UNIVERSITÄT DES SAARLANDES
Dr.-Ing. Hendrik P.A. Lensch
Max Planck Institut Informatik
Art Tevs (tevs@mpi-inf.mpg.de)
Boris Ajdin (bajdin@mpi-inf.mpg.de)
Matthias Hullin (hullin@mpi-inf.mpg.de)

28. January 2008

Computer Graphics I
Assignment 10

Submission deadline for the exercises: Monday, 4th February 2008
Rule: Solutions have to be submitted in the lecture room before the lecture.

10.1   Image Based Rendering (40 Points)

a) What is the Plenoptic Function? What does it capture? Describe its representation and give a couple of examples what is it good for. (10 Points)

b) What is the Lightfield (also known as Lumigraph)? Give an exmple of a lightfield and show how you would acquire it for a given scene. (10 Points)

c) Ignoring time and wavelength, the Plenoptic function is 5D. However, a lightfield representation is only 4D. How is this dimensionality reduction possible? What assumption is being made? Give examples when this assumption will not hold. (10 Points)

d) Describe a way of how to reconstruct an image of a new camera viewpoint given this representation? (10 Points)

10.2   Digital Refocusing (60 Points)

In this exercise you have to use a lightfield to refocus an image a posteriori. Download the exercise's source code from `http://www.mpi-inf.mpg.de/departments/d4/teaching/ws2007-2008/cg/ibr.tgz` and unpack it. Take a look into the new interface of the `PerspectiveCamera` class which is now capable of using frustum planes to sample the scene.

a) Your task is to create a camera grid with shearing perspective to sample the light field. Add missing code parts in `Lightfield::sampleLightField()` to sample a lightfield of the scene. The frustum coordiantes of each sampling camera (on the UV-plane) has to be choosen in a way, that its focal plane overlaps with the focal plane (i.e. ST-plane) of the reference/center camera (see Fig. 1). (25 Points)

b) Implement the missing code parts in `Lightfield::refocus()` to achieve digital refocusing of sampled lightfield. For each pixel in the resulting image you intersect corresponding rays of grid cameras with the focal plane. The pixel value is computed by acquiring and averaging all the pixels of the intersections. (35 Points).
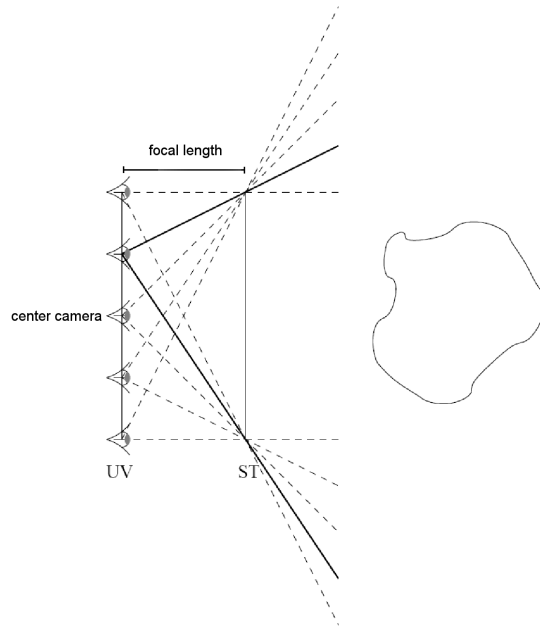
Figure 1: Four sampling cameras are placed on the UV-plane around the reference/center camera. Shearing perspective projection provides a complete coverage of the sampling images on the focal plane (ST-plane).
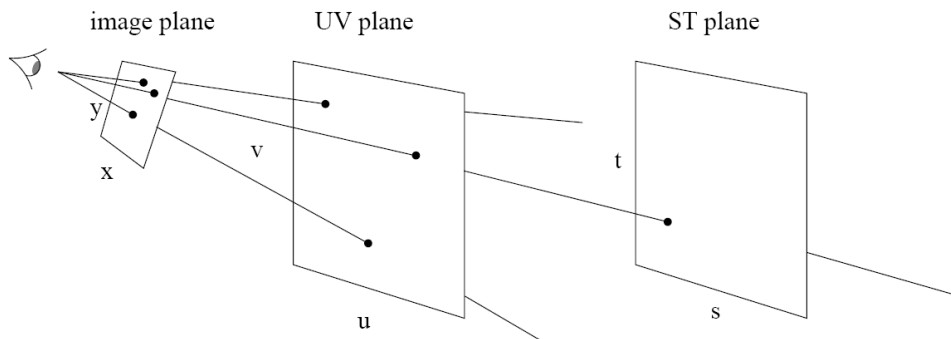

Figure 2: Resulting color of a ray is computed by using colors of the intersection of a ray between the ST-plane and UV-plane. In our case we do encounter only the intersection with ST-plane because the rays are started directly from the UV-plane (from the associated camera origin).