Begonnen am	Tuesday, 25. January 2022, 12:34
Status	Beendet
Beendet am	Tuesday, 25. January 2022, 12:56
Verbrauchte Zeit	21 Minuten 58 Sekunden
Bewertung	**95,00** von 100,00

Frage **1**

Richtig

Erreichte Punkte 5,00 von 5,00

Given are two kernels ***H1*** and ***H2***, as well as an image ***I***. Which of the following rules are correct (multiple choices possible).

Note: *k* indicates a scaling factor and ***** convolution.

Wählen Sie eine oder mehrere Antworten:

- a. ***H1*(H2*I)=(H1*H2)*I*** ✔
- b. ***H1*(H2*I)=H2*(H1*I)*** ✔
- c. ***I+(H1*H2)=I*(H1+H2)***
- d. ***H1*I+H2*I=(H1+H2)*I*** ✔
- e. ***(kH1)*I=k(H1*I)*** ✔

Die Antwort ist richtig.

I+(H1*H2)=I*(H1+H2) is clearly not making any sense. The rest are the common convolution rules.

Die richtigen Antworten sind: ***H1*I+H2*I=(H1+H2)*I***, ***(kH1)*I=k(H1*I)***, ***H1*(H2*I)=H2*(H1*I)***, ***H1*(H2*I)=(H1*H2)*I***

Frage 2

Richtig

Erreichte Punkte 5,00 von 5,00

The image below shows radial distortion for which the first coefficient in the polynomial that models the lens is positive. Correct or wrong?

Bitte wählen Sie eine Antwort:

- Wahr ✔
- Falsch

The image shows barrel distortion, and the first coefficient of the polynomial must be positive (>0).

Die richtige Antwort ist 'Wahr'.

Frage **3**

Richtig

Erreichte Punkte 5,00 von 5,00

At which angle (in degree) does this kernel blur the image most (horizontal = 0 degree, clockwise increasing)?

(1, 0, 0, 0, 0, 0, 0, 0, 0,
0, 1, 0, 0, 0, 0, 0, 0, 0,
0, 0, 1, 0, 0, 0, 0, 0, 0,
0, 0, 0, 1, 0, 0, 0, 0, 0,
0, 0, 0, 0, 1, 0, 0, 0, 0,
0, 0, 0, 0, 0, 1, 0, 0, 0,
0, 0, 0, 0, 0, 0, 1, 0, 0,
0, 0, 0, 0, 0, 0, 0, 1, 0,
0, 0, 0, 0, 0, 0, 0, 0, 1)/9

Antwort: 45 ✔

This kernel blurs the image most at 45 (or 225) degree.

Die richtige Antwort ist: 45

Frage **4**

Richtig

Erreichte Punkte 5,00 von 5,00

The essential matrix is applied to the normalized image plane! Correct or not?

Bitte wählen Sie eine Antwort:

- (●) Wahr ✔
- ( ) Falsch

The essential matrix is applied to the normalized image plane. The fundamental matrix is applied to the physical image plane.

Die richtige Antwort ist 'Wahr'.

Frage **5**

Richtig

Erreichte Punkte 5,00 von 5,00

Without considering the individual intrinsic and extrinsic camera parameters, you have learned that a 3D point with coordinate ***P=(x,y,z,1)*** can be mapped to its 2D image coordinate ***p=(u,v,1)*** with a 4x3 projection matrix ***M: p=1/z*M*P*** — or: ***u=(m1*P)/(m3*P) , v=(m2*P)/(m3*P)***.

Obviously, by knowing correspondences between enough ***(P,p)***-pairs (i.e., 3D points and their corresponding 2D image points on the sensor), we can solve this linear equation systems in the coefficients of ***M*** (e.g., using least-squares). How many corresponding pairs ***(P,p)*** are needed at least for a solution in ***M***?

