Imagining how light behaves in 2-D world gives researchers insights for faster 3-D rendering

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Though sophisticated three-dimensional imagery is abundant in computer-generated games and movies, a group of researchers from Disney Research, Zürich, University of California, San Diego, Limbic Software, and RWTH Aachen University say they have gained insights to improve the rendering of those images by envisioning a flat, two-dimensional world.

The fundamental physics of light is easier to understand in that 2D world than in a 3D environment, they said, and enabled them to develop simplified equations for governing the behavior of light. This in turn allowed the team of researchers to find practical improvements to 3D photorealistic rendering techniques which improved their speed and quality.

"Rendering techniques have become so incredibly sophisticated and complex that skilled artists can now easily create photorealistic depictions of synthetic worlds and are limited only by their imaginations," said Dr. Wojciech Jarosz, research scientist at Disney Research, Zürich and coauthor of the work. Ultimately, all of these rendering techniques simulate how light would bounce around in a virtual environment. This physical lighting simulation is what allows these computer-generated images to look so convincingly photorealistic. "Unfortunately, these methods can often be incredibly slow, taking hours to simulate a single frame of a movie, and the physical processes they try

to mimic are incredibly complex," he added.

This increased complexity not only limits artists, but hampers researchers such as Jarosz who pursue improved approaches and can make it more difficult to discuss and teach the underlying concepts. To address this ever increasing complexity, the team of researchers decided to go back to basics. They imagined how light would behave in a fictional two-dimensional world to avoid dealing with the harsh complexities of how light behaves in our physical 3D world.

"It turns out that we can define a 2D world where light behaves much the same way as it does in our 3D reality — however, all the fundamental equations governing the physics of light become significantly simpler," Jarosz explained. This seemingly frivolous exercise actually provides tangible benefits for developing better 3D rendering techniques. All the common rendering techniques can be analyzed in this simplified 2D setting and their weaknesses and strengths can be more easily discovered.

In addition to improving 3D rendering techniques, Jarosz, who is also an adjunct lecturer at ETH, the Swiss Federal Institute of Technology, speculates that the simplified view of the physics of light could also serve as a good teaching tool within computer graphics curricula at universities.

More information: These ideas will be presented Aug. 7 in the "Sampling, Reconstructing, and Filtering Light" session at SIGGRAPH 2012, the International Conference on Computer Graphics and Interactive Techniques at the Los Angeles Convention Center. For a copy of the research paper, please visit the project website at http://zurich.disneyresearch.com/~wjarosz/publications/jarosz12theory.html.

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