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# StyleGAN encoder for image-to-image translation

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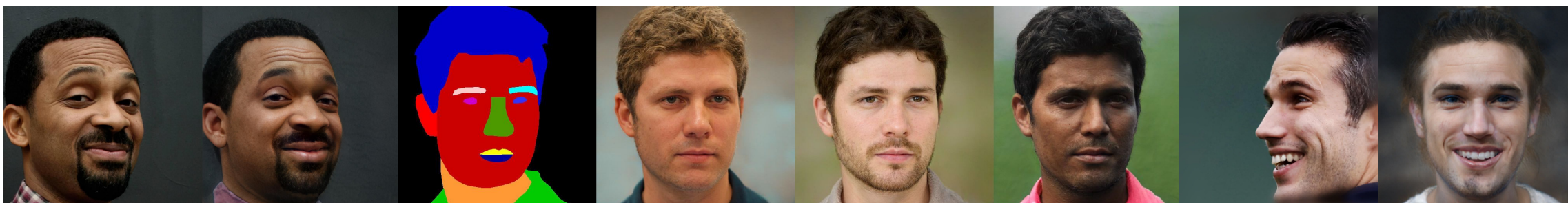
Vision and Perception  
project

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# Project Goal and Overview

- Given: **Variety of image-to-image translation tasks**



- Goal: **Generic framework - pixel2style2pixel (pSp)**
  - Novelty:** ENCODER that directly generates style vectors in  $\mathcal{W}^+$
  - New methodology for utilizing pre-trained StyleGAN generator.

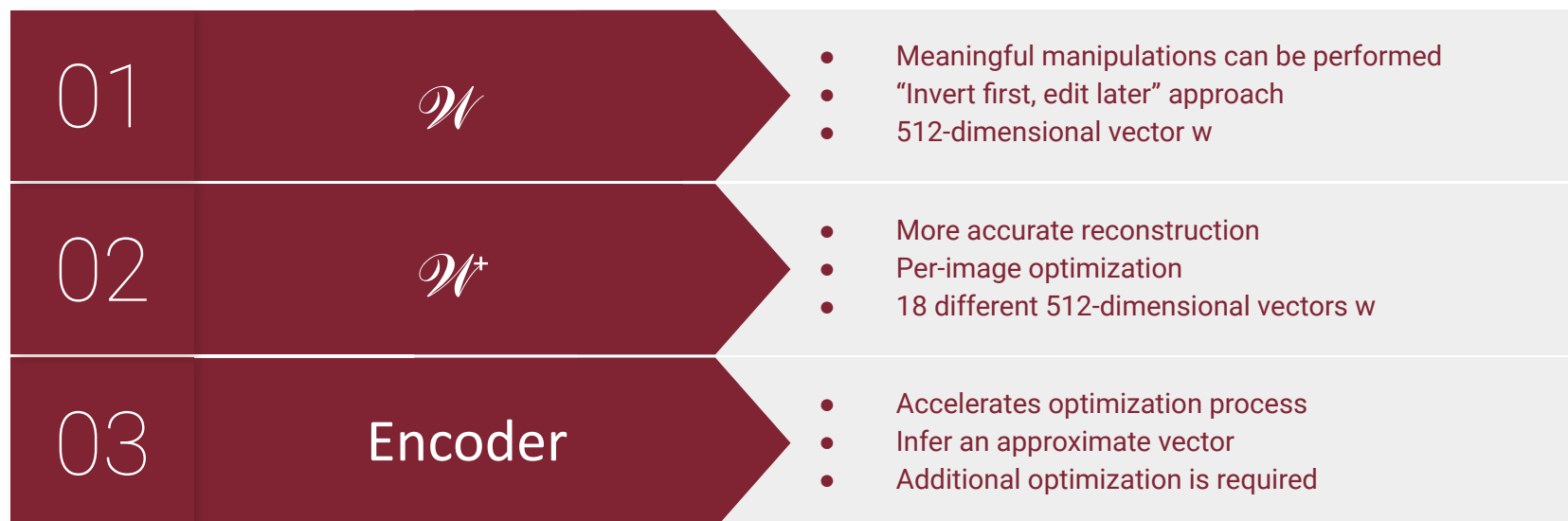
# Advantages over previous algorithms



- No additional optimization over latent space;
- Domain-independent;
- Supports multi-modal synthesis;
- Support for tasks without p2p correspondence;
- No adversary required.

