# WanderGAN

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**Abstract**

A search journey in the imagined visions of a neural network. Given a photo, an artificial intelligence painter tries to recreate its likeness, and takes us through a visual journey in its search for the perfect reproduction. The spectator can intervene in the process, and focus on areas of her interest in the intermediate imagery. The painter will then shift its efforts to recreate the chosen impression. The emerging experience may resemble wandering within a vision or a dream.

## Introduction

Modern generative neural networks can produce mesmerizing visual outputs ranging from psychedelic to photorealistic to artistically creative imagery. But how can these be used to tell a story and create an immersive experience? BigGAN (Brock, Donahue and Simonyan 2018), is a recent state-of-the-art generative adversarial network capable of generating diverse images of high-fidelity (Figure 1). Artist Mario Klingemann[1] has manually searched or found interesting non-realistic images generated by the algorithm, and created ad-hoc fiction (Figure 2).

BigGAN is a decoder – it generates images based on a latent list of numbers. It lacks a corresponding encoder – i.e. there is no structured way to find the numbers that would generate a desired image. Trying to find these numbers is known as the inverse rendering problem. In this work, we use evolutionary search methods[2] to solve this problem. By iterative trial-and-error we find the numbers that generate images more and more similar to our target image (Figure 3). The final results can vary from a perfect match (Figure 3A), a result of similar content and style (Figure 3B), and a result of similar semantics (Figure 3C). The search process constitutes our journey.

Two different metaphors could be used to describe the complexity of the problem. In the first metaphor, we are traversing a foreign world, in order to find a specific an artifact or viewpoint of unknown location, having just a photo of it. But, instead of being able to go north, south, east or west, we have 2000 different possible directions to go. In the second metaphor, we have a savant painter who is blind and deaf. We try to get him to paint a specific image, by only giving him cues of "hot or cold". In both cases a visual journey is created by the process of searching for the desired image.

In WanderGAN, we visualize this search process and allow experiencing it as a visual journey[3] (figure 4), as well as interactively intervening in the choice of goal. Sometimes in a dream we try to follow an elusive visual stimulus. Sometimes when daydreaming or recollecting a dream, we try to recall a mystical place of which we have a vague impression. WanderGAN tries to simulate such experiences, and the spectator may realize that the journey is actually more important than the goal. However, it is the search for the goal that creates the journey. This works condones the search that leads the marvelous journey to one's Ithaka.

WanderGAN can be experienced in two different modes: (1) An interactive installation – the work is exhibited on a large touchscreen that the spectator interacts with for wandering and creating her own story. The installation can be adapted to be site-specific, by using images from the location, as the images opening the journey. (2) A live video-art performance by the creator.

On the technical side, we face three main challenges: (1) finding an efficient global optimization method to solve the high-dimensional (1128 dimensions) non-linear search problem of inverse-rendering, which we addressed by combining evolutionary strategies, local search, and pre-trained image classification. (2) defining a relevant similarity metric to balance between visual similarity and perceptual similarity, that works well also when the images being compared are very dissimilar, such that misaligned images of similar semantic and stylistic contents are preferred over other dissimilar images (3) an efficient implementation allowing usage in the capacity of a live interactive art installation.

## References

Brock A.; Donahue, J.; and Simonyan, K. 2018. Large Scale GAN Training for High Fidelity Natural Image Synthesis. arXiv:1809.11096 [cs.LG]

[1] https://twitter.com/quasimondo/status/1064248673683554305

[2] See video: https://youtu.be/DgKhdOJmTpE

[3] See video: https://youtu.be/-oFv_j3gtIE

**Figure 1:** Photorealistic images generated with BigGAN from (Brock, Donahue and Simonyan 2018).

**Figure 2:** Non-realistic Images generated with BigGAN by Mario Klingemann.

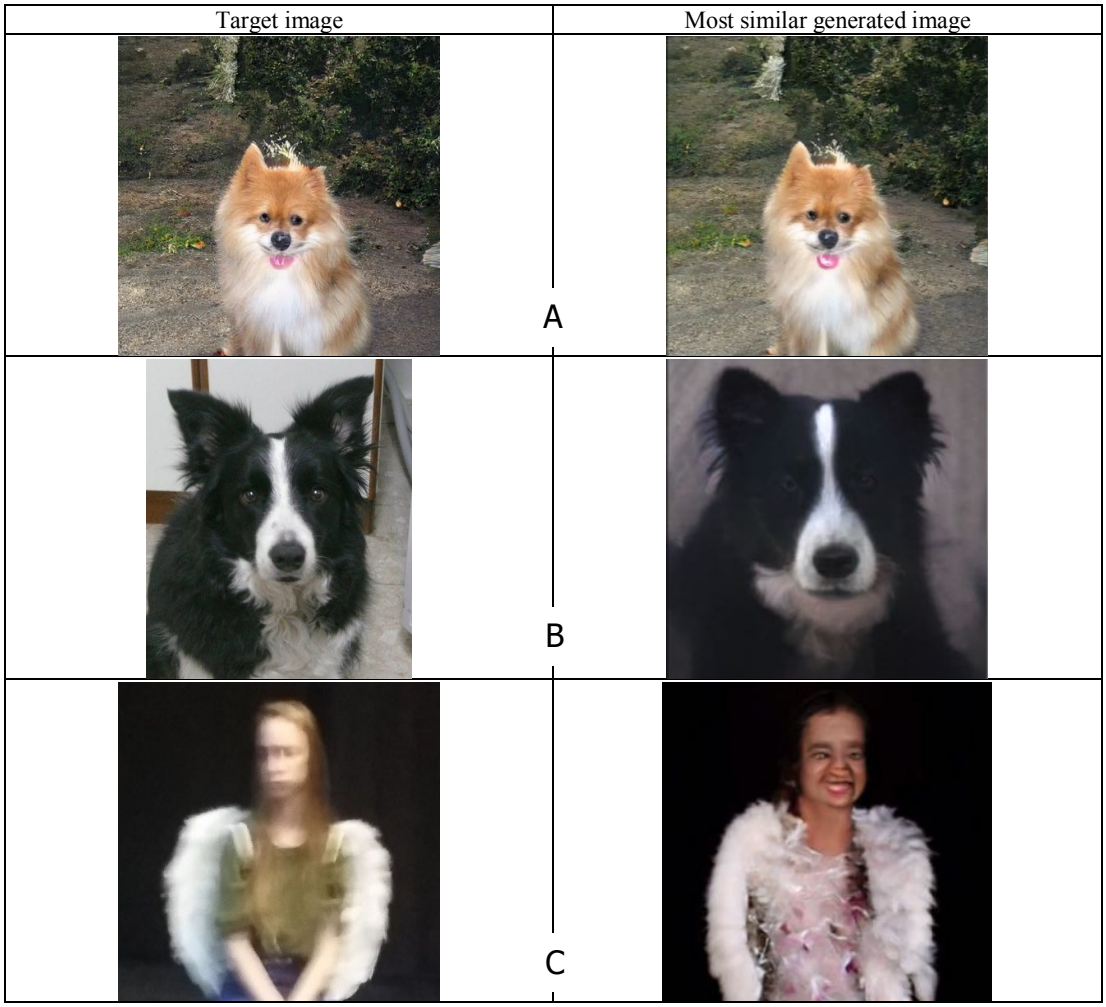


**Figure 3:** Examples of WanderGAN's evolutionary search results: A=perfect match B=content and style match C=semantic match.

**Figure 4:** Illustrative image from WanderGAN installation for Midarom Festival, Israel 2019.