Stereo Correspondence Constraints

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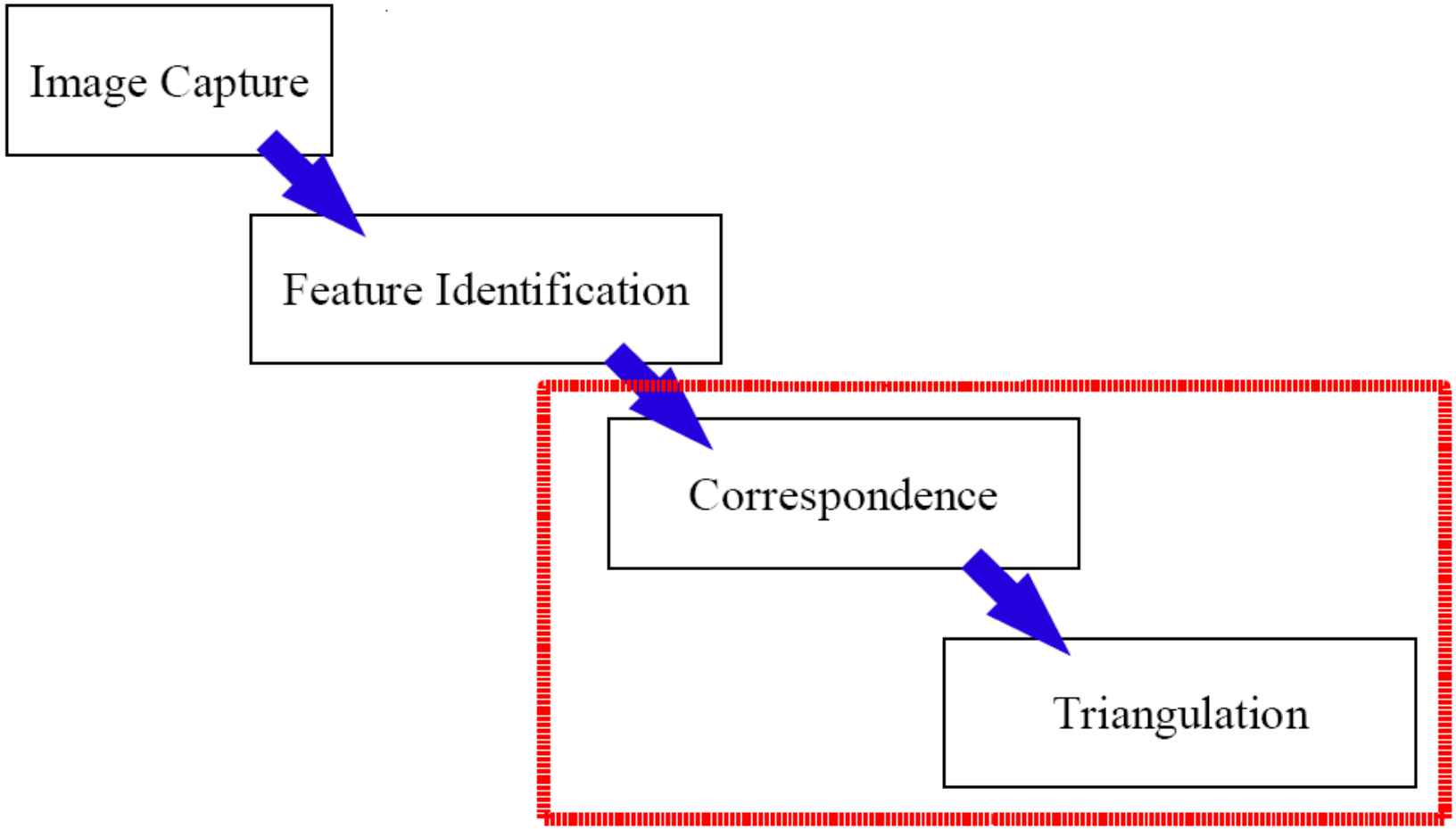
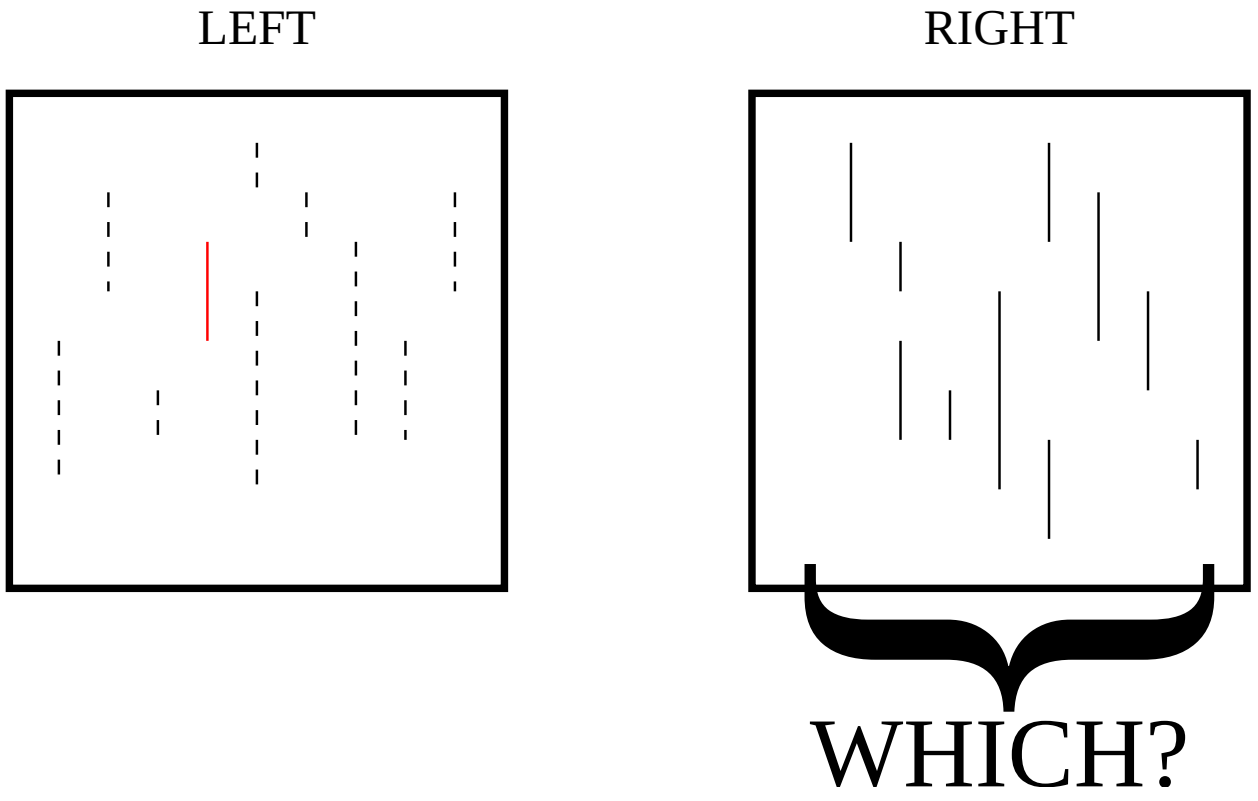
Stereo Matching Overview



