

Researchers develop a new method for denoising images

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Towards Better Image Denoising with a Self-Supervised Post-Correction Network

Path tracing

- ✓ Renders high-quality 3D visuals
- ✓ Based on Monte Carlo (MC) denoising
- ✓ Uses supervised machine learning

However, the supervised learning-based method may fail if the test image is very different from reference image.

How can we effectively denoise test images that are very different from training data?

Self-supervised loss function

- ✓ Does not require reference images for training
- ✓ Guides a post-correction network, without relying on external dataset
- ✓ Complements supervised learning denoisers

A new method for MC denoising

Post-correction network

- ✓ 9 convolutional layers
- ✓ Does not rely on a pre-trained network
- ✓ Optimized with the self-supervised loss function

3-fold improvement in rendered image quality

Rapid on-the-fly training and final inference (~12 s)

The proposed post-correction network based on self-supervised learning enhances MC denoising, with potential applications in computer graphics

Self-Supervised Post-Correction for Monte Carlo Denoising
Back et al. (2022)
ACM SIGGRAPH 2022 Conference Proceedings | 10.1145/3528122.3530750

Gwangju Institute of Science and Technology

The model can be trained on the fly to output high-quality images in just 12 seconds. Credit: Bochang Moon from Gwangju Institute of Science and Technology, Korea

High-quality computer graphics, with their ubiquitous presence in games, illustrations, and visualization, 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 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, in a new study, 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 long 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 using 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," says Dr. Moon, speculating about the potential applications of their work.

More information: Jonghee Back et al, Self-Supervised Post-Correction for Monte Carlo Denoising, *Special Interest Group on Computer Graphics and Interactive Techniques Conference Proceedings* (2022). [DOI: 10.1145/3528233.3530730](https://doi.org/10.1145/3528233.3530730)

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