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Czech Technical University in Prague

Faculty of Electrical Engineering

Department of Computer Graphics
and Interaction

Master's thesis

Production-Ready Pipeline for Example-Based Stylization of Animated Sequences

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9th January 2018

Acknowledgements

I would first like to express profound gratitude to my supervisor doc. Ing. Daniel Sýkora, Ph.D. for giving me the wonderful opportunity to work on a project combining science and art. I have always been very fond of both and being able to work on this thesis has been an amazing experience. I would also like to thank him for his exceptional guidance, especially for his patience, encouragement and for sharing his incredible network of the most interesting people from the industry with me, they provided me with very valuable feedback. One of them is Jakub Javora whom I would like to thank very much for his bright, creative mind and for painting some of the beautiful examples used in this work. Last but definitely not least I must express the biggest thanks to my family for their understating and cheerful support and my best friend Alena without whom I may have finished the work earlier but would not have experienced so many wonderful travelling adventures, thank you, it was definitely worth a couple of extra sleepless nights to finish this thesis.

Declaration

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Citation of this thesis

Sochorová, Šárka. *Production-Ready Pipeline for Example-Based Stylization of Animated Sequences.* Master's thesis. Czech Technical University in Prague, Faculty of Electrical Engineering, 2018.

Abstrakt

Ve své práci se zabývám vývojem zásuvného modulu pro aplikaci Adobe Photoshop, který využívá nástroj StyLit na stylizaci 3D renderů do uměleckého stylu podle jednoduché malby koule. Syntéza textur, kterou StyLit provádí, je vedena uživatelem pomocí řídících kanálů primárně generovaných během renderování jako oddělené světelné složky stylizované 3D scény. Implementací StyLitu do prostředí Photoshopu umožňuji umělcům a animátorům použití libovolného počtu těchto kanálů a pohodlnou tvorbu kanálů nových, což otevírá dveře nespočtu nových možností, jak StyLit využít. Součástí mé práce je soubor 25 ukázkových PSD souborů, kde demonstruji, že StyLit nemusí stylizovat pouze 3D scény podle stylu navrhnutého umělcem, ale dokáže stylizovat také fotografie podle existujících maleb, kolorizovat černobílé malby, stylizovat 3D podle přírodních textur, řídit vyplňování ploch texturou a mnoho dalších. K těmto novým postupům využití StyLitu, které jsem navrhla, je také natočeno několik mluvených video tutoriálů, kde podrobně vysvětluji a popisuji daný příklad a jak dosáhnout požadovaných výsledků. StyLit je primárně určen k tvorbě tradičně animovaných filmů stylizací 3D renderů, tento účel jsem neopomněla a plugin je rozšířen o funkcionalitu dávkové stylizace sekvencí snímků. Kromě toho jsem však ukázala, že StyLit nemusí být nástrojem pouze pro animátory, ale také pro digitální umělce zabývající se malbou, fotomanipulací, concept artem, ilustrací, ale také pro uživatele, kteří uměleckého ducha postrádají, a přesto pro ně práce ve Photoshopu může být díky StyLitu snazší a efektivnější.

Klíčová slova animace, stylizace, syntéza textur, adobe photoshop, plugin, stylit.

Abstract

In my thesis I develop an Adobe Photoshop extension module which uses StyLit, a tool for artistic 3D render stylisation based on a simple sphere painting. The texture synthesis that StyLit performs is controlled by the artist using guiding channels generated during the rendering as separated illumination effects of the target 3D scene. By introducing StyLit into the Photoshop environment I enabled artists and animators to use any number of such guiding channels or to create their own ones comfortably which brought numerous new possibilities for StyLit usage. As a part of my thesis I created a set of 25 example PSD files where I show that StyLit can not only stylise 3D renders according to a style designed by the artist but it can also stylise photographs with an existing panting, colourise greyscale paintings, stylise 3D renders using natural textures, guide a content-aware area filling and many more. Those new use-cases for using StyLit are complemented by a set of narrated video tutorials explaining in great detail a given example and how to achieve the best results. StyLit was originally designed to help create traditionally animated movies by stylising 3D renders. I have not left this purpose out and extended my plug-in by the functionality of a batch process stylising image sequences. I also showed that StyLit is a useful tool not only for animators but also for digital and concept artists, illustrators, matte painters and even for those users who lack the artistic abilities yet working in Photoshop can be thanks to StyLit easy and effective.

