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Feb 23, 2025

CS5330

Homework 7

Questions & Answers

1. **What makes the bi-illuminant dichromatic reflection model different from the standard dichromatic reflection model.**

   Dichromatic reflection model says only consider the dominant light which is the direct light source. This model also does not address the issues of shadow. The model also says that every pixel is defined as body reflection plus the surface reflection, but it only takes into account the dominant light on to both body and surface reflection.

   Bi-illuminant dichromatic reflection model considers both dominant light and ambient light. The model also touches upon the color changes in the shadow areas. Just as dichromatic reflection, this model takes both body reflections and surface reflections into account and factor in both dominant and ambient light to it.

2. **Why is it challenging to make use of the idea of log space chromaticity?**

   It is challenging because:

   - There could be multiple light sources in real life
   - This is also an image specific which is difficult in dynamic real-world scenarios. For instance, if you walk out of the door where there's clear blue sky, now your log space chromaticity represents the scene based on the clear blue sky, but saying it is raining and the sky is dark or cloudy, the entire space chromaticity is changed.

3. **Why do we use projective coordinates when modeling the relationship between the 3-D world and a 2-D image of it?**

   Because projective geometry allows us to model the perspective projection that occurs in cameras and human vision (real world) accurately. Through projective geometry, we can also conduct rigid transformations that allows us to do scaling, rotating, and translation. This gives a comprehensive framework for describing relationships between 3D scene and their 2D projection.

4. **What do the extrinsic parameters of a camera specify?**

   Extrinsic parameters of a camera specify the location of the camera. It has the position and the orientation of the camera. Therefore, if you move the camera around, the value here changes.

5. **What do the intrinsic parameters of a camera specify?**

The intrinsic parameters of the camera specify the intrinsic values belong to the camera like the focal length, size of pixel, center of camera's senser, and distortion parameters. Since this is the internal configuration of the camera, if you move the camera around, this value does not change.

6. **What are the four coordinate systems we use for developing the camera calibration matrix? Give a few sentences on each that show your own understanding of them**

   The four coordinate systems we are using for developing the camera calibration matrix are:

   - World coordinate: this is the real-world 3D coordinate system defined by users based on known reference point. It provides a fixed frame of reference for describing the positions of objects and the camera in the physical space.
   - Camera coordinate (camera Euclidean): this is a 3D coordinate system centered at the camera's optical center. Its Z-axis typically aligns with the camera's optical axis, while the X and Y axes define the image plane (y is up direction and x is left direction. It represents the camera's perspective of the 3D world.
   - Image coordinate (image Euclidean): This 2D coordinate system describes points on the image plane. Its origin is usually at the intersection of the optical axis with the image plane, and its axes are parallel to the camera's X and Y axes. Transformation from camera Euclidean to image Euclidean is the projection matrix based on the focal length.
   - Image affine: This change from 2D world unit in image Euclidean to 2D in image coordinate or pixel). Its origin is typically at the top-left corner of the image, with the x-axis pointing right and the y-axis pointing down. It uses pixel units and accounts for factors like pixel size and any potential skew.