Stereo Correspondence Problem

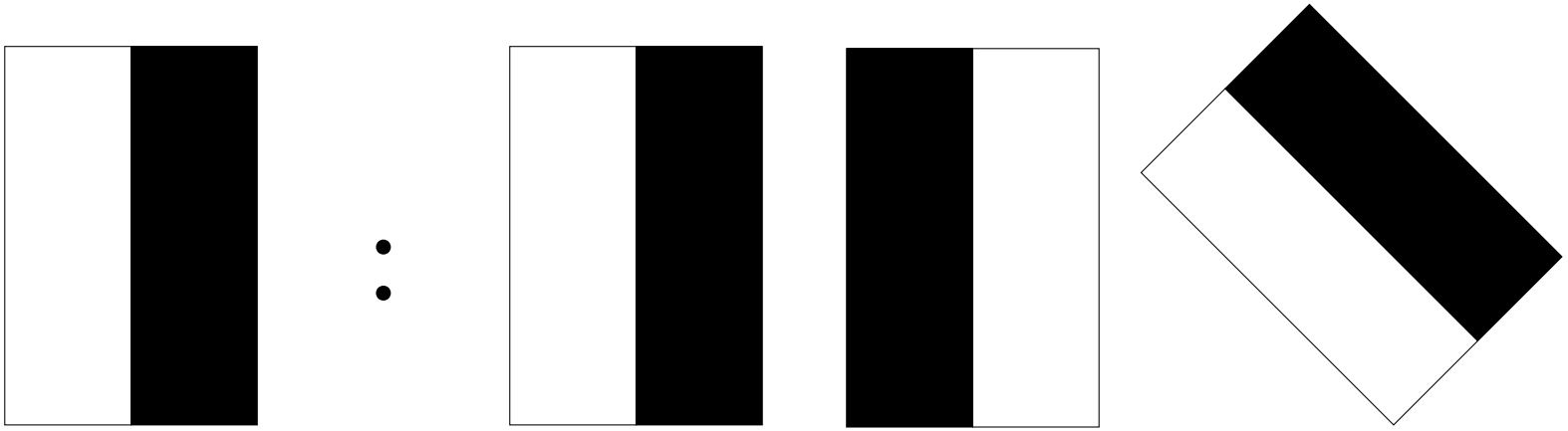
Which feature in left image matches a given feature in the right?



