Chapter 4
Recording Studio: Data Acquisition and Data Processing

This chapter describes our recording studio. First, the physical studio, the camera system, and the full body laser scanner are presented. Thereafter, the acquisition pipeline is detailed, with all necessary steps to generate the input data for the projects described in this book.

It is a new trend in computer graphics to employ data acquired from the real world into the animation or rendering pipeline. For instance, the new research directions of performance capture and 3D Video investigate the possibility of generating realistic moving human models of real subjects from a set of images or video streams of the subject performing.

In this chapter, we extend the studio described in [30], which was originally designed for different surround vision applications. We present our new acquisition setup that provides high quality data for the different projects involving arbitrary subjects, motions, and clothing styles. Although our focus is different from previous work, the old functionality should be preserved, and augmented to meet the new requirements: high frame rates, high image resolution, better lighting conditions, and a device to reconstruct high-quality surface models for the subjects being recorded.

This chapter is structured as follows: Sect. 4.1 presents related acquisition systems for capturing multi-view video data. Thereafter, the details of the main components of our studio are presented, Sect. 4.2. At the end, in Sect. 4.3 all necessary recording steps to generate the data used in our projects are described, including camera calibration, recording session and data processing.

4.1 Related Acquisition Facilities

For video-based human motion capture, researchers use multiple video streams showing a moving person from different viewing directions to acquire the motion parameters. Commercial motion capture systems exist that use optical markers on the body in connection with several high-resolution special purpose cameras [21]. Examples of such commercial systems are provided by [1, 2, 24, 3, 4, 5].
In contrast, marker-free motion capture systems do not require any intrusion into the scene. Examples of early motion capture acquisition systems are presented by [11, 17, 14] and [7, 18] using reconstructed volumes. Most recently, a system using a database of human shapes and fast high-resolution cameras was presented by [8]. A commercial marker-less motion capture system developed by Organic Motion™ [27] is also available. Please refer to [25] for an extensive review of video-based motion capture systems.

Multi-view video streams can also be used for scene reconstruction. In this case, the viewer has the possibility to interactively choose the viewpoint of the dynamic 3D scene, while it is rendered [22]. A system for recording and editing 3D videos is described in [35] and further extended in [101]. Examples of other 3D Video systems are presented by [20, 28].

Alternatively, for reflectance acquisition systems, different acquisition setups consisting of high-quality cameras and a set of light sources have been proposed [33, 12]. [10] presented the light stage and most recently successively extended it, being able to acquire simple motion and dynamic reflectance fields of humans [6].

Most of the previous setups can acquire data for different and challenging tasks as motion capture, scene reconstruction and reflectance estimation. However, there is no system described in the literature yet that is able to provide high-resolution temporally-coherent virtual actors for arbitrary real-world subjects.

### 4.2 Recording Studio

Our studio is designed to acquire high-quality surface models of human subjects as well as image footage for measuring human motion, dynamic shape deformations, and appearance. In the following sections, we describe in details the requirements and solutions for each component of our studio: the studio room, the camera and lighting system, and the full body laser scanner.

#### 4.2.1 Studio Room

The studio is installed in a room of approximately $9 \times 4.8$ meters in size. Its spatial dimensions are large enough to allow the scanning of subjects as well as recording of dynamic scenes from a large number of viewpoints. The ceiling has a height of approximately 4m. Along one of the shorter walls, an area of $2.5 \times 4.8$ meters is separated as a control room of the studio and for our full body laser scanner, Sect. 4.2.4. The walls and the floor can be covered with opaque black curtains and a carpet, respectively, which enables us to minimize the effects of indirect illumination in a scene. The recording area, the control room of our studio, and the laser scanner are shown in Fig. 4.1.

#### 4.2.2 Camera System

The cameras used in the studio need to provide high frame-rates, high resolution, precise color reproduction, lossless data capture, and external synchronization,