PRESS RELEASE

Researchers from the Gwangju Institute of Science and Technology Develop a New Method for Denoising Images

The approach involves a post-correction network optimized by a self-supervised machine learning framework to improve the quality of unfamiliar images

High-quality visual displays rendered using the "path tracing" algorithm are often noisy. Recent supervised learning-based denoising algorithms rely on external training dataset, take long to train, and do not work well when the training and test images are different. Now, researchers from the Gwangju Institute of Science and Technology, VinAI Research, and the University of Waterloo have put forth a novel self-supervised post-correction network that improves the denoising performance without relying on a reference.

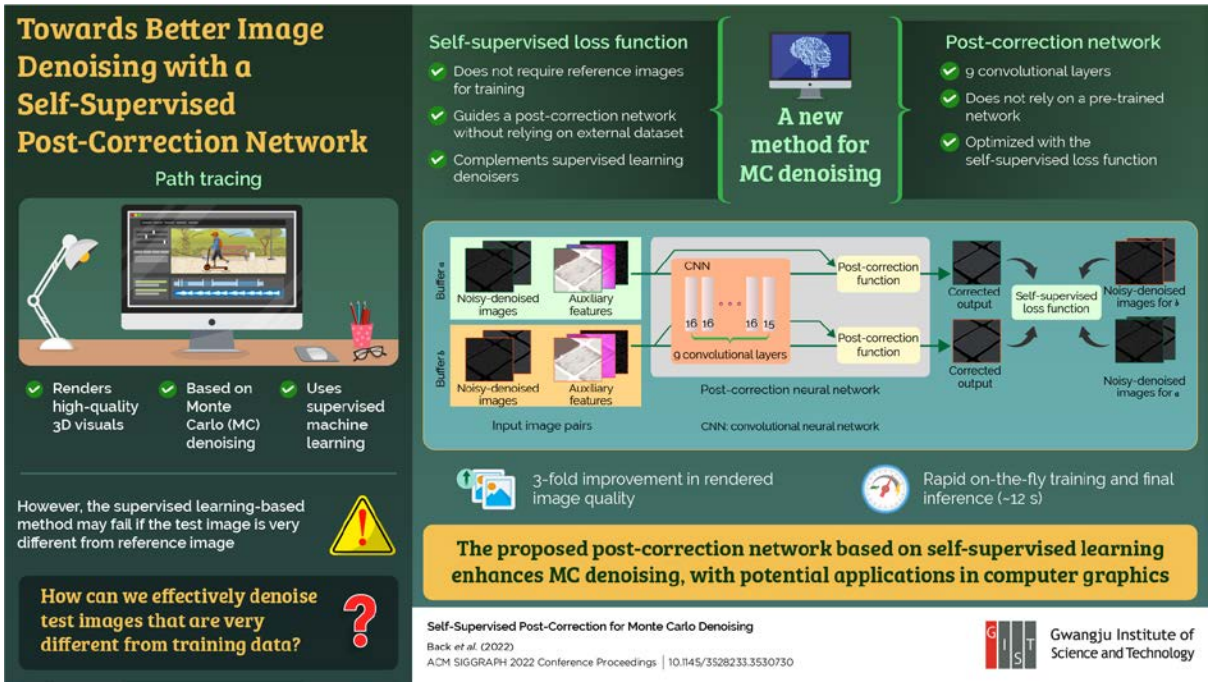

Image title: Towards better image denoising with a self-supervised post-correction network

Image caption: Researchers from the Gwangju Institute of Science and Technology in Korea, VinAI Research in Vietnam, and the University of Waterloo in Canada have proposed a new method to improve the quality of path-traced visuals using a post-correction network and a self-supervised machine learning framework. The model can be trained on the fly to output high-quality images in just 12 seconds.

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High-quality computer graphics, with their ubiquitous presence in games, illustrations, and visualizations, are considered state-of-the-art in visual display technology. The method used to render high-quality and realistic images is known as "path tracing," which makes use of a Monte Carlo (MC) denoising approach based on supervised machine learning. In this

learning framework, the machine learning model is first pre-trained with noisy and clean image pairs and then applied to the actual noisy image to be rendered (test image). While considered to be the best approach in terms of image quality, this method may not work well if the test image is markedly different from the images used for training.

To address this problem, a group of researchers, including Ph.D. student Jonghee Back and Associate Professor Bochang Moon from the Gwangju Institute of Science and Technology in Korea, research scientist Binh-Son Hua from VinAI Research in Vietnam, and Associate Professor Toshiya Hachisuka from University of Waterloo in Canada, proposed a new MC denoising method that does not rely on a reference. Their study was made available online on 24 July 2022 and published in *ACM SIGGRAPH 2022 Conference Proceedings*.

"The existing methods not only fail when test and train datasets are very different but also take a long time to prepare the training dataset for pretraining the network. What is needed is a neural network that can be trained with only test images on the fly without the need for pretraining," says Dr. Moon, explaining the motivation behind their study.

To accomplish this, the team proposed a new post-correction approach for a denoised image that comprised a self-supervised machine learning framework and a post-correction network, basically a convolutional neural network, for image processing. The post-correction network did not depend on a pre-trained network and could be optimized using the self-supervised learning concept without relying on a reference. Additionally, the self-supervised model complemented and boosted the conventional supervised models for denoising.

To test the effectiveness of the proposed network, the team applied their approach to the existing state-of-the-art denoising methods. The proposed model demonstrated a three-fold improvement in the rendered image quality relative to the input image by preserving finer details. Moreover, the entire process of on the fly training and final inference took only 12 seconds!

"Our approach is the first that does not rely on pre-training with an external dataset. This, in effect, will shorten the production time and improve the quality of offline rendering-based content such as animation and movies," remarks Dr. Moon, speculating about the potential applications of their work.

Indeed, it may not be long before this technique finds use in high-quality graphics rendering in video games, augmented reality, virtual reality, and the metaverse!

Reference

Authors:	Jonghee Back[1], Binh-Son Hua[2], Toshiya Hachisuka[3], and Bochang Moon[1,*]
Title of original paper:	Self-Supervised Post-Correction for Monte Carlo Denoising
Journal:	*ACM SIGGRAPH 2022 Conference Proceedings*

DOI: 10.1145/3528233.3530730

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About the authors

Jonghee Back is a Ph.D. student in the Computer Graphics Lab in the School of Integrated Technology at GIST. His research interests are in the field of artificial intelligence with a focus on physically based rendering.

Binh-Son Hua is a research scientist at VinAI Research in Vietnam. He received his Ph.D. from the National University of Singapore in 2015. His research interests are in computer graphics and computer vision, focusing on physically-based image synthesis and 3D deep learning.

Toshiya Hachisuka is currently an Associate Professor at the David R. Cheriton School of Computer Science at the University of Waterloo in Canada. He received his Ph.D. in Computer Science from the University of California, San Diego, in 2011. His research interests comprise computer graphics rendering, light transport, Monte Carlo methods, and numerical computation.

Bochang Moon is an Associate Professor in the School of Integrated Technology at GIST, where he heads the Computer Graphics Lab. He received his Ph.D. in Computer Science from the Korea Advanced Institute of Science & Technology in 2014. His research interests include photorealistic rendering, Monte Carlo ray tracing, rendering using artificial intelligence, and augmented and virtual reality.