Different pairings give different depth results

Often considered the key problem of stereo

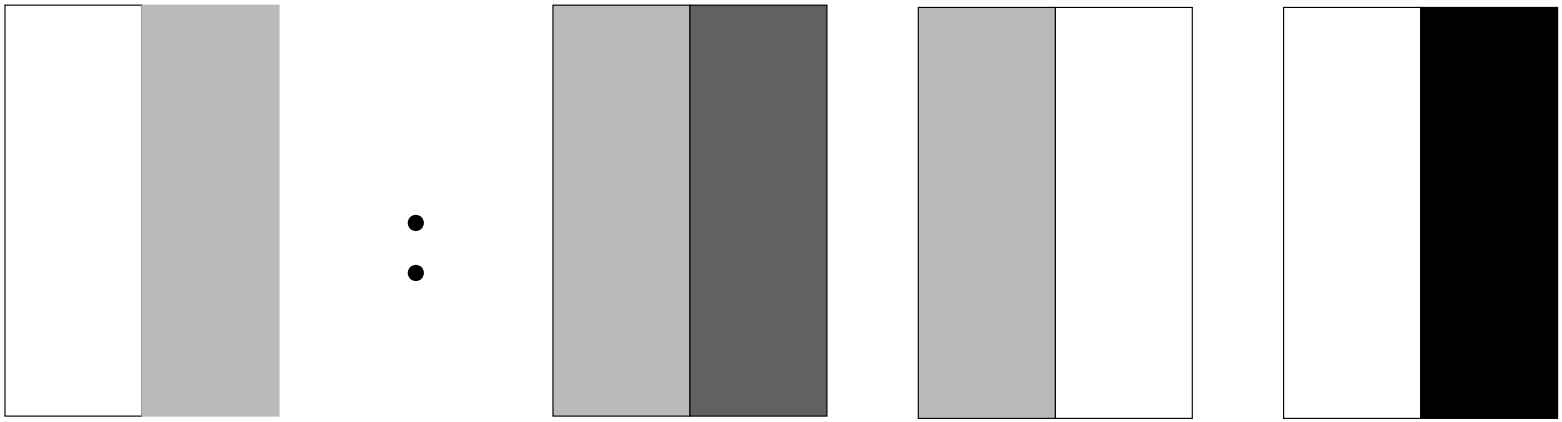
Constraining Matches: Edge Direction



OK BAD BAD

Match features with nearly same orientation

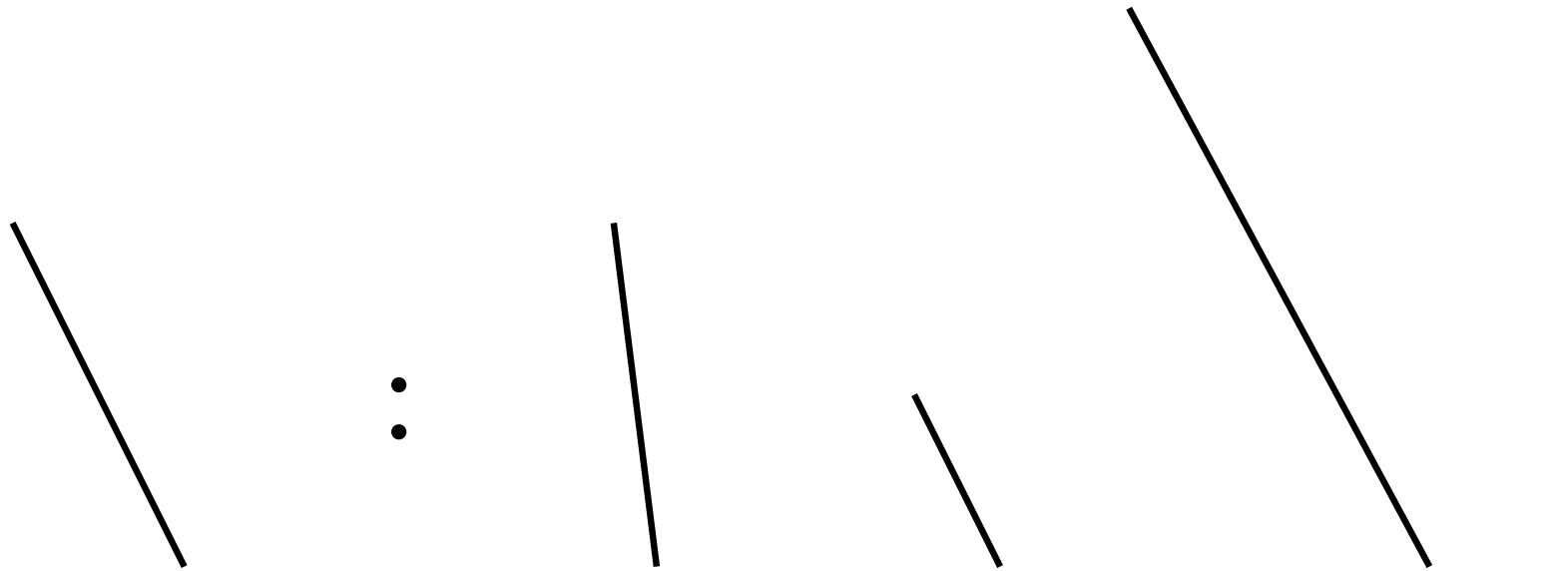
Constraining Matches: Edge Contrast



OK BAD BAD

Match features with nearly same contrast across edge

Constraining Matches: Feature Shape



Match features with nearly same length

Constraining Matches: Uniqueness and Smoothness

Smoothness: match features giving nearly same depth as neighbors

Uniqueness: a feature in one image can match from the other image:

