Computer Vision – Week 1

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1.

a. Homogenous form:

$$x_1 = (2, -1, 1)$$
$$x_2 = (1, -2, 1)$$
$$x_3 = (1, 1, 1)$$
$$x_4 = (-1, 0, 1)$$

b. Lines:

$$l_1 = x_1 \; x \; x_2 = (-1 * 1 - (-2) * 1, 1 * 1 - 2 * 1, 2 * (-2) - 1 * (-1)) = (1, -1, -3)$$
$$l_2 = x_3 \; x \; x_4 = (1 * 1 - 0 * 1, 1 * (-1) - 1 * 1, 1 * (0) - 1 * (-1)) = (1, -2, 1)$$

c. Intersection:

$$x_0 = l_1 \; x \; l_2 = (-7, -4, -1)$$
$$Cartesian => x_0 = (7, 4)$$

2.

a. translation: $\begin{bmatrix} t_1 \\ t_2 \end{bmatrix}$: 2 Dof

b. euclidean: $\begin{bmatrix} cos\,\theta & -sin\,\theta & t_x \\ sin\,\theta & cos\,\theta & t_y \\ 0 & 0 & 1 \end{bmatrix}$: 3 Dof

c. similarity: $\begin{bmatrix} scos\,\theta & -ssin\,\theta & t_x \\ ssin\,\theta & scos\,\theta & t_y \\ 0 & 0 & 1 \end{bmatrix}$: 4 Dof

d. affine: $\begin{bmatrix} a_{11} & a_{12} & t_x \\ a_{21} & a_{22} & t_y \\ 0 & 0 & 1 \end{bmatrix}$: 6 Dof

e. projective: $\begin{bmatrix} h_{11} & h_{12} & h_{13} \\ h_{21} & h_{22} & h_{23} \\ h_{31} & h_{32} & h_{33} \end{bmatrix}$: 8 Dof

Projective has only 8 Dof because the important of this transformation is ratio not the actual value themselves, so this matrix can be changed by multiplication by an arbitrary non-zero scale factor, which make one of the 9 elements result into 1, for example, $1/h_{33}$. Therefore, there are only 8 independent ratios among 9 elements.

3.

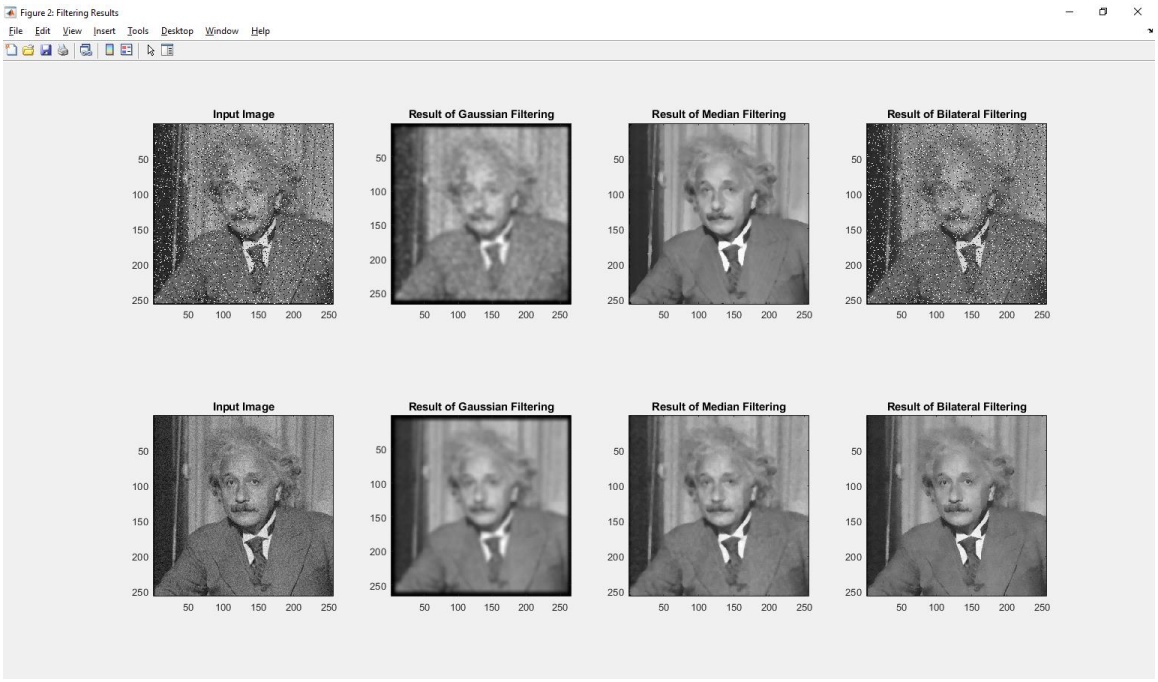
Figure 2: Filtering Results
File Edit View Insert Tools Desktop Window Help
Input Image
Result of Gaussian Filtering
Result of Median Filtering
Result of Bilateral Filtering
Input Image
Result of Gaussian Filtering
Result of Median Filtering
Result of Bilateral Filtering