# StyleGAN

- STYLE-based generator architecture (operates **globally** instead of locally);
- State-of-the-art visual quality on the high resolution images;
- Disentangled LATENT SPACE  $\mathcal{W}$ .



Trade-off: FAST vs ACCURATE inversion (?)

# New encoder

- Idea: **Feature Pyramid Network**

Style vectors are extracted from different pyramid scales and inserted in correspondence to their spatial scales.

- **Motivation:** Different style inputs correspond to different levels of detail, which are roughly divided into three groups — coarse, medium and fine.
- **Result:** Latent space manipulations without requiring time-consuming optimization.

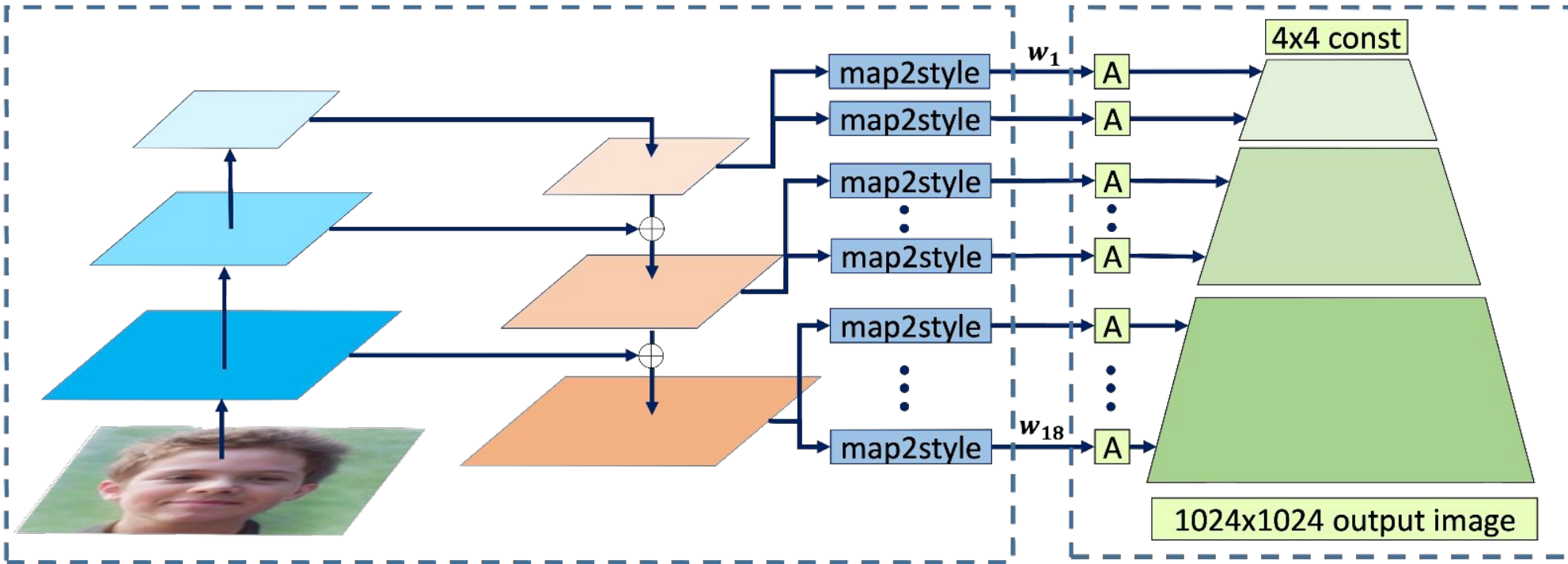
- Math part: 
$$pSp(x) = G(E(x) + \text{avg}(w))$$

Encoder aims to learn the latent code with respect to the average style vector of the pre-trained generator.