Keywords animation, stylisation, texture synthesis, adobe photoshop, plugin, stylit.

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Chapter 1

Introduction

1.1 Problem description

Animated movies are an integral part of the entertainment industry. From the legendary Walt Disney's Snowhite and the Seven Dwarfs to today's Minions, Finding Dory, Zootropolis and many more, animation has certainly come a long way. However without trying to undermine the quality of contemporary 3D films, one thing is desperately missing from all of those otherwise wonderful movies. a peculiar, traditional, artistic style. The quality of an authorship recognised in paintings or even live action movies. Traditional animation is a combination of the two yet the majority of released animated movies in theatres are computer made and tend to have a very similar synthetic appearance. Based on the visual style those movies are difficult to tell apart and that is unfortunate because if they were traditionally made there would be plenty of space for artistic creativity and author handwriting which the audience would, without doubt, find enjoyable. The problem is that traditional animation, where each frame is painted and can be taken for a piece of art, takes time. It cannot be cheated, the process is difficult to automate and the work is hard to divide and distribute if the author wants to preserve their own style.

Figure 1.1: The Old Man and the Sea, Alexander Petrov, 1958

A great example of such process is the work of Alexander Petrov. His famous oscar-winning short film *The Old Man and the Sea* (Fig. 1.1) is an oil painting animation on glass that lasts 22 minutes and consists of over 29 000 frames which took two years to finish. That is the reason we never saw traditionally painted feature films in the cinema until the recent release of *Loving Vincent*, the world's first fully painted feature film, proving that traditional animation has its place in cinema.

A way to create traditional animated movies fast would be to automate the process of transferring an art style onto synthetic-looking 3D renders. There have been many attempts of performing a style transfer and turning 3D renders or photographs into a painting. A thorough study of example-based texture synthesis techniques was done by WeI et al. [2009] [1]. Most of them are mainly guided by colours and normals which hardly delivers satisfying results. Such processes are not able to distinguish among context-depending illumination effects resulting in incorrect choice of texture patches for parts of the scene with similar colours (Fig. 1.2). Also the texture of the art style is often washed out turning a rich life-looking brushwork of the original style into homogeneous areas (Fig. 1.3).

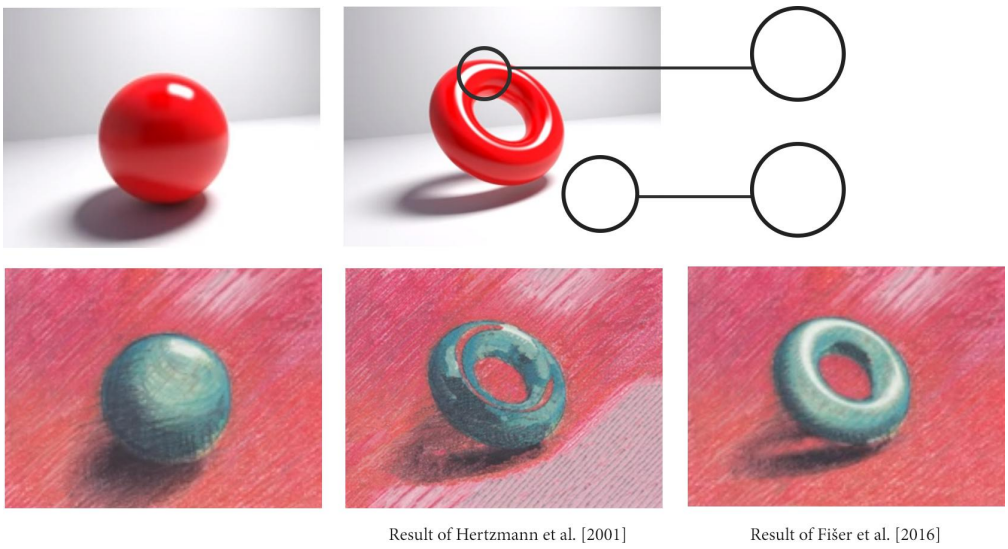


Figure 1.2: Comparison of the texture synthesis based on colours by Hertzmann et al. [2001] [2] and on light propagation in the scene by Fišer et al. [2016] [3]. Guiding the synthesis by colours and normals is not sufficient when two different features of the image such as specular light on the model and the background of the scene are of the same colour. Issued caused by an incorrect choice of the texture patch for those areas are solved by guiding the synthesis by illumination.