4. Figure 1

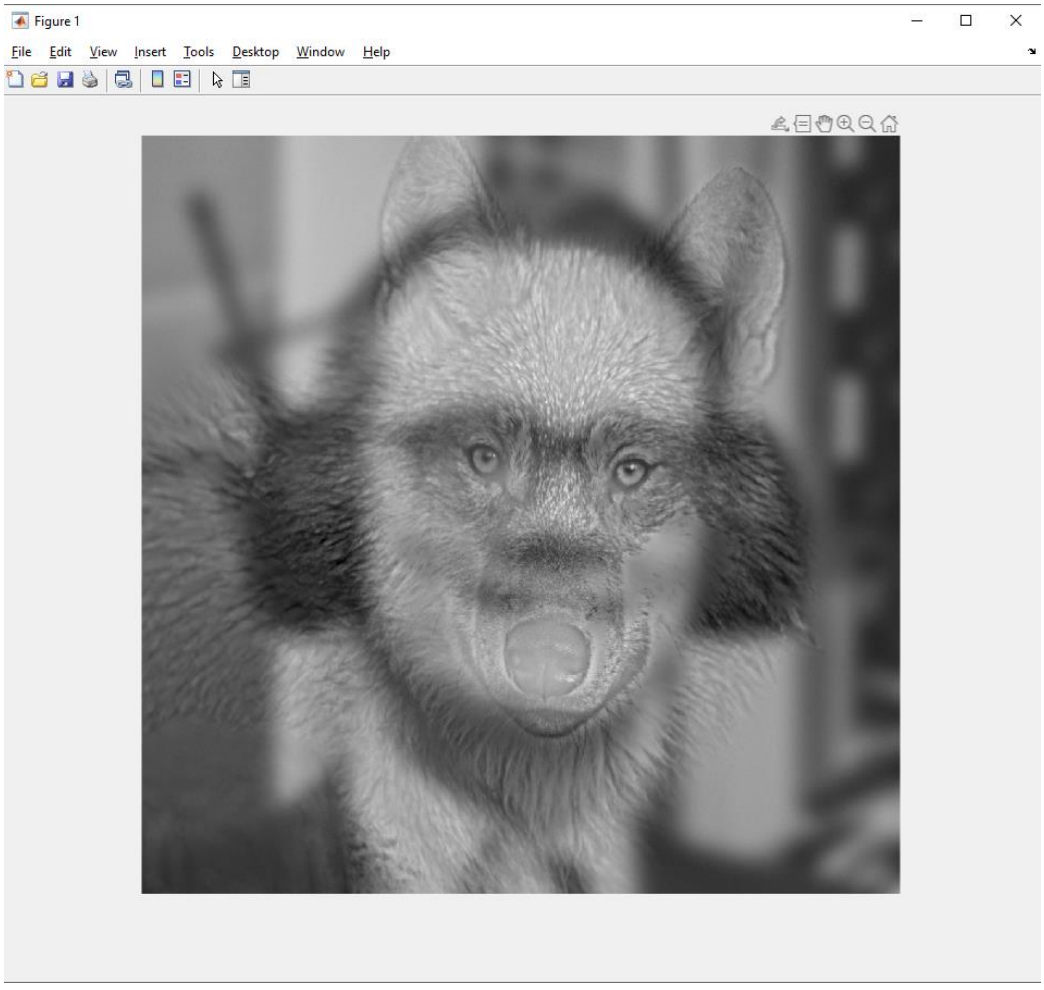
Figure 1
File Edit View Insert Tools Desktop Window Help