0 - occlusion

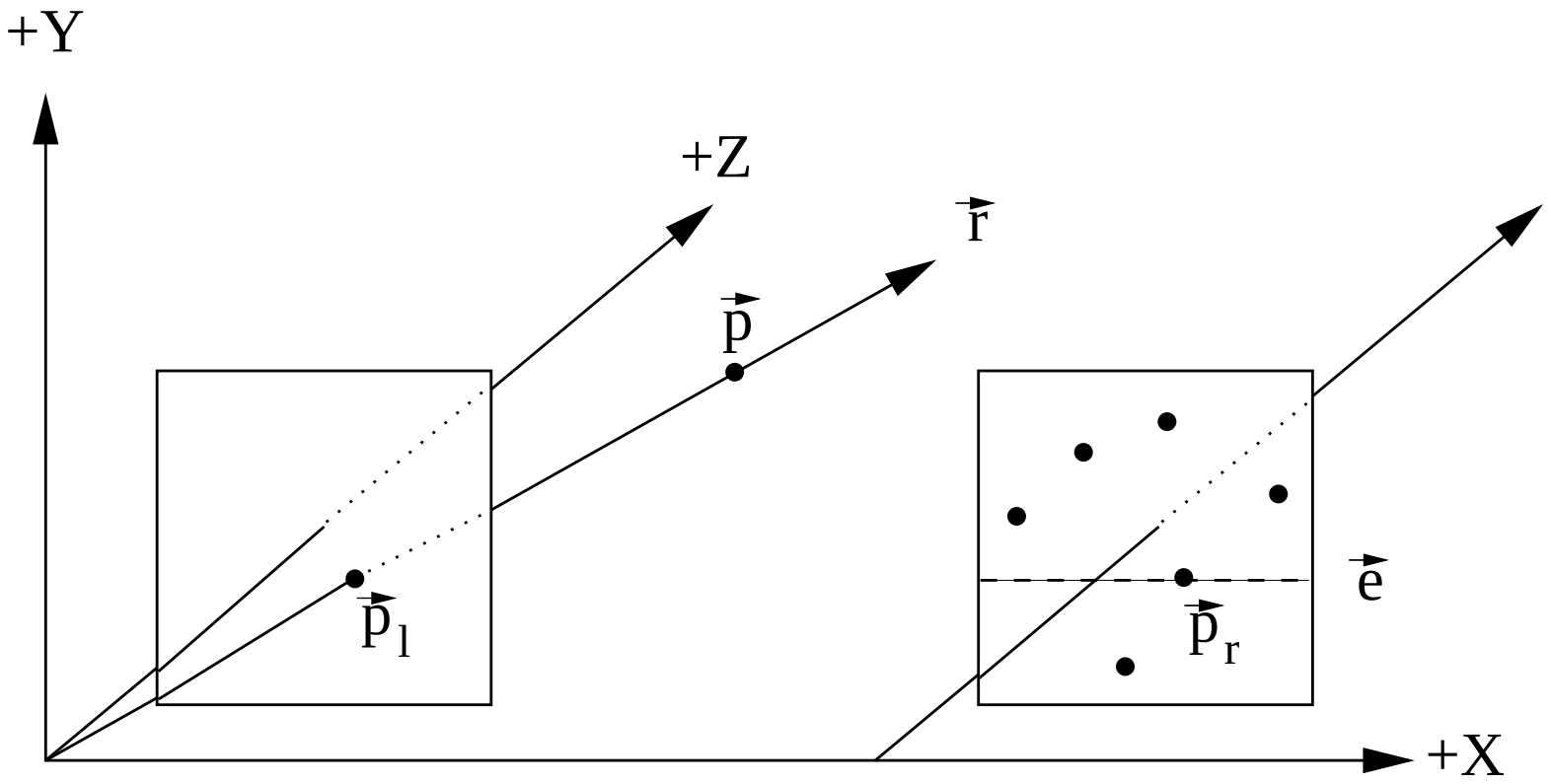
1 - normal case

2+ - transparencies, wires, vines, etc from coincidental alignments

Constraining Matches: Epipolar Geometry

Feature $\vec{p_l}$ in left image lies on a ray $\vec{r}$ thru space.

