

Kernel-Predicting Convolutional Networks for Denoising Monte Carlo Renderings

Proceedings of SIGGRAPH 2017
ACM Transactions on Graphics (TOG)
Vol. 36, No. 4, July 2017

Steve Bako^{* 1}
Mark Meyer⁴
Pradeep Sen¹

Thijs Vogels^{* 2,3}
Jan Novák³
Tony DeRose⁴

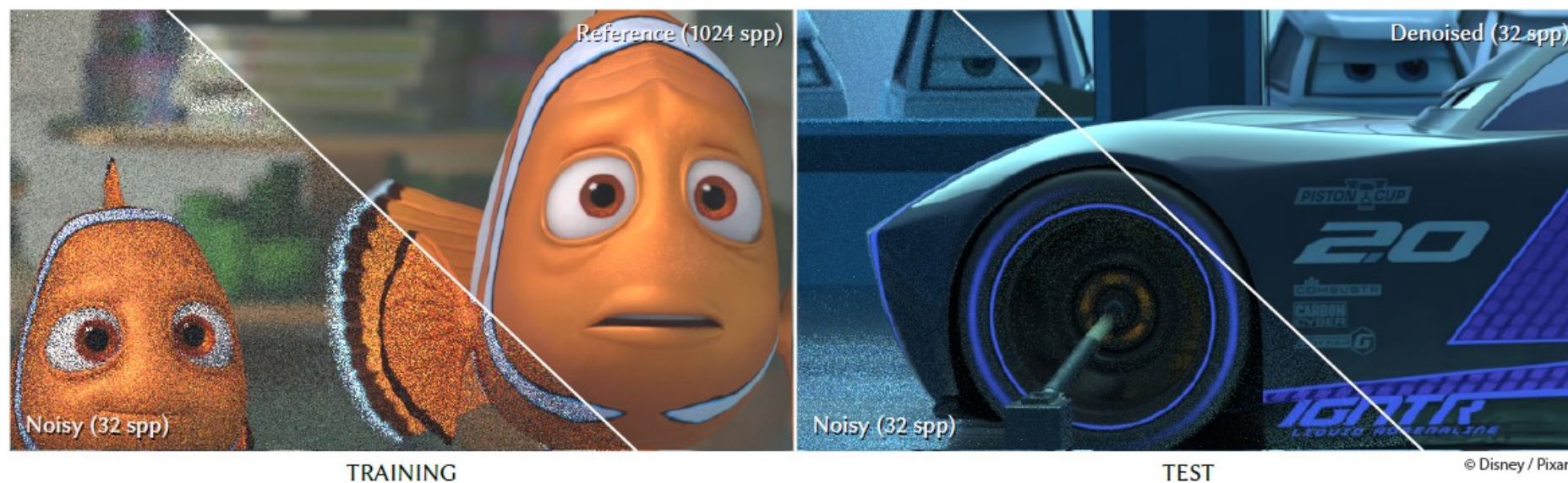
Brian McWilliams³
Alex Harvill⁴
Fabrice Rousselle³

¹ University of California, Santa Barbara

² ETH Zurich

³ Disney Research

⁴ Pixar Animation Studios



Abstract

Regression-based algorithms have shown to be good at denoising Monte Carlo (MC) renderings by leveraging its inexpensive by-products (e.g., feature buffers). However, when using higher-order models to handle complex cases, these techniques often overfit to noise in the input. For this reason, supervised learning methods have been proposed that train on a large collection of reference examples, but they use explicit filters that limit their denoising ability. To address these problems, we propose a novel, supervised learning approach that allows the filtering kernel to be more complex and general by leveraging a deep convolutional neural network (CNN) architecture. In one embodiment of our framework, the CNN directly predicts the final denoised pixel value as a highly non-linear combination of the input features. In a second approach, we introduce a novel, kernel-prediction network which uses the CNN to estimate the local weighting kernels used to compute each denoised pixel from its neighbors. We train and evaluate our networks on production data and observe improvements over state-of-the-art MC denoisers, showing that our methods generalize well to a variety of scenes. We conclude by analyzing various components of our architecture and identify areas of further research in deep learning for MC denoising.

Paper and Additional Materials



Paper
111 MB



Lo-res PDF
13 MB



Renderman
Supplemental
1 GB



Tungsten
Supplemental
139 MB



Source code
1.2 GB



External URL
(Coming soon)

Bibtex

```
@article{Bako17,
  author = {Bako, Steve and Vogels, Thijs and McWilliams, Brian and Meyer, Mark and Novak, Jan and Harvill, Alex and Sen, Pradeep and DeRose, Tony and Rousselle, Fabrice},
  title = {Kernel-Predicting Convolutional Networks for Denoising Monte Carlo Renderings},
  journal = {ACM Transactions on Graphics (TOG) (Proceedings of SIGGRAPH 2017)},
  volume = {36},
  number = {4},
  article = {97},
  month = {July},
  year = {2017},
}
```

*Joint first authors

© 2017 Copyright held by the owner/author(s): Disney / Pixar.

The definitive version of this work was published in ACM TOG and can be accessed through "External URL."

The source code provided on this website is for non-commercial, research purposes only.

This material is partially supported by the National Science Foundation under grants #13-21168 and #16-19376. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.