Adaptive rendering method reduces discolored pixels in photo-realistic images

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(a) Ours, 16 spp rMSE 0.00541   (b) MC input, 16 spp rMSE 0.68832   (c) Ours, 16 spp rMSE 0.00541   (d) Reference,32K spp

Credit: Disney Research

Disney Research has developed a new method to improve the rendering of high-quality images from 3-D models by drastically reducing the noise, or discolored pixels, contained in the animated images, while preserving fine detail.

The researchers found that they could improve the performance of Monte Carlo ray tracing - a popular technique for producing photo-realistic animations - by varying the polynomial functions used to control image reconstruction based on the complexity of each region of the image.

"Our new method outperforms existing state-of-the-art denoising techniques in terms of both numerical accuracy and visual quality," said Markus Gross, vice president at Disney Research.

The research team will present their adaptive polynomial rendering method July 24 at the ACM International Conference on Computer Graphics & Interactive Techniques (SIGGRAPH) in Anaheim, Calif.

Monte Carlo ray tracing renders 3-D scenes by randomly tracing the possible light paths for each pixel in the image. This produces highly realistic images, but can require more than 10,000 ray samples for each pixel, which requires large amounts of time. To speed the process, adaptive techniques have been developed that reduce the number of ray samples, but introduce noise, or discolored pixels, into the image. Denoising algorithms are thus used to filter out as much noise as possible during image reconstruction.

Polynomial functions can be used to approximate the image in this reconstruction step, but usually these polynomials are fixed. The Disney researchers, however, found that they could reduce noise by choosing the most appropriate polynomial function for each region within the image.

"The main observations of this new work are that polynomial functions can accurately approximate small image regions of varying complexity and, further, that automatically choosing the correct polynomial function for each region is important," said Kenny Mitchell, senior research scientist at Disney Research and a professor at Edinburgh Napier University.

"For instance, low-order polynomials, such as linear functions, make a good choice to represent smooth image regions," he explained. "In contrast, higher order polynomials, such as cubic functions, are used to represent more complex regions, such as edges and corners."

The new method automatically selects the appropriate functions for each image region to maximize the quality of the denoised result, said Bochang Moon, a post-doctoral researcher at Disney Research.

More information: s3-us-west-1.amazonaws.com/dis … -Rendering-Paper.pdf

Provided by Disney Research