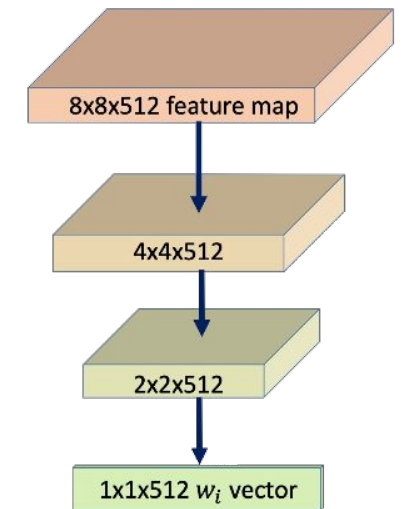
# Architecture

The pSp Encoder

StyleGAN Generator



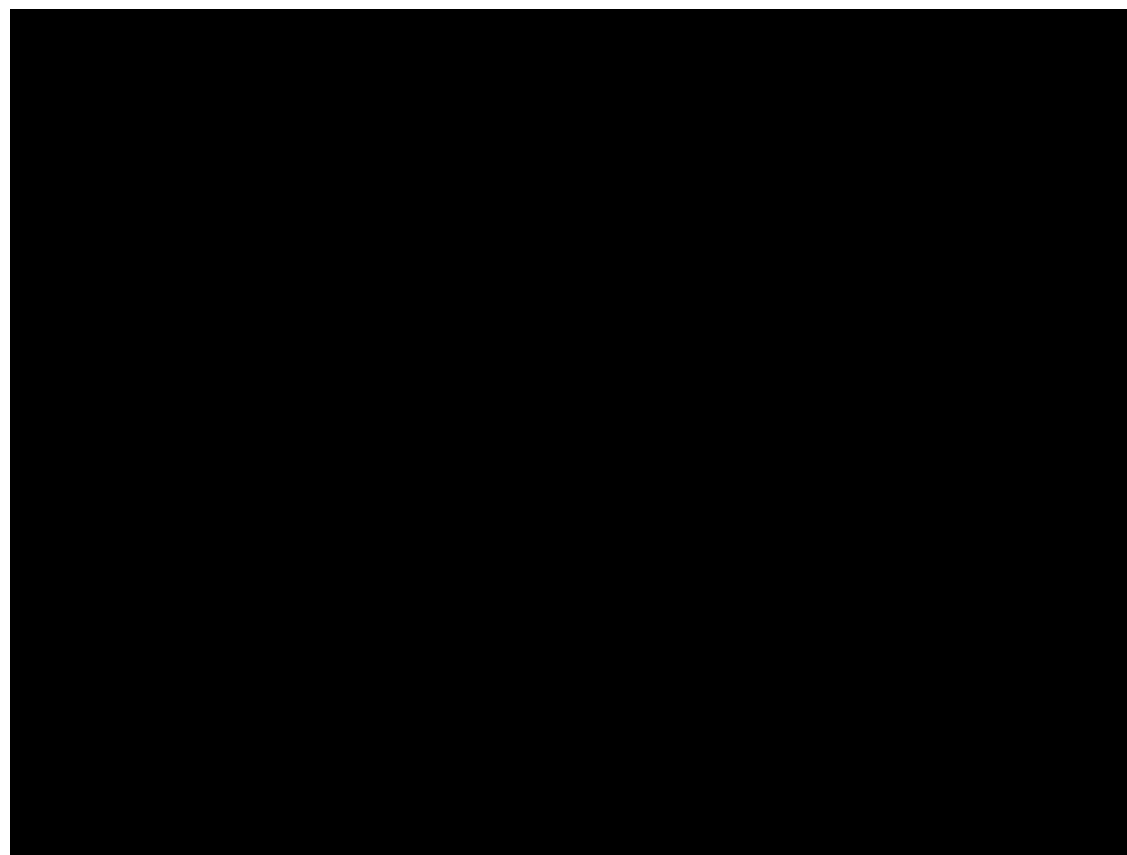
map2style



