Quiz 07.md

Quiz 07

Attempts	Score
1/1000	7/7

Question 01

Consider the general image inpainting form $\nabla L \cdot \vec{N} = 0$, meaning we propagate the information L in the direction $\vec{N}$, as we have discussed in Video 3 this week. Consider $\vec{N} = (\nabla I)^{\perp}$ meaning the perpendicular $(\perp)$ to the gradient of the image. What will happen if instead of propagating the Laplacian of I as in the video, we propagate the image I itself?

Answer

Any inpainted region will solve the basic equation $\nabla L \cdot \vec{N} = 0$ for this choice.

Explanation

Since $L = I$, we have that $\nabla L \cdot \vec{N} = 0$ becomes $\nabla I \cdot \vec{N} = 0$, and for $\vec{N} = (\nabla I)^{\perp}$, we obtain $\nabla I \cdot (\nabla I)^{\perp} = 0$, which by definition holds for every image. Therefore, any inpainted region holds the equation and we don't obtain the desired result.

Question 02

Consider a region to be inpainted with `N` missing pixels, in an image with `M` pixels total. In the "smart cut-and-paste" algorithm, how many patch comparisons will need to be performed if a single pixel is inpainted per match? Consider only the order of magnitude, ignoring image boundaries for example.

Answer

`N * M`

Explanation

For each pixel to be inpainted, we have to compare to all patches centered at each one of the M image pixels, and therefore we have a total of `N * M` searches. Some recent techniques speed-up this by either pre-processing the image or by reducing searchers to pre-specified neighborhoods.

Question 03

For a given image `I`, $\mathbf{div}(\frac{\nabla I}{|\nabla I|})$ is equal to (`div` stands for the divergence)

Answer

The Euclidean curvature of the image level lines.

Explanation

This is the Euclidean curvature as we discussed in the previous week when describing basic properties of curves represented as level-lines of surfaces (functions). In video 4 this week we further discussed the use of this term as a way to smoothly continue the edges inside the region being inpainted.

Question 04

Consider that you have an image with a single circle, and a small part of it is covered and needs to be inpainted. What would you use for that?

Answer

A Hough transform.

Explanation

While other techniques might do a decent job, if we know the shape of the occluded object, a circle in this case, the best is to use the Hough transform to detect such object (circle) using the un-occluded regions, and once the estimation has been done, then the shape can be completed.

Question 05

Assume you have a fast moving rigid object in a video, that needs to be removed (inpainted). Which one of the following operations is expected to do a good inpainting job? If you think that more than one option is possible, pick the one that will produce the best result and/or is the simplest one.

Answer

Temporal median filtering: The pixels in the region to be inpainted are replaced by the median of pixels in the same (x,y) spatial location and at different frames t (median of (x,y,t) for t in some time interval with the current frame at its center).

Explanation

If the object is moving then pixels become un-occluded as the object passes by. If the object is moving fast, only a few frames contain the object for a given pixel location, and therefore a median will work since the majority of the pixels are un-occluded for a given time window (the size of the time window depends on the velocity of the moving object). A Gaussian will mix occluded and un-occluded pixels and then will not perform as well. A cut-and-paste technique might work but is too expensive for this simple scenario.

Question 06

How would you detect scratches in an old movie, knowing they are vertical straight lines?

Answer

With the Hough transform.

Explanation

The Hough transform is ideal for this since we can easily control the orientation.

Question 07

Assume the above scratches are a single pixel wide and appear in relatively uniform areas, how would you inpaint them?

Answer

Simple linear interpolation.

Explanation

For such scenarios linear interpolation is the simplest thing to do and the most efficient.