Antwort: 6 ✔

Since ***M: p=1/z*M*P*** is a linear equation system, and ***u=(m1*P)/(m3*P) , v=(m2*P)/(m3*P)*** are two linear equations in ***M*** or ***m1, m2, m3*** — with ***4x3=12*** unknowns, we need at least ***6*** corresponding pairs ***(P,p)*** to solve for the ***12*** coefficients of ***M***. Each pair causes two equations: ***u=(m1*P)/(m3*P) , v=(m2*P)/(m3*P)*** ! Having these two pairs (e.g., by capturing an image of ***6*** known 3D points and marking their 2D projections in the image), we can solve for ***M*** with a linear least squares method.

Die richtige Antwort ist: 6

Frage **6**

Richtig

Erreichte Punkte 5,00 von 5,00

The Gray Code is often used for active range scanning (structured light). Why is its Hamming distance 1?

Wählen Sie eine Antwort:

- a. For faster transmission compared to ordinary binary codes.
- b. The bit difference between two subsequent code words is 2^1 (2 to the power of 1) to detect errors in transmission.
- c. For better compression.
- d. The bit difference between two subsequent code words is 1 to detect errors in transmission. ✔

Die Antwort ist richtig.

The Hamming distance (bit difference between two subsequent code words) of the Gray Code is 1 to detect errors in the transmitted code (if the bit difference between two subsequent code words is not 1, it must be an error).

Die richtige Antwort ist: The bit difference between two subsequent code words is 1 to detect errors in transmission.

Frage 7

Richtig

Erreichte Punkte 5,00 von 5,00

Convolution in the frequency domain is multiplication in the spatial domain. Correct or wrong?

Bitte wählen Sie eine Antwort:

- Wahr ✔
- Falsch

Yes, correct. The classical interpretation of the convolution theorem is convolution in spatial domain is multiplication in the frequency domain. However, it also applies the other way around: Convolution in the frequency domain is multiplication in the spatial domain.

Die richtige Antwort ist 'Wahr'.

Frage 8

Richtig

Erreichte Punkte 5,00 von 5,00

The Hough space for finding lines in a 2D image is two-dimensional.
Which statement about the Hough Transform is correct?

Wählen Sie eine Antwort:

- a. The hough space for finding (infinitely large) planes in a 3D volume is two-dimensional.
- b. The hough space for finding (infinitely large) planes in a 3D volume is three-dimensional. ✔
- c. The hough space for finding circles in a 2D image is two-dimensional.
- d. The hough transform can only be applied to find lines.

Die Antwort ist richtig.

Planes in 3D are described by 3 paramters: two angles and a distance from the origin. Thus the Hough space is three-dimensional.

Circles in 2D would be described with 3 parameters: x,y (center) and r (radius). Thus the Hough space (= parameter space) is three-dimensional.

Die richtige Antwort ist: The hough space for finding (infinitely large) planes in a 3D volume is three-dimensional.

Frage 9

Richtig

Erreichte Punkte 5,00 von 5,00

We said, that the transport of light is geometrically invertible (Helmholz Reciprocity). This is used for dual photography, where ***p*** is the image a projector projects onto a scene, ***c*** the image that a camera records, and ***T*** the light-transport matrix.

Let's assume that ***p*** is a uniform white image. We said that with ***c*=*Tp*** (forward light-transport), ***c*** shows the scene from the perspective of the camera under a white projector illumination. Assuming that ***c*** is a uniform white image, the result of ***p*=*T''c*** (where ***T''*** is the inverse of ***T***) implements what is called the inverse light transport. It computes an image that shows the scene from the perspective of the projector, but where the colors are inverted. Projecting these inverse colors compensates the actual modulation of light within the scene and the result is a uniform white image when observed from the perspective of the camera. The principle is used for radiometric compensation (i.e., for image correction of projectors that have to display images at textured surfaces).

However, what is the result of ***p*=*T'c*** (where ***T'*** is the transpose of ***T***), assuming that ***c*** is a uniform white image?

