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Example Questions for
Correspondence Problems in Computer Vision

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1. Explain the idea behind robust data terms and sketch a function that could be used for robustification. Why should separate robustification be applied in the case of two non-correlated (independent) constancy assumptions?

(2 + 1 + 1 p.)

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2. Let a colour sequence $\mathbf{f}(x, y, t) = (R(x, y, t), G(x, y, t), B(x, y, t))^\top$ be given, where $(x, y)^\top$ is the location within a rectangular image domain Ω and $t \geq 0$ denotes time. You know that typical image sequences for your application contain shadow and shading, as well as multiplicative changes of the overall intensity. Moreover, you expect large displacements. Write down an energy functional to compute the optic flow $(u(x, y, t), v(x, y, t))^\top$ that addresses the aforementioned problems. Use a discontinuity-preserving smoothness term of your choice. Why is an image-driven smoothness terms not recommendable in this context? Explain!

(4 + 1 p.)

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3. What are the Essential matrix and the Fundamental matrix describing? How are they related mathematically? Name one property that they share and one property that is different for both of them.

(2 + 1 + 2 p.)

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4. What is a joint probability density function? How can it be computed? What can it be used for?

(2 + 1 + 1 p.)

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5. Name two smoothness terms for variational methods based on second-order-regularization and state their field of application. Write down the formula for one of them and explain the underlying concept.

(2 + 2 + 1 + 1 p.)

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6. Check which of the following statements A–F are true, and which are false.

(1 p. for each correct "true" or "false" answer, -1 p. for each incorrect "true" or "false" answer, 0 p. for each unanswered statement. Negative total numbers of points are adjusted to 0.)

A: The spatiotemporal variant of the method of Lucas and Kanade requires to solve a 3×3 linear system of equation in each point.

B: Multigrid methods are based on correction steps using the residual equation.

C: In contrast to image-driven regularizers, flow-driven smoothness terms yield oversegmentation artifacts in highly textured regions.

D: The epipolar constraint relies on the assumption that the baseline and the two optical rays form an orthogonal system.

E: Mutual information cannot be used to robustify variational optical flow methods with respect to global additive illumination changes.

F: Integrating the incompressibility constraint (divergence-free-constraint) into a variational method yields non-linear Euler-Lagrange equations per construction.