# GAN Inversion



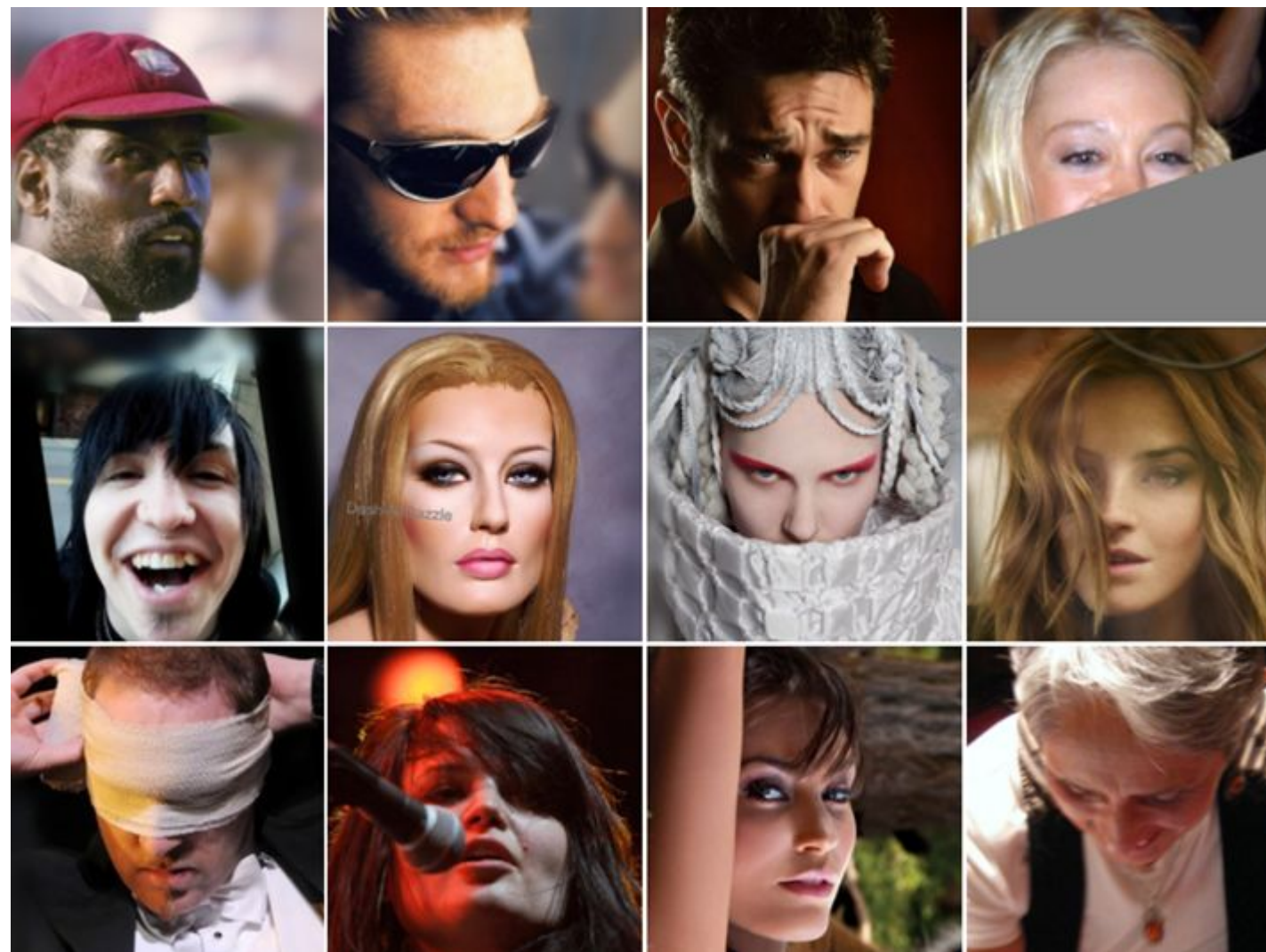
We use pSp to find the latent code of real images in the latent space of a pre-trained StyleGAN generator.