$\vec{r}$ projects to an epipolar line $\vec{e}$ in the right image, along which the matching image feature must lie.



Images are linked by the **Fundamental matrix F**

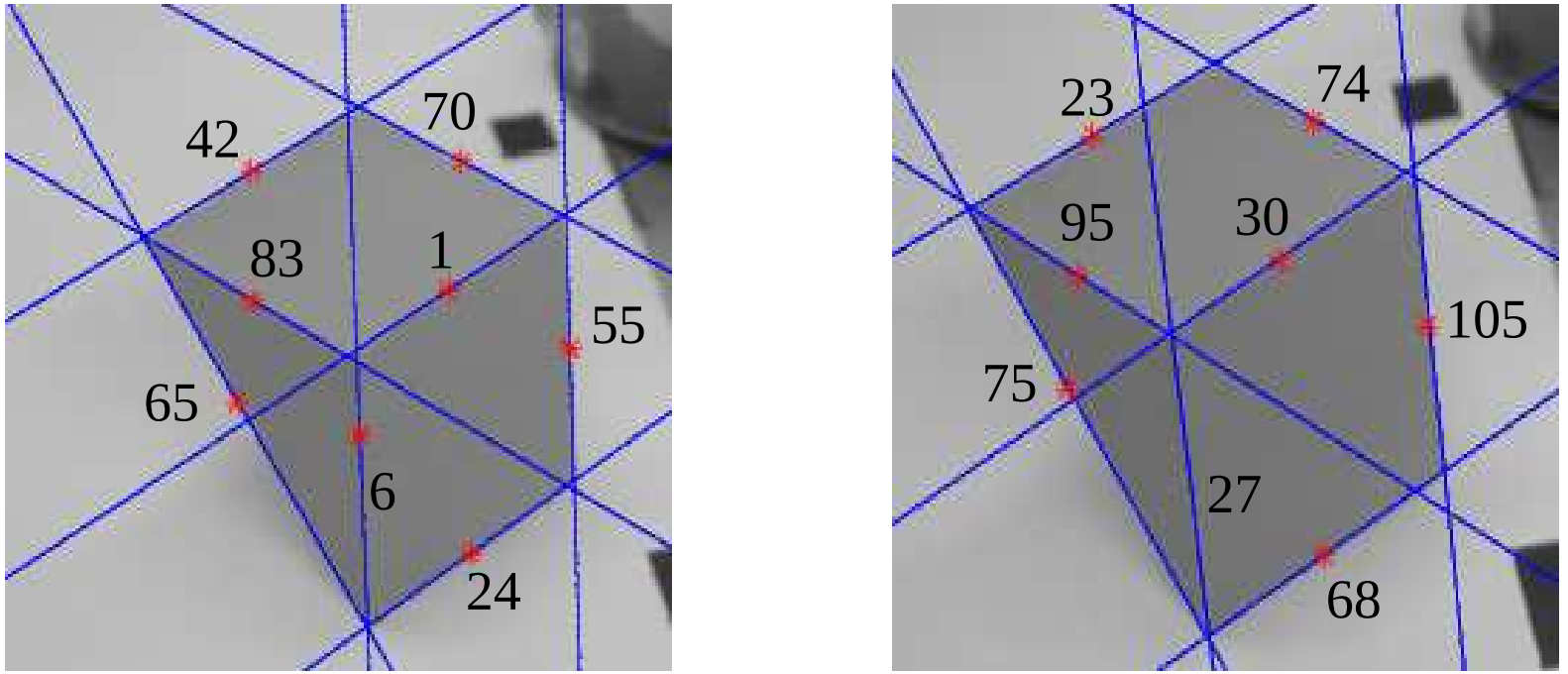
Epipolar line is defined by: $\vec{e} = \mathrm{F}\vec{p}_l$

