Artificial intelligence for better computer graphics

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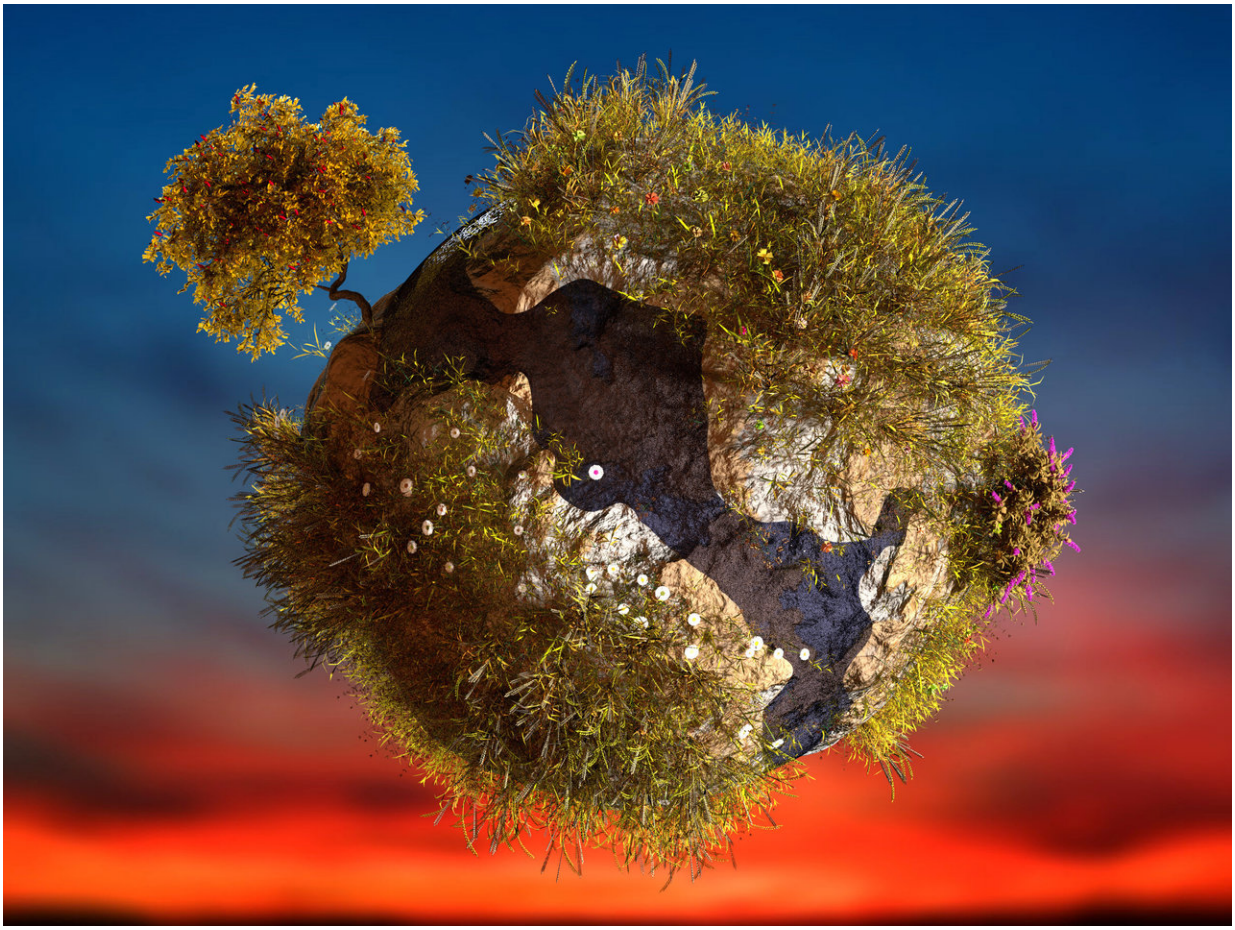

Credit: Vienna University of Technology

At the TU Wien (Vienna), neural networks have been developed which

make it much easier to create photorealistic pictures of a wide variety of materials.

If computer-generated images are to look realistic, different materials have to be presented differently: The metallic sheen of a coin looks quite different from the dull gloss of a wooden plate or the slightly transparent skin of a grape. Exactly simulating such material effects usually requires a lot of experience and patience. Many different parameters need to be adjusted carefully, then the computer takes a while to calculate the corresponding image, and then the same procedure is repeated, until the result is fully satisfactory.

At TU Wien (Vienna), new methods have now been developed that make this process much faster and easier. An artificial intelligence recognizes the designer's creative desires and autonomously proposes suitable sample images. A neural network applies the selected material parameters to a sample object in real time. For very different applications in the graphics area, this is a big step forward—from game design and film animation to architectural visualization.

Artificial intelligence instead of raytracing

"Usually we have to manually adjust up to hundreds of parameters to make an object looks photorealistic," says Károly Zsolnai-Fehér from the Institute for Visual Computing and Human-Centered Technology at the Vienna University of Technology. "If you want to create an image that contains many different materials, finding a completely satisfactory solution is challenging and time-consuming."

Credit: Vienna University of Technology

This is why Zsolnai-Fehér, who works in the team of Prof. Michael Wimmer, has used methods of artificial intelligence. In order for the computer to learn how to display a specific material, different versions of a sample object are displayed. A person clicks on the image which looks closest to the desired result. After a few practice rounds, the artificial intelligence has learned the physical properties of the desired material. "That way the system acquires parameters which can then be used to insert objects of this material into any image, matching any specific lighting," explains Michael Wimmer.

Credit: Vienna University of Technology

Not only Pretty, but also Fast

However, it is not enough for the computer to adapt quickly to the wishes of the human graphic designer—it is also important that the preview images in each test round are displayed as quickly as possible. In most cases, photorealistic images are generated by physically simulating the propagation of light rays as precisely as possible. However, with such physics-based methods, creating a test image takes a few minutes. If the software has to calculate a new test images hundreds of times in search of the optimal parameters, this soon becomes a nerve-wracking experience for the humans involved.

Therefore artificial intelligence is also used when generating the preview images: In addition to the machine learning algorithm, which suggests the appropriate parameters, Károly Zsolnai-Fehér has also developed a neural network, which applies the respective material parameters to a sample object much faster than is has ever been possible with standard computer code. If necessary, the results can then be adjusted and refined in a very user friendly way.

Even complicated materials, such as reflecting surfaces or turbid screens, are not a problem for the neural networks. "Our approach is suitable for beginners and professionals alike, and I hope it will find wide application in the field of computer graphics," says Zsolnai-Fehér.

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Stirring Attention in the Graphics Community

The new methods were presented for the first time at the world's largest and most prestigious computer graphic conference SIGGRAPH, which took place in August 2018. "Károly Zsolnai-Fehér's new methods have since raised a lot of attention among computer graphics professionals," says research group leader Michael Wimmer. "The method is a great step forward for the graphics community." Images created using the new neural network nave now even been chosen for the cover of the official SIGGRAPH conference report.

More information: Károly Zsolnai-Fehér et al. Gaussian material synthesis, *ACM Transactions on Graphics* (2018). DOI: 10.1145/3197517.3201307

Provided by Vienna University of Technology