StyLit by Fišer et al. [2016] [3] solves both of those issues as its texture synthesis is led by light propagation and global illumination of the scene and they encourage adaptive uniform patch usage to stylise the image. That way the mistakes in shading caused by colour similarities never happen and since they use texture

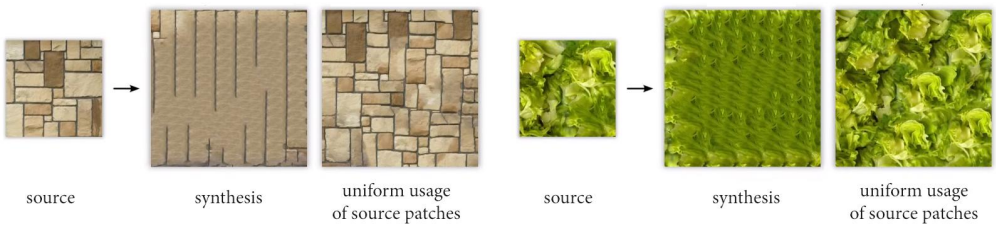


Figure 1.3: An example of the washed-out effect of the original style and loss of the texture richness. This issue can be solved by encouraging uniform patch usage. Image from Kaspar et al. [2015] [4]

patches directly from the exemplar art style the stylised image shows the same well-pronounced brush work. With StyLit artists can produce results looking like a traditional painting with little effort which gives hope that movies such as the above-mentioned *The Old Man and The Sea* could start appearing on the silver screen. That could be a revolution for the world of animation.

Figure 1.4: Results of stylising images with StyLit.

1.2 Goals

My goal is to create a Photoshop plugin that will allow artists to use StyLit in real production and make the stylisation easy and effective. I will design a workflow for the plugin usage and prepare a user manual containing sample PSD project examples and narrated video tutorials to simplify the learning process for potential users. By integrating StyLit into Photoshop artists will be able to use all its functionality most importantly layers, masks, adjustment layers and smart objects making the work non-destructive. I also want to automate the process for stylising

image sequences making StyLit easy to use for animators and have the plugin tested at Anifilm, an animation studio in Prague, on a short stylised film.

My other goal is to show that StyLit can be used for more than an artistic stylisation of 3D renders, a purpose for which it was originally designed. The biggest advantage is that StyLit's synthesis is guided therefore the artist has control over how their images are stylised. At the moment the Light Path Expressions [5] images produced during rendering of the 3D scene by calculating the light propagation are used as guiding channels for the texture synthesis. Those images contain separated global illumination effects such as specular or diffuse light. 3D modelling software, some of which are Autodesk Maya, Cinema 4D or 3ds Max can produce plenty of such channels through multipass rendering making it easy for the user to obtain them. In my plugin artists could not only use any number of those guiding channels but also create their own. By creating customised channels for the texture synthesis, StyLit could be also used for in particular photograph stylisation, 3D render stylisation using an existing style exemplar, natural texture synthesis or grey-scale painting colourisation. My goal is to explore the usage of such channels and discover new use cases for StyLit turning it into a tool not only for animators but also concept artists, photo-manipulators or illustrators.

1.3 Related Work

There is a great number of tools on the public market focusing on art stylisation of images. The most popular and successful ones are *Prisma* and *DeepArt*, both implementations of the work by Gatys et al. [2016] [6]. They use Deep Neural Networks trained on object recognition to analyse two input images: a painting and a natural photograph. The result of the stylisation is a picture resembling both of the input images aiming to preserve the content of the photograph and the style of the painting. This technique often fails to truthfully transfer the rich texture of an artistic piece as the parametric method used for the synthesis ignores to a certain extent the low-level structure of the style thus its characteristic features such as expressive brush work are lost in the process. Another limitation of the parametric method is that there is no intuitive way to guide the synthesis therefore the stylisation is always unpredictable. The resulting images then resemble more a filtered photograph rather than a realistic painting. This approach was later extended by Selim et al. [2016] [7] who focused on style transfer on portraits and by Ruder et al. [2016] [8] who presented image stylisation for videos. However these applications of Deep Neural Networks are performed on natural images only, never transferring an artistic style on a rendered image of a 3D model which leaves them unusable for 3D animation stylisation.