# CelebA Dataset

- 202 599 celebrity images, each with **40** attribute annotations.
- The images cover large pose variations and background clutter.
- 10 177 number of identities
- 5 landmark locations
- Resizing
- Rescaling





# Results

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# StyleGAN results

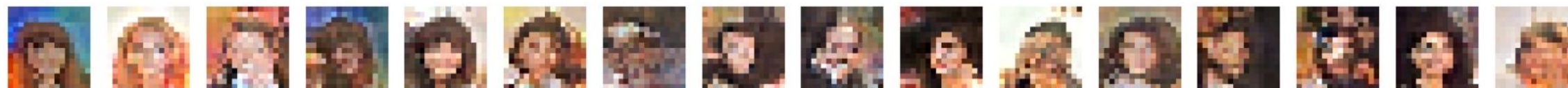
Model resolution: 4 x 4



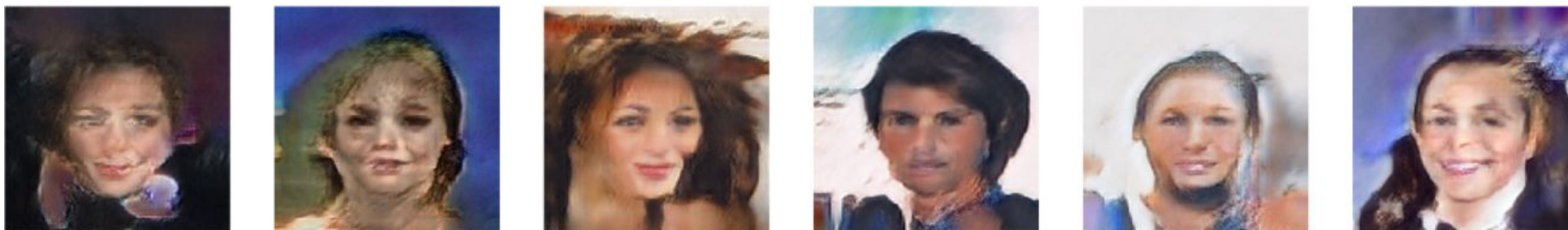
Model resolution: 8 x 8



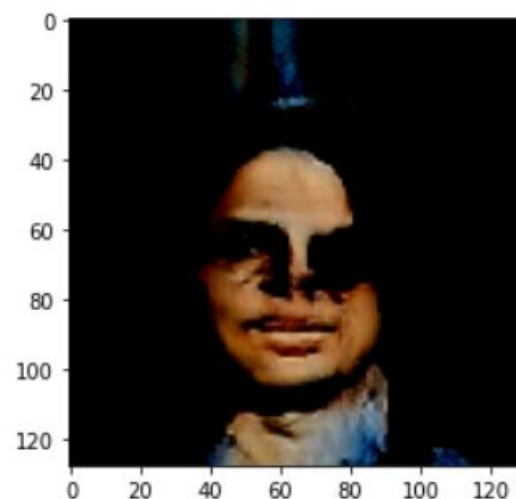
Model resolution: 16 x 16



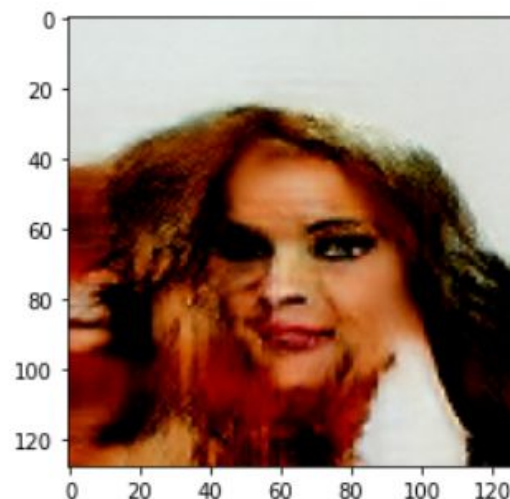
Model resolution: 128 x 128



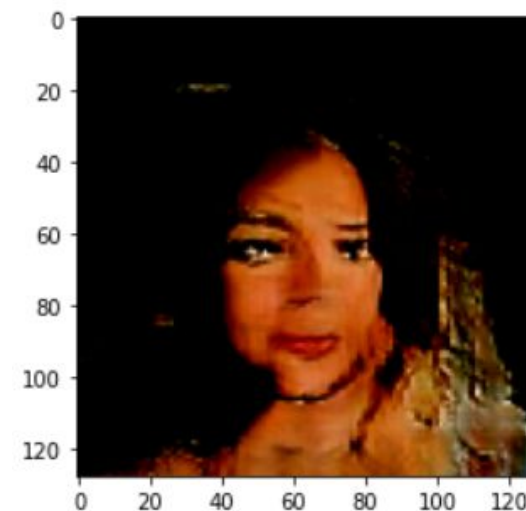
# pSp with Encoder



Epochs: 10

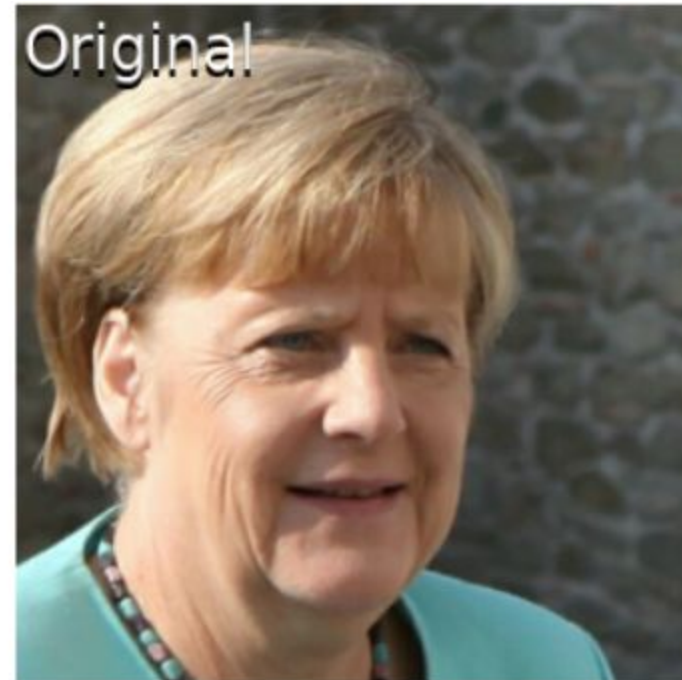
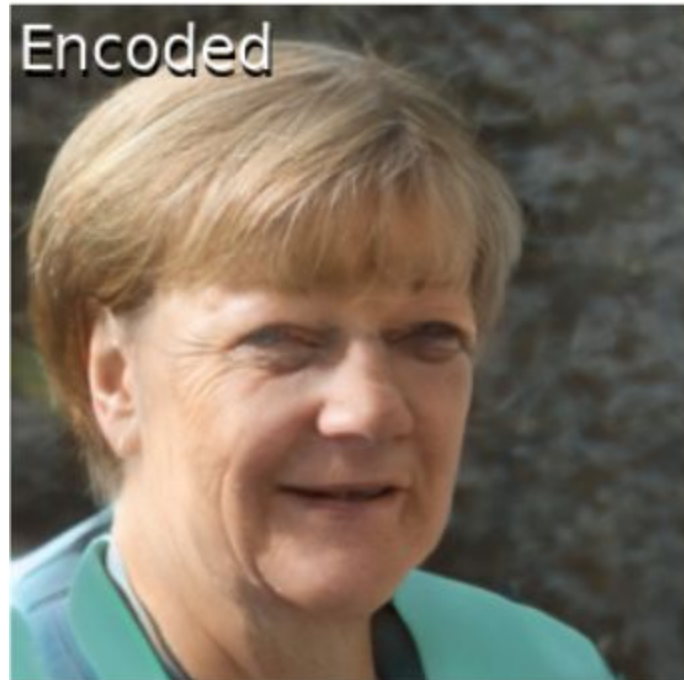


Epochs: 20



Epochs: 40

# Encoder



# Wrap-Up and Conclusions

- APPLICABILITY
  - PsP can be used to **directly encode translation tasks** into StyleGAN, thereby supporting input images that do not reside in the StyleGAN domain (**out-of-domain support**);
  - Capable of solving a **wide variety of image-to-image translation tasks** (e.g face frontalization, conditional image synthesis, ect), **requiring only minimal changes** (training losses and methodology);
  - Generates the **high-quality images**;
- EXTENSIONS
  - Going **beyond the facial domain**;
- LIMITATIONS
  - Method is limited to images that can be generated by **StyleGAN**;
  - Globality of approach introduces a challenge in **preserving finer details** of the input image e.g. earrings, background details);