Figure 2

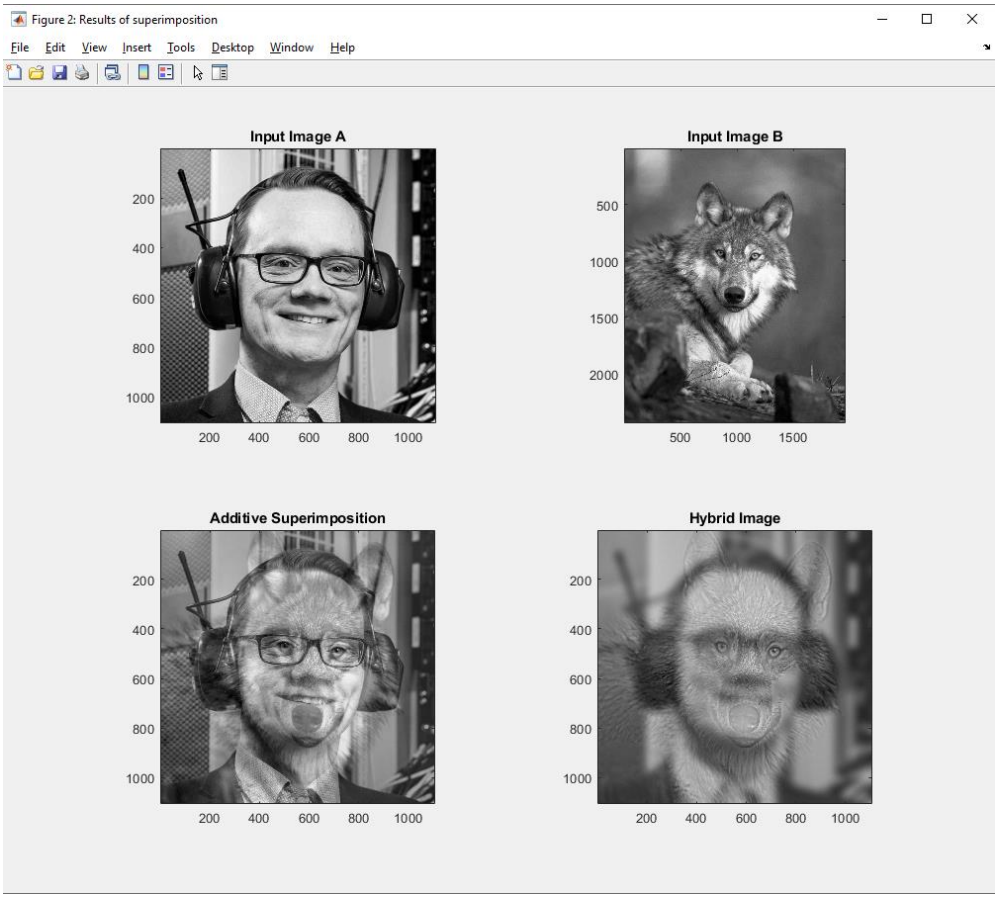

Figure 3