

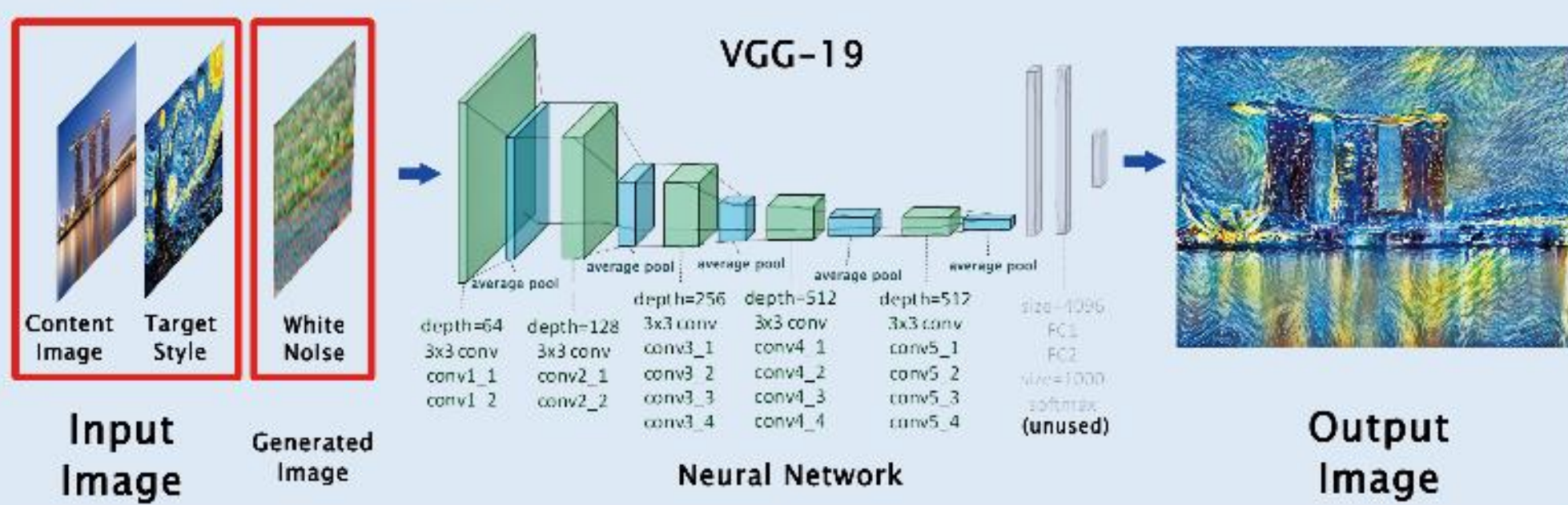


Abstract

This project aims to offer a playful image-processing tool to stylize pictures or even doodles into master paintings. Firstly, it realized style migration with the help of VGG19 neural networks. Secondly, using the stylized images from the first part, it allows people to create art pieces on their own, turning simple doodles into beautiful freehand brushwork. In a word, this project helps you to create your own imaginary Singapore during your stay here.

Part I. Style Migration

1.1 General Structure



- Realize style migration with the application of pre-trained VGG19 CNN
- Fully connected layers are not used in this model
- Original max pooling layers are changed into average pooling layers
- Generate a white-noise image for content & style training
- Loss function is elaborately designed to minimize the difference in style & content

1.2 Loss Function

$$L_{total}(\bar{p}, \bar{a}, \bar{x}) = \alpha L_{content}(\bar{p}, \bar{x}) + \beta L_{style}(\bar{a}, \bar{x})$$

$$L_{content}(\bar{p}, \bar{x}) = \frac{1}{2} \sum_l \sum_{ij} (F_{ij}^l - P_{ij}^l)^2$$

$$\frac{\partial L_{content}}{\partial F_{ij}^l} = \begin{cases} (F^l - P^l)_{ij} & \text{if } F_{ij}^l > 0 \\ 0 & \text{if } F_{ij}^l < 0 \end{cases}$$

$$L_{style}(\bar{a}, \bar{x}) = \sum_{l=0}^L \sum_{ij} w_l \frac{1}{4N_l^2 M_l^2} (G_{ij}^l - A_{ij}^l)^2$$

