Light Stage 2.0

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At SIGGRAPH 2000, we presented an apparatus for capturing the appearance of a person's face under all possible directions of illumination. The captured data can be directly used to render the person into any imaginable lighting environment, and can also be used to build photo-real computer graphics models that capture the unique texture and reflectance of the face. We have recently been developing the next generation of this lighting apparatus, which we call Light Stage 2.0.

Light Stage 2.0 is a much faster and more precise version of its predecessor. The original device allowed a single light to be spun around on a spherical path so that a subject could be illuminated from all directions, and regular video cameras were used to record the subject's appearance as the light moved. This system had two major problems. First, since the light was moved around by pulling on various ropes, it was hard to be sure what the precise location of the light was at any given time. Second, because the device could not be spun very fast, and because of the limit of 30 frames per second imposed by the video cameras, it took over a minute to do a data capture. Since the subject must remain still during the data capture, this meant we could only capture people in very passive expressions, and even then multiple trials were often needed.

With Light Stage 2.0 (shown in Figure 1), we can capture all of the different lighting directions much more rapidly, with only a single rotation of a semicircular arm, and with greater accuracy. Thirty strobe lights arrayed along the length of the arm flash repeatedly in rapid sequence as the arm rotates. High-speed digital cameras capture the subject's appearance. This allows all directions of illumination to be provided in about four seconds, a period of time for which a person can easily remain still. It is also much easier to capture facial expressions that would be very difficult to maintain for an extended period of time (smiling, frowning, wincing, etc.).

We are currently working on integrating geometry capture to provide a truly complete model of the subject. For this, we use digital LCD projectors to project different structured patterns onto the subject, quickly recording the appearance of the subject under each of the patterns with our high-speed cameras. From these structured-light data, the geometry of the subject is easily recovered. These data together with the reflectance data may provide more complete and photo-real models of faces than ever before.

In the next few months, we will be researching new ways of analyzing the large amount of information captured in a Light Stage 2.0 scan and adapting the datasets for use in facial animation. We would also like to make our capture process even faster, with the goal of being able to capture both geometry and reflectance information in about five seconds. Our future plans include new prototype lighting devices that will allow similar datasets to be captured many times a second. This will allow an actor's performance to be recorded and then rendered photo-realistically into virtual environments with arbitrary lighting, where the performance can be viewed from arbitrary angles.