Matched points satisfy $\vec{p}'_r \vec{e} = 0$

Reduces 2D search to 1D search

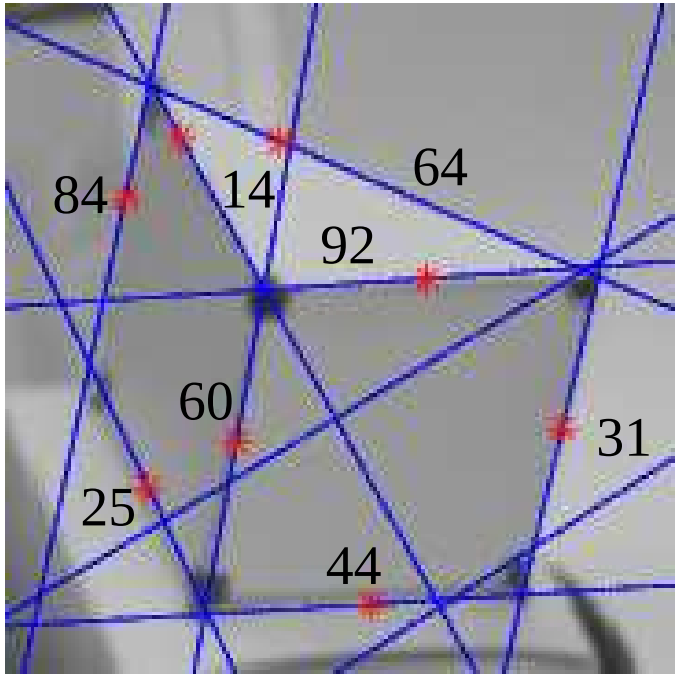
If images are 'rectified', then the epipolar line is an image row

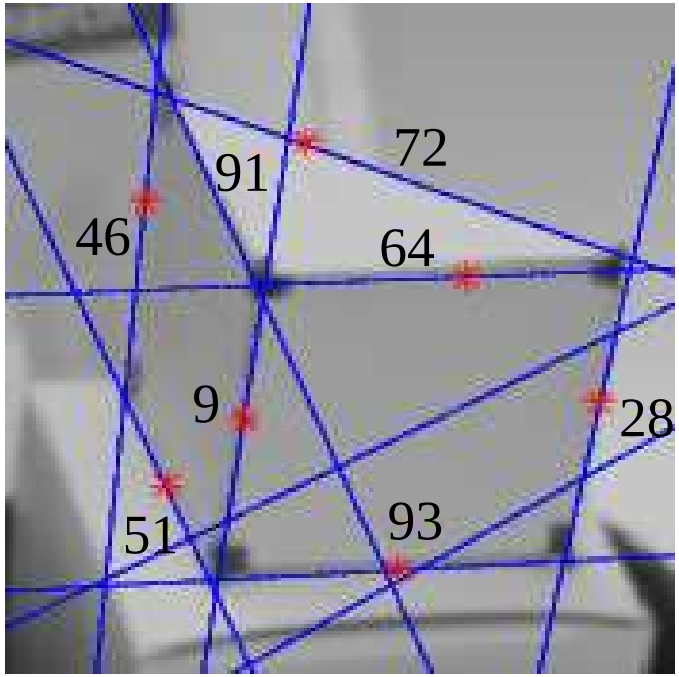
Constrained Matches Block 1



Based on Orientation, Contrast, Disparity Limit, Epipolar constraints

Constrained Matches Block 2





Lines 92 & 64 did not match (contrast difference related to line positions)

What We Have Learned

- A set of correspondence constraints
- The epipolar constraint