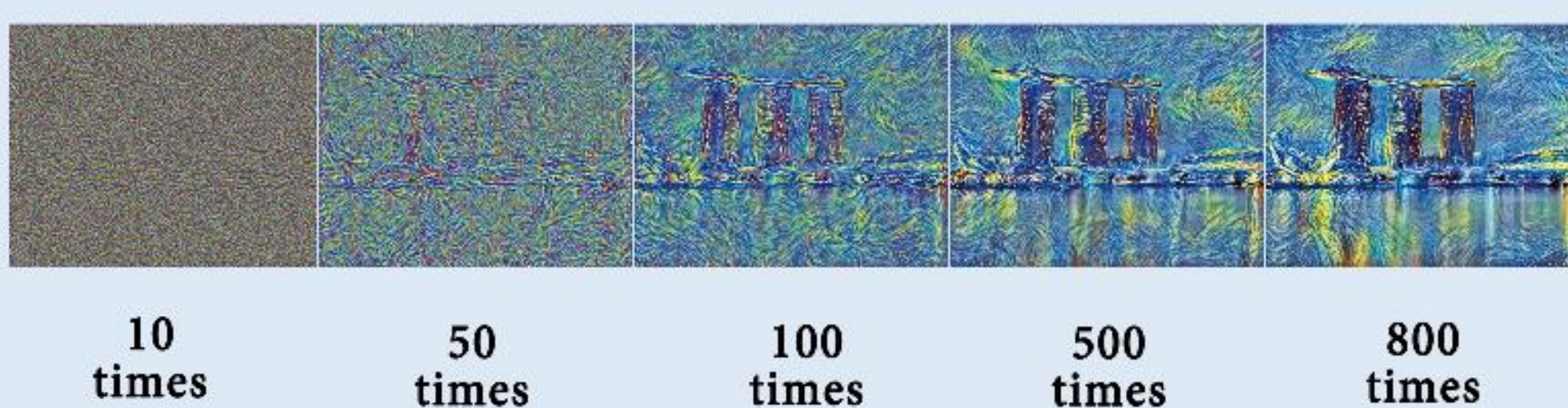
$$G_{ij}^l = \sum_k F_{ik}^l F_{jk}^l$$

$$\frac{\partial E_l}{\partial F_{ij}^l} = \begin{cases} \frac{1}{N_l^2 M_l^2} ((F^l)^T (G^l - A^l))_{ji} & \text{if } F_{ij}^l > 0 \\ 0 & \text{if } F_{ij}^l < 0 \end{cases}$$

First part of the loss function is the Euclid distance between the content of white-noise image and the provided picture.

Second part of the loss function is the difference of the Gram matrix between target style image and the provided picture.

1.3 Image Effect with Different Times of Iteration

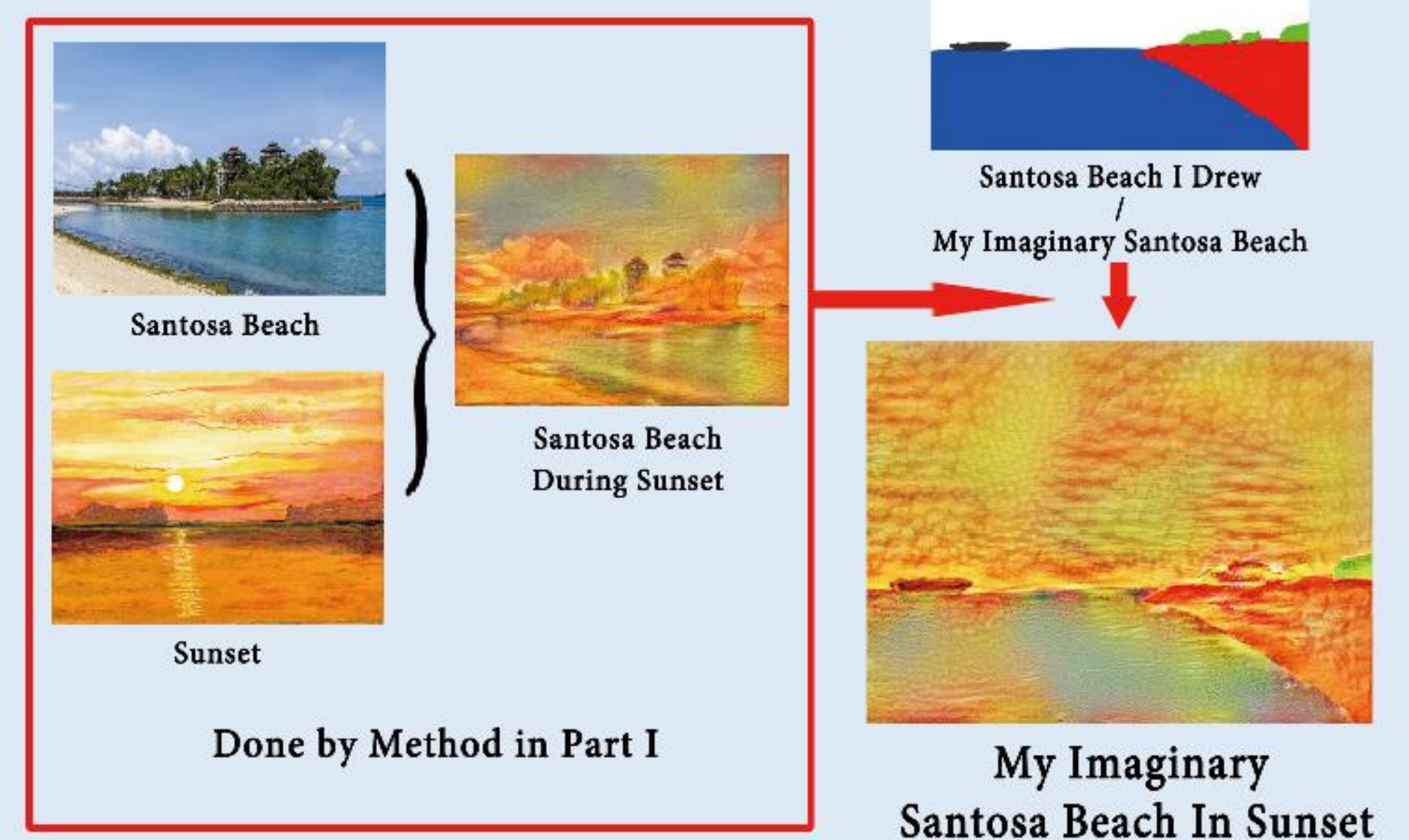


1.4 Other Style Demos



Part II. Doodle Singapore

2.1 Demo



2.2 Analysis

- Realize style construction from simple freehand doodles
- Adopt the same VGG19 neural network for style migration
- General structure of the loss function is the same as Part I

$$E = \alpha E_c + \beta E_s$$

- Loss function is composed of the distance between content and distance between style with simple adjustment towards the specific function form