

University at Buffalo
Department of Computer Science and Engineering
CSE 473/573 – Computer Vision and Image Processing

Homework #4

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1. Bias-variance Trade-off (25 points)

Bias means how far predict value is from the real value. Bias is the error because of too simple model. Variance is computed result of the distance between predict values. Variance is the error because of too complex model. High bias refers to underfitting, and high variance refers to overfitting. If model becomes simple, bias is getting bigger, and variance is getting smaller. However, if model becomes complex, bias is getting smaller, and variance is getting bigger. That's bias-variance trade-off. We cannot reduce both bias and variance. So, if we want to minimize the error, we should find the point where the sum of bias and variance has minimum value.

2. Image Rectification (25 points)

When you compute fundamental matrix F ,

$$\begin{aligned} & x_r (f_{11} x_l + f_{12} y_l + f_{13}) + \\ & y_r (f_{12} x_l + f_{22} y_l + f_{23}) + \\ & 1 (f_{13} x_l + f_{23} y_l + f_{33}) \end{aligned} = 0$$

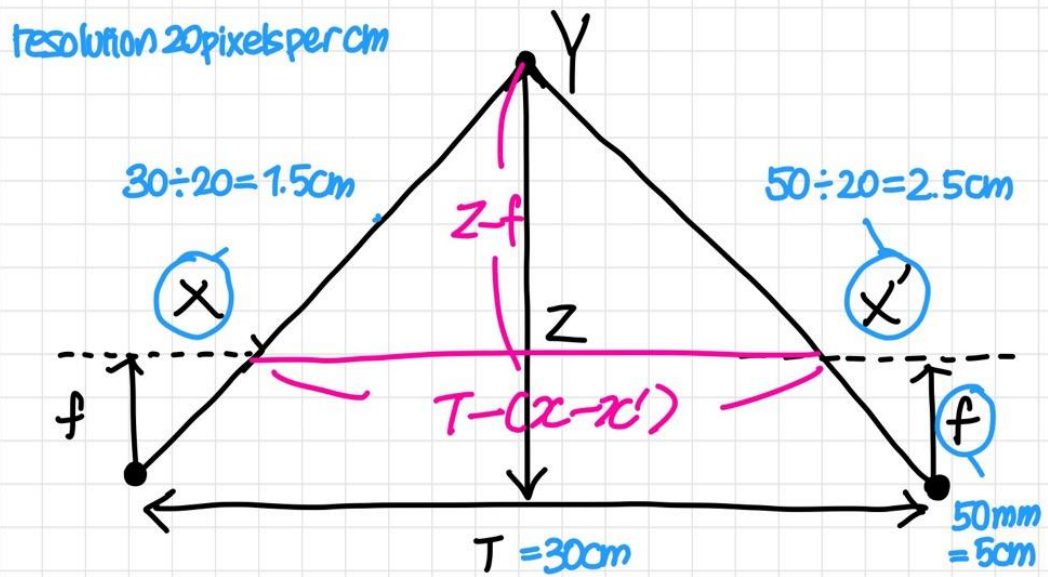
$$A \cdot f = 0$$

$$f = [f_{11} \ f_{12} \ f_{13} \ f_{21} \ f_{22} \ f_{23} \ f_{31} \ f_{32} \ f_{33}]^T$$

So, A should be

$$\begin{bmatrix} x_1' x_r', x_1' y_r', x_1', y_1' x_r', y_1' y_r', y_1', x_r', y_r', 1 \\ x_1^2 x_r^2, x_1^2 y_r^2, x_1^2, y_1^2 x_r^2, y_1^2 y_r^2, y_1^2, x_r^2, y_r^2, 1 \\ \vdots \\ x_1^N x_r^N, x_1^N y_r^N, x_1^N, y_1^N x_r^N, y_1^N y_r^N, y_1^N, x_r^N, y_r^N, 1 \end{bmatrix}$$

3. Stereo (50 points)



$$1) \frac{T - (x - x')}{Z - f} = \frac{I}{Z}$$

$$\frac{30 - (1.5 - 2.5)}{Z - 5} = \frac{30}{Z}$$

$$30(Z - 5) = 292 \quad Z = 150$$

$$30Z - 150 = 292$$

$$-Z = -150$$

$$2) Z = f \cdot \frac{T}{|x - x'|} = 5 \times \frac{30}{1} = 150$$