Question 1.

Please briefly describe the optical flow constraint equation and derive it from the sum of square difference (SSD) error of the two images before and after translation. Note that you need to specify any parameter or assumption you use in your answer.

(Hint: )

Answer 1.

The optical flow constraint equation is , where , , and are the first derivatives of image at in x-direction, y-direction, and temporal domain respectively. The optical flow constraint equation can be derived from by Taylor series expansion as follows:

From the above equation, will have the minimum when . If we divide equation by , we can get . Hence, is derived.

Question 2.

Explain why the sum of square difference (SSD) error (note that ) in Lucas-Kanade algorithm will have minimum when is the solution of , where is the Hessian matrix and is the gradient-weighted residual vector.

Answer 2.

, where and .

will have minimum when and , hence,

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Therefore, , where and .