(a) Style exemplar (b) StyLit result (c) DeepArt result

(d) Style exemplar (e) FaceStyle result (f) Prisma result

Figure 1.5: An example of how using the light propagation in the scene for the synthesis guidance instead of colours and normals preserves the stylisation of individual illumination effects such as specular light or shadows. Encouraging adaptive uniformity for source patches usage preserves the low-level structure of the style making the result look like a realistic painting. Images from [3] and [9]

A successful technique to transfer an arbitrary artistic style faithfully and to stylise 3D renders was presented by Fišer et al. [2016] [3]. In the illumination-guided example-based synthesis framework *StyLit* they proposed a novel approach to solve the two main issues with the former-state-of-the-art techniques: the incapability of distinguishing among context-depending illumination effects and the loss of the richness of a hand-painted texture during the style transfer. Synthesis relying mainly on colours and normals was replaced by computing the light propagation in the scene and using the Light Path Expressions to guide the synthesis. This ensured that the specific style for individual illumination effects such as specular light or shadows was transferred correctly on corresponding parts of the stylised image. The problem with loss of the artistic style fidelity in the form of either artificial repetitions in the texture or homogeneous areas instead of individual brush strokes was solved by using the source patches uniformly and controlling

the overall error budget which helped to eliminate usage of potential artefacts-causing patches. Later this now-state-of-the-art technique was extended by Fišer et al. [2017] [9] into *FaceStyle*, a tool for portrait video stylisation. By delivering impressive results where both the subject's identity and richness of detailed hand-painted art style were preserved they surpassed the former state-of-the-art approach by Selim et al. [2016] [7].