Wählen Sie eine Antwort:

- a. It computes an image that shows the scene from the perspective of the projector under a white illumination from the perspective of the camera. ✔
- b. In an image that shows the scene from the perspective of the camera, but where the scene depth appears reversed.
- c. In a uniform white image from the perspective of the projector.

Die Antwort ist richtig.

p*=*T'c implements what is called reverse light transport (dual photography).

It computes an image that shows the scene from the perspective of the projector under a white illumination from the perspective of the camera. So the positions of the physical camera and physical projector are flipped. The resolution of this dual image has the same resolution as the projector.

Die richtige Antwort ist: It computes an image that shows the scene from the perspective of the projector under a white illumination from the perspective of the camera.

Frage 10

Richtig

Erreichte Punkte 5,00 von 5,00

How is the process called which maps epipolar lines to scan lines?

Wählen Sie eine Antwort:

- a. Relation
- b. Correlation
- c. Rectification ✔
- d. Normalization

Die Antwort ist richtig.

Die richtige Antwort ist: Rectification

Frage 11

Richtig

Erreichte Punkte 5,00 von 5,00

We cannot apply an order constraint when searching for matching features along scanlines (i.e. the feature order a,b,c,d,... along a scanline can not be expected to be the same in each image)? Correct or wrong?

Bitte wählen Sie eine Antwort:

- (•) Wahr ✔
- ( ) Falsch

This is correct. The feature order is not identical in case of occlusion and self-occlusion.

Die richtige Antwort ist 'Wahr'.

Frage 12

Richtig

Erreichte Punkte 5,00 von 5,00

Given a rotation matrix ***R*** and the corresponding quaternion ***q*** *(with its conjugate* ***q'****)*, how can the rotation of a 3x1 vector ***v*** be implemented (multiple choices possible)?

Wählen Sie eine oder mehrere Antworten:

- [ ] a. ***q'vq***
- [x] b. ***qvq'*** ✔
- [x] c. ***Rv*** ✔
- [ ] d. ***vR***
- [ ] e. ***qv***

Die Antwort ist richtig.

Either by ***Rv*** or by ***qvq'***.

Die richtigen Antworten sind: ***Rv***, ***qvq'***

Frage 13

Richtig

Erreichte Punkte 5,00 von 5,00

Convolving once with a kernel of ***sigma*** is the same as convolving two times with a Gaussian kernel with ...

Note: * indicates multiplication.

Wählen Sie eine Antwort:

- a. ***sigma****sqrt(2)
- b. ***sigma****2
- c. sqrt(***sigma***)*2
- d. ***sigma***/sqrt(2) ✔

Die Antwort ist richtig.

sigma/sqrt(2) is the correct answer.

Die richtige Antwort ist: ***sigma***/sqrt(2)

Frage 14

Falsch

Erreichte Punkte 0,00 von 5,00

What is the diameter of a **80mm** focal length **f/4** lens? Your answer should be in **mm**.

Antwort: 320 ✖

Since the ***f***-Number is focal length / lens diameter, the answer is ***20 mm = 80 mm / 4***.

Die richtige Antwort ist: 20

Frage 15

Richtig

Erreichte Punkte 5,00 von 5,00

We said that for affine structure from motion and ***n*** point correspondences / ***m*** cameras we get ***2nm*** equations in ***8m+3n*** unknowns. Due to the ambiguity in ***Q***, we can add constraints: ***2nm>8m+3n-12***. This implies, that for reconstructing ***2*** views, at least ***4*** points are needed. Note, that points and cameras are reconstructed in affine space. For a transformation to Euclidean space, an additional Euclidean update is needed. We want to ignore this here.

With the same idea explained above: How many point correspondences are sufficient (minimum) to reconstruct two cameras and all the needed (minimum number of) points in projective space? Thus, if ***4*** points is the minimum for two cameras in the affine case, how many points are needed for two cameras in the projective case?

Please provide your answer in the following format: ***NM***, where ***N*** is the number of points and ***M*** is the number of views.

