?
Diffeomorphism of a square grid (taken from Wikipedia)

The transformation is invertible and smooth here.
Registering Different Modalities?

**FLAIR modality**

**T1C modality**

Using mutual information or other information theoretic criteria
How About Stitching Pieces Together?

• Reconstructions of a page from torn pieces - demonstration