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Grade received 100% **Latest Submission Grade** 100% **To pass** 70% or higher

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1. Which of the following is true for motion field? **1 / 1 point**

- ○ Motion field is the projection of 2D relative velocity vectors in the camera coordinates onto the 2D image plane
- ◉ Motion field is the projection of 3D relative velocity vectors in the world coordinates onto the 2D image plane
- ○ Motion field is the projection of 2D relative velocity vectors in the image plane into the 3D world coordinates
- ○ Motion field is the projection of 2D relative velocity vectors in the image plane into the 2D camera coordinates

Correct
Motion field projects 3D relative velocity vectors onto the 2D image plane.

2. Under which of the following conditions would optical flow differ from motion field? **1 / 1 point**

- ○ Moving light source
- ○ Moving camera
- ○ Noise in the images varying over time
- ◉ All the above

Correct
In all the situations, motion field is zero, but optical flow is not.

3. Which of the following is NOT an assumption required by the optical flow constraints? **1 / 1 point**

- ( ) Time step is small
- ( ) Displacement is small
- (•) No image noise exists
- ( ) Brightness of image points remains constant

Correct
Optical flow constraints do not require an assumption on the image noise.

4. You have captured the following tensor where the rows represent $x = k, k+1$, the columns $y = l, l+1$, and the inner vector time $\begin{bmatrix} t \\ t+1 \end{bmatrix}$: **2 / 2 points**

$$\begin{bmatrix} \begin{bmatrix} 1 \\ 4 \end{bmatrix} & \begin{bmatrix} 2 \\ 1 \end{bmatrix} \\ \begin{bmatrix} 8 \\ 5 \end{bmatrix} & \begin{bmatrix} 6 \\ 7 \end{bmatrix} \end{bmatrix}$$

For example, the point $I(k, l, t) = 1$, the $I(k+1, l+1, t) = 6$, and $I(k+1, l+1, t+1) = 7$. Compute $I_y(k, l, t)$.

- (•) -0.5
- ( ) 0.5
- ( ) -1
- ( ) 1

Correct
To compute $I_y(k, l, t)$, we only need to compute the brightness changes from all points of $l+1$ to l, divided by the number of image points. Therefore:

$$I_y(k, l, t) = \frac{(2+1+6+7)-(1+4+8+5)}{4}$$
$$I_y(k, l, t) = \frac{16-18}{4} = -0.5$$

5. Which of the following statements about the geometric interpretation of the optical flow constraint is false? **1 / 1 point**

- ○ The optical flow constraint can be represented as a line.
- ○ The optical flow can be split into two components: the normal flow and the parallel flow.
- ○ The normal flow can be computed from a single constraint.
- ◉ The parallel flow can be computed from a single constraint.

Correct
We cannot compute the parallel flow. Finding the optical flow only using the optical flow constraint is impossible: the problem is under-constrained.

6. Given $I_x = 8, I_y = 6, I_t = -5$, what is the magnitude of the normal flow? **2 / 2 points**

- ○ -1
- ○ 1
- ○ -0.5
- ◉ 0.5

Correct
We compute the magnitude of the normal flow as seen in the lecture:

$$\hat{u}_n = \frac{|I_t|}{\sqrt{I_x^2 + I_y^2}}$$

$$\hat{u}_n = \frac{5}{\sqrt{64+36}} = 0.5$$

7. Which of the following is false about the Lucas-Kanade solution? **1 / 1 point**

- ◉ The Lucas-Kanade solution solves for the parallel component of optical flow directly
- ○ The Lucas-Kanade solution provides additional constraints to the constraint equation
- ○ The Lucas-Kanade solution assumes constant flow in a local region
- ○ All the above

Correct

Lucas-Kanade solution provides an additional assumption that locally the optical flow is constant. This assumption provides additional constraint equations which lead to an overdetermined equation system for solving for the actual optical flow.

8. The Lucas-Kanade solution to Optical Flow Estimation involves solving a linear system $A\mathbf{u} = B$. Which of the following occurrences does NOT jeopardize the estimation?

1 / 1 point

- ○ $A^T A$ is not invertible.
- ◉ A is not square.
- ○ A is not well-conditioned.
- ○ The difference between the eigenvalues of $A^T A$ is very large.

Correct

A does not need to be square in order to solve the linear system using the Least-Squares method (the Pseudo-Inverse), therefore the second answer choice is correct. All the other conditions do jeopardize the computation.

9. Which of the following regions within pictures is good for calculating optical flow?

1 / 1 point

- ○ A thin pole
- ○ A white wall
- ◉ A flower bed containing different flowers with different colors
- ○ A roof with repeated patterns

Correct

In general, a textured region with large and diverse gradient magnitude is good for optical flow calculation, as it helps prevent the constraint equations being linear combinations of one another, hence the third answer choice is correct.

10. Which of the following statements about Coarse-to-Fine Optical Flow estimation is false?

2 / 2 points

- ○ The Coarse-to-Fine algorithm leverages the fact that downscaling an image renders the motion smaller.
- ○ In the Coarse-to-Fine algorithm the optical flow estimate from each image contributes to the overall optical flow estimate.
- ○ Given the computed optical flow estimate at the second largest possible scale (from the original), we only need the original-scale images to compute the overall optical flow.
- ◉ The flow estimation is bidirectional: a larger scale image can contribute to estimating a smaller scale image optical flow and vice versa.

Correct

The flow estimation is only unidirectional: the smaller scale images can contribute to estimating the larger scale image optical flow, as each smaller scale optical flow contributes to warping each larger scale image, but not the other way around. This would otherwise defeat the purpose of Coarse-to-Fine Flow Estimation, since we start by being unable to estimate the original scale images optical flow.