High Dynamic Range Imaging (HDRI) **"The Basics"**

By Professor Kirt Witte

What is HDR all about?

Film cameras were developed in order to record light so that it could be reproduced on photographic paper; digital cameras so that it could be reproduced on a computer screen. Neither computer screens nor paper can display nearly the dynamic range (ratio between dark and bright regions) as what is present in the real world, and as a result cameras are not designed to capture even close to such a range. However, by taking a series of pictures with different exposure settings the range can be covered. With this technique such a series of images can be combined into a single high dynamic range image called a radiance map. Radiance maps are useful for representing true illumination values in image-based rendering applications, and are useful for recording incident illumination and using this light to illuminate CG objects for realistic compositing.

What does "Dynamic Range" mean?

The dynamic range of a scene is the contrast ratio between its brightest and darkest parts. A High-Dynamic Range image is an image that has a greater dynamic range than can be shown on a standard display device (8-bit), or that can be captured with a standard camera with just a single exposure. LDRs (Low Dynamic Range Images) are the "normal" 24-bit/8-bits per channel images we are all used to working with on our color computer monitors. HDR Images are typically generated by combining multiple normal images of the same scene taken with different intensity levels, or as the result of creating a global illumination rendering. In practice, high dynamic range pixels use floating-point numbers, capable of representing light quantities of one to a million and beyond. Low-dynamic range images usually represent pixels using eight bits per channel, with pixel values ranging as integers between 0 and 255.

What is a Light Probe?
A light probe image is an omnidirectional, high dynamic range image that records the incident illumination conditions at a particular point in space.

What is tone-mapping?
A classic photographic task is the mapping of the potentially high dynamic range of real world luminances to the low dynamic range of the photographic print. This tone reproduction problem is also faced by computer graphics practitioners who must map digital images to a low dynamic range print or screen.

Tone reproduction (also known as tone mapping) provides a method of scaling (or mapping) luminance values in the real world to a displayable range. Tone reproduction is necessary to ensure that the wide range of light in a real-world scene is conveyed on a display with limited capabilities.

In other words, taking an HDR image and making a good looking LDR out of it using the highlight details from one area, the midtones from another exposure, and the show details from another area, then combining them into one realistic, beautiful image that cannot be created or captured using traditional film or digital media. It creates a hyper-real image that most people would think looks very natural.

Why should you care about HDR?
HDR is a relatively new industry trend that is coming on very fast. ILM, Rhythm & Hues, and Digital Domain use for most of their CG shots. Video games and video card manufacturers are also supporting it. HDR will be ever more important to the CG world. It's not going to go away, so better to learn about it now and realize its huge potential.

So how can it make my work better or easier?
HDR allows you to get realistic CG lighting very quickly and easily. It is especially important for compositors to be able to CG elements into a live action "real" scene.

But I don't know much about photography or creating panoramas…
No problem! Go buy a large chrome ball from your local gardening store, due a calibration test, then start shooting away! Even easier, just download or purchase pre-made HDRs/Radiance maps off the Internet!

Lighting CG just got a whole lot easier and better. Enjoy!

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