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High Dynamic Range Imaging: Next Generation Digital Photography and Cinema

MPI Informatik develops unique solutions for efficient storage and compression of HDR video. The HDRI development is nothing else as filling the existing gap between imaging technology and the human eye capabilities (Max-Planck-Institut für Informatik, CeBIT 2006 in Hannover, Hall 09, Booth B 43)

The quest for better quality of images and video continues since the inception of the television, photography and cinema. A huge progress in this direction has been achieved by introducing digital technology, which is predominant today. A dominant trend that currently revolutionizes the consumer market is increasing the image resolution by the introduction of High Definition TV displays and imaging sensors of high resolution in digital cameras. Yet another revolution is round the corner and this time it is known as "High Dynamic Range".

High Dynamic Range Imaging (HDRI for short) is a set of techniques that allow a far greater dynamic range of exposures than normal digital imaging techniques. The intention is to accurately represent the wide range of intensity levels found in real scenes, ranging from direct sunlight to the deepest shadows. For digital photography this means that under- or overexposed images will not be a problem anymore - everybody can make a perfect (at least technically) shot without any skills in photography. For television this means that we will have more and more an impression that we observe the real world scenes through a big window. For computer games this means that we will have a feeling of being even better immersed in the game action with all good and bad consequences of this unprecedented experience.

In fact the HDRI development is nothing else as filling the existing gap between imaging technology and the human eye capabilities - the eye is the ultimate standard for quality. The human eye can see a tremendous range of luminance levels, ranging from a moonless sky (3*10-5 cd/m2) to direct sunlight (2*109 cd/m2). The eye can see simultaneously as much as 5 orders of magnitude of luminance contrast. Though most of the digital cameras and displays can capture or show 2-3 orders of magnitude (dynamic range 1:100 - 1:1000, 40-60 dB), the next generation monitors and cameras start to operate at the sensitivity levels and dynamic range of the human eye.

Before HDR TV sets and computer monitors start to appear at our homes, the full imaging pipeline including acquisition, processing, broadcasting, and display must be developed. This pretty much happens these days. German companies such as SPHERON VR and IMS CHIPS provide solutions for HDR image and video capture. Extended dynamic range cameras for professional digital cinamatography, such Dalsa's Origin, have been developed. On another end all major display manufactures are involved in the development of LCD displays of wider dynamic range and better color gamut. First devices of this kind can be purchased even today, e.g., the HDR display from the BrightSide Technologies.

MPI Informatik develops unique solutions for efficient storage and compression of HDR video. Our goal is to develop a video format that is at least as good as the human eye. This means that stored information can be used on all future display devices, even if the development of such devices is counted in tens of years from now. The problem with traditional video compression (e.g., MPEG-4, ISO/IEC 14496-2/10) is that it is designed to encode just enough

information that is needed for existing displays. This means that with the development of new displays the quality of current DVDs will not be acceptable, pretty much as we do not accept today old fashioned HVS video. To overcome this problem, we have developed at the MPI Informatik High Dynamic Range (HDR)video compression algorithm that can store complete color information that is visible to the human eye. HDR video can encode luminance levels ranging from moonless sky to the surface of the sun (up to 300dB) and can represent the complete gamut of visible colors . Such extended information is more than sufficient to play video on the next generation of displays.

In facts it is not necessary to wait for the next generation of displays and enjoy the advantages of HDR video even on existing TV sets and computer monitors. We have developed at the MPI Informatik a HDR video player that can make the best use of the HDR video and present the best quality video for a given display device. Through the choice of rendering algorithm we can much better optimize image contrast, brightness, and colorfulness than it is possible with traditional video signal. Moreover, the image appearance can be much better tuned to ambient lighting of the room in which the TV set is placed.

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