AS 202.

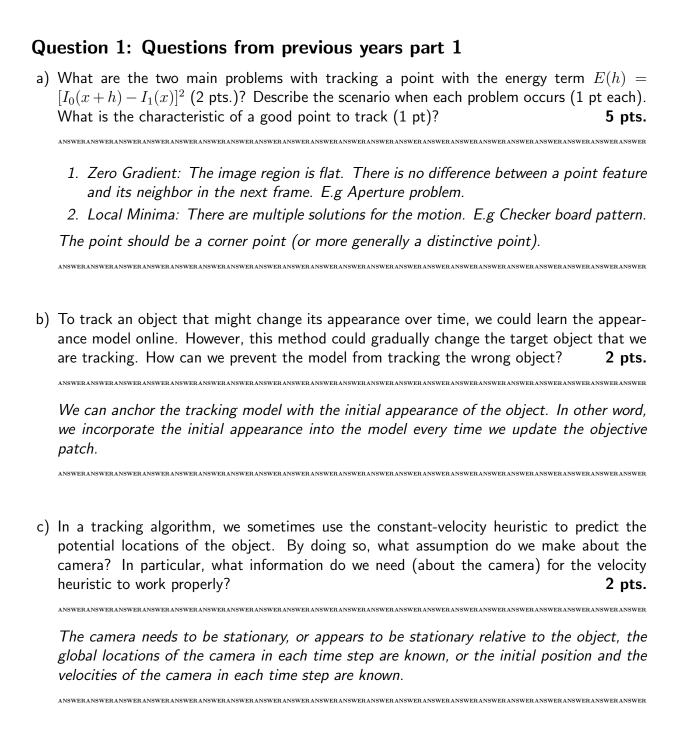
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Exam Preparation Exam: Tracking

December, 2022



d)	Judge the correctness of the following statements and select the corresponding box (☑). For each statement, 1 pt, 0 pt and -1 pt are given for a correct answer, both empty/selected boxes, and an incorrect answer, respectively. The minimum number of points is 0. 3 pts.									
								True	False	
	1)	1) Histogram of Oriented Gradients can be made a rotation invariant \qed								
	2)	feature descriptor 2) Hungarian Algorithm can be used to match candidate regions between two frames based on similarity scores between each pair.								
	3) To track by detection, we do not need to know the type or shape of the object to be tracked beforehand.									
	True False Reason 1) \square \square The matching can be seen as a bipartite matching problem. 3) \square \square								ERANSWER ANSWER	
Question 2: Questions from previous years part 2 a) When we track a point with the energy term $E(h) = [I_0(x+h) - I_1(x)]^2$, we could have a problem with local minima. Explain when the local minima problem occurs (1 pt) and how can we prevent it by changing the frame-rate (2 pts)? 3 pts.										
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	1.	1. Local Minima happens when there are high frequency details that look the same in multiple direction e.g checker board.								
	2. The problem can be prevented by increasing the frame-rate to be faster than the motion Nyquist rate or more than half of the motion wavelength.									
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b)	Explain technical pros and cons of the Lucas-Kanade template tracker. Give at least 2 examples for each category. 4 pts.									
	ANSWER AND									
	1. Good: It can handle different parameter space (e.g. different motion or transformation models).									
	2.		,	nverge fast in a	high-frame ra	te video.				
	3. Bad: It is not robust to noise and large displacement (low-frame rate video).									
	4. Bad: Some transformations are not possible to parameterize, thus can not be used in the framework.									
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c)	Explain how we can use a template to track an object that ch	nanges its appearance over
	time (1 pt). What are the problems that might occur if we on	ly keep the information of
	the template from the previous step T_{t-1} (1 pt)? And how can	we adjust the algorithm to
	prevent such problem? Write a simple equation in term of T_i	and initial target T_0 (1pt).
	Explain beyond using a single keyword as an answer.	3 pts.

 ${\tt ANSWERA$

- 1. We can update the target template over time using the current tracked bounding box.
- 2. However, the target template could gradually change into something else that is not intended to be tracked (drifting).
- 3. This could be prevent by also using the initial template to update the current target. $T_i = \alpha T_{i-1} + (1-\alpha)T_0$

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d) In a tracking algorithm, we sometimes use the constant-velocity heuristic to track object motion. Explain what the constant-velocity heuristic is (1 pt) and provide 2 reasons why it can help improving the tracking results (3 pts).

4 pts.

ANSWER ANSWER

The constant-velocity heuristic assume that all objects of interest move at a constant velocity relative to the camera. It can help with motion tracking to

- 1. Predict the probable location of the object,
- 2. Reduce noise in the motion,
- 3. Disambiguate multiple objects using their trajectories.

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e) Explain the four steps in the general framework for offline multiple object tracking. Give a brief (one-sentenced) explanations for each step.4 pts.

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- 1. Object Detection: Find objects in each frame with your best object detection algorithms.
- 2. Motion Estimation: Propagate the objects from Frame T to Frame T+1. It may not depend on Frame T+1.
- 3. Initial Association: Associate objects with estimated motion and appearance features.
- 4. Association Optimization: Optimize the association with matching constraints using Hungarian matching or GNN.

ANSWER ANSWER

f) Judge the correctness of the following statements and **select** the corresponding box (). For each statement, 1 pt, 0 pt and -1 pt are given for a correct answer, both empty/selected boxes, and an incorrect answer, respectively. The minimum number of points is 0. 2 pts.

				True	False			
1)	For mi	ulti-objed	ct tracking, the method's result does not depend on					
,	the fea							
2)	To do tracking by detection with a neural network, we must know $\ \square$							
	tne ca	tegory o	f the object to track.					
ANSWERANSW								
	True	False	Reason					
1)			Bounding box size can greatly influence the results.					
2)	<u> </u>		3 · · · · · · · · · · · · · · · · · · ·					
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