Antwort: 72 ✔

A perspective projection matrix is ***3x4*** (with lower right coefficient being ***1***). Thus, ***M*** has ***11*** unknowns. The projective transform ambiguity matrix ***Q*** is ***4x4*** (with the lower right coefficient being ***1***). Thus it has ***15*** unknown. As for the affine case explained above, we can infer from this that: ***2nm > 11m+3n-15***. By knowing this, a minimum of ***n=7*** points are needed for ***m=2*** views.

The correct answer is therefore ***72***.

Die richtige Antwort ist: 72

Frage 16

Richtig

Erreichte Punkte 5,00 von 5,00

The sensor response of a camera is normally non-linear while the response of the human visual system is linear.
The response of consumer cameras is adapted (to a linear response) to produce pleasing images. Correct or wrong?

Bitte wählen Sie eine Antwort:

- Wahr
- Falsch ✔

Wrong!

Sensor response is normally linear while the response of the human visual system is nonlinear. Images of consumer cameras have an adapted non-linear response, to produce pleasing images for humans.

Linearization of a camera means measuring the nonlinear response function and inverting it. A linear response is required for all computer vision task that consider linearity in mathematical models.

Die richtige Antwort ist 'Falsch'.

Frage **17**

Richtig

Erreichte Punkte 5,00 von 5,00

The average of three pixels is 180. While one pixel is twice another one, it equals the third one. What are the values of all three pixels? Provide your answer in the following format: **XXXYYYZZZ**, where XXX is the value of the first pixel, YYY the value of the second pixel, ZZZ the value of the third pixel.

Antwort: 216108216 ✔

You can solve it with a linear equation system easily by hand on paper. You need to find the three unknowns ***x,y,z*** in the following three equations:

1/3x+1/3y+1/3z = 180

x=2y —> x-2y=0

x=z —> x-z=0

The solution is: ***216, 108, 216***, and the correct answer is ***216108216***, or any permutation of the three numbers.

The second solution is: 135, 270, 135 (this will also count in any permutation).

Die richtige Antwort ist: 216108216

Frage **18**

Richtig

Erreichte Punkte 5,00 von 5,00

The complexity of IPC's (Iterative Closest Point Method) correspondence match, if no optimal data structures are used is ***O(N^2)*** (for every point the closest neighbor has to be found).
What is its complexity if k-d trees are used?

Wählen Sie eine Antwort:

- a. ***O(N log N)*** ✔
- b. ***O(N^2)***
- c. ***O(N)***
- d. ***O(N^3)***

Die Antwort ist richtig.

With k-d trees, the complexity is ***O(N log N).***

Die richtige Antwort ist: ***O(N log N)***

Frage 19

Richtig

Erreichte Punkte 5,00 von 5,00

Which of the following statements is correct (multiple choices possible)?

Wählen Sie eine oder mehrere Antworten:

- [x] a. The gradient field of an image is a conservative vector field. ✔
- [x] b. The gradient field of an image has zero curl. ✔
- [x] c. The divergence of the gradient field is the Laplacian of the corresponding image. ✔
- [ ] d. After processing the gradient field, the corresponding image can always be reconstructed by integration.

Die Antwort ist richtig.

"After processing the gradient field, the corresponding image can always be reconstructed by integration." is wrong, as processed gradient fields might no longer be conservative (contains curls). Usually, a Poisson solver is used for reconstruction.

Die richtigen Antworten sind: The gradient field of an image has zero curl., The gradient field of an image is a conservative vector field., The divergence of the gradient field is the Laplacian of the corresponding image.

Frage 20

Richtig

Erreichte Punkte 5,00 von 5,00

Multiplying with the intrinsic matrix K maps a point from the normalized image plane to the physical image plane. Correct or wrong?

Bitte wählen Sie eine Antwort:

- (•) Wahr ✔
- ( ) Falsch

Correct. Multiplying with K maps from the normalized image plane to the physical image plane. The inverse of K maps from the physical to the normalized image plane.

Die richtige Antwort ist 'Wahr'.

◄ Recording

Direkt zu: