Introduction to Computer Visualization

SinGAN: Learning a Generative Model from a Single Natural Image

Marcin Hamerlik   
*Faculty of Electronics*  
*Wrocław University of Science and Technology*   
Wrocław, Poland  
[209854@student.pwr.edu.pl](mailto:209854@student.pwr.edu.pl)

Osman Velat Kabak  
*Faculty of Electronics*  
*Wrocław University of Science and Technology*   
Wrocław, Poland  
[248673@student.pwr.edu.pl](mailto:248673@student.pwr.edu.pl)

# Introduction

In the recent years the application of programming solutions and algorithms to images has been a growing trend. Thanks to new solutions it is possible to utilize the computing power of machines to learn and recognize images and apply them to a variety of tasks and business venues. However, most of those solutions come with limitations or costs that impede their usage – such as processing time and need of multiple datasets to properly learn the model required for processing a specific image, thus lengthening the time spent on a given task or creating a highly-specialized solution that may not be applicable anywhere else.

The SinGAN is a new proposed model that attempts to overcome these obstacles via a model generated from just a single image. An extension of the Generative Adversarial Nets (GANs) technology, it uses a pyramid of conventional GANs to analyze the single image and gain training data not just from objects of interest but also “noise”. Additionally, SinGAN offers not only data recognition but also dynamic image generation and manipulation using the same model.

This paper will attempt to analyze and test the functionality and applicability of SinGAN in order to determine its potential real-life applications both by studying it’s open-source code and documentation but also through practical testing of its capabilities on varied samples. The end result will also be compared with other options currently available to properly gauge how SinGAN fits in the business sector of image processing.

# Related Works

A number of articles and publications has been gathered to achieve the goals of this article and offer a better understanding of not only the technology behind SinGAN but also image processing in general and its current real-world applications.

**SinGAN: Learning a Generative Model from a Single Natural Image [1]** is the main article describing the idea behind SinGAN and its specifications. The article focuses both on the motivations and inspirations behind the model but also the mechanics behind it’s unique approach – complete with diagrams, mathematical background and data. Furthermore if offers its own exhaustive testing of various capabilities and comparison of their results as well as it’s mechanical advantages and disadvantages. For anyone interested in the SinGAN technology, this is the go-to source of easily-understandable information.

**Image Generation with GANs-based Techniques: A Survey [2]** offers an extended summary of the currently-available image generation techniques and how they work. This will be crucial in determining the image-generation functionality of SinGAN and can serve as a base for experiment techniques, result analysis, and applicability criteria. Notably, it does contain information on SinGAN and its category of image generation which can be used for this article.

**Generative Adversarial Nets [3]** has been selected as the main source of information on GANs and how they work. This will be crucial to understanding how SinGAN works and determining whether it’s application of technology furthers the technique itself. Additionally it is a good summary of the advantages and disadvantages of the technology itself which further lets us analyze how SinGAN performs.

**Improved Techniques for Single-Image GANs [4]** covers the methodology and implementation of Single-Image GANs. This publication offers the most recent (as of March 2020) summary of the single-image training technology and will be used as a basis for determining how well SinGAN performs in compared to other implementations of the technique. Additionally, it contains a massive base of testing samples and how different solutions perform which will make the testing phase of this work much faster.

**Program-Guided Image Manipulation [5]** concerns the area of dynamic, algorithm-based image manipulation, chosen to be the main source of information needed to accurately gauge the capabilities of SinGAN in this area. The publication contains code samples, diagrams and examples of various techniques used for program-guided image manipulation, including GAN-based models and the techniques used by the SinGAN model itself.

# Technology

# Experiment Design

# Results

# Conclusions

# References

Shaham, Tamar Rott et al. “*SinGAN: Learning a Generative Model From a Single Natural Image*.” 2019 IEEE/CVF International Conference on Computer Vision (ICCV) (2019): 4569-4579.

1. Esfahani, Shirin Nasr and Shahram Latifi. “*Image Generation with GANs-based Techniques: A Survey*.” International Journal of Computer Science and Information Technology 11 (2019): 33-50.
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