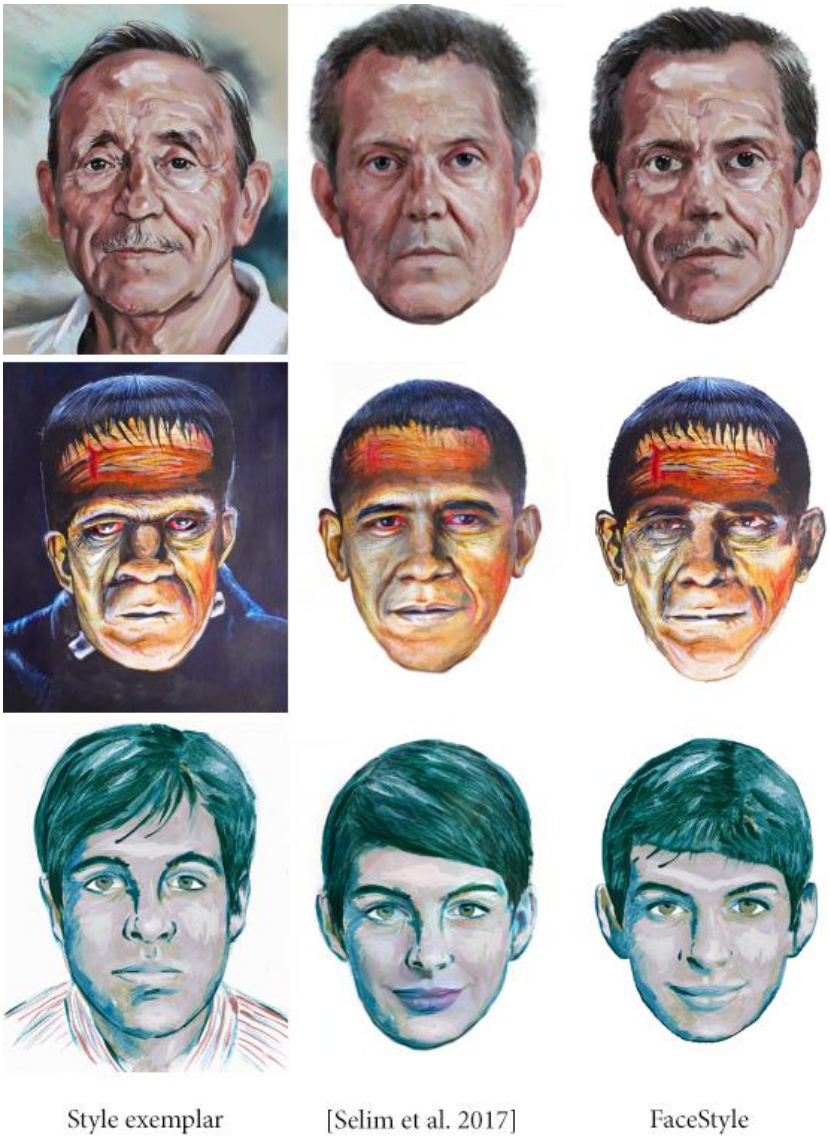


Figure 1.6: Comparison of neural-based parametric method of style transfer by Selim et al. [2016] [7] with the patch-based non-parametric method of FaceStyle [9]. Art styles by (top to bottom): © Graciela Bombalova-Bogra, © Scary Zara Mary via facebook, © Jen Garcia via Flickr. Image from [9]

Chapter 2

StyLit

The texture synthesis that StyLit performs is based on the concept of image analogies proposed by Herzmann et al. [2001] [2]. The input is three images:

- **A** - the exemplar scene
- **A'** - the artistic representation of the exemplar scene
- **B** - the target scene

The output **B'** is a stylised image **B** where the style from **A'** is transferred to **B'** according to the similarity between **A** and **B**.

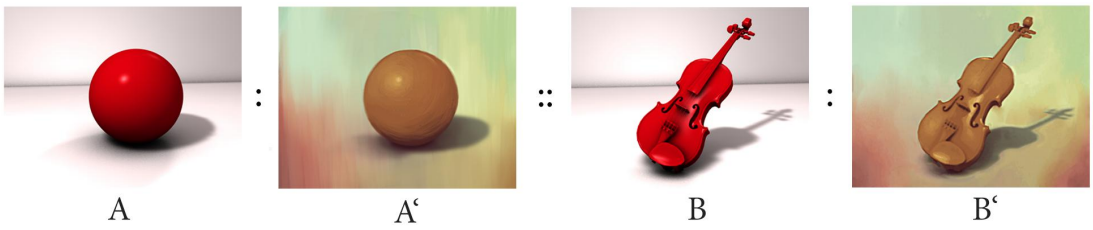


Figure 2.1: The concept of image analogies.

Unlike Herzmann et al. [2001] who use colours and normals to guide the synthesis, Fišer er al. [2016] use light propagation in the scene as a guidance for the texture synthesis which ensures the preservation of the style of the individual illumination effects. The advantage is that the source and target scenes are computer generated therefore the global illumination effects can be computed during rendering using the *Light Path Expressions (LPE)* technology. It stores various light effects such as specular or diffuse light in individual buffers and delivers the final render in separate channels. Generating such channels is available in most of the widely used 3D modelling software through multipass rendering and it is often used in visual effects where it is necessary to manipulate the light layers individually.

2.1 Work-flow

The goal is to turn a 3D render of a complicated scene into a realistic-looking painting using a style exemplar of a very simple 3D scene. According to the image analogies, there are three inputs:

1. **The target scene** - a render of a complicated, difficult-to-paint 3D scene to be stylised.

2. **The source scene** - a render of a simple 3D scene which contains all important illumination effects that might appear in the target scene. An ideal source scene is a sphere on a table. Not only it shows well shading and highlights but also shadows, colour bleeding, caustics or glossy reflections. On top of that a sphere is an essential model for form study therefore artists are more than familiar with painting it and creating the exemplar style should be very easy even for beginner artists.

3. **The style exemplar** - an artistic reproduction of the source scene using any media from charcoal and pencils to watercolour, acrylic or oil paints. The key step is to paint on a paper that is aligned with a printed copy of the rendered source scene. The painted sphere and all its components regarding shading and highlights need to match the source 3D sphere in order to correctly transfer the style including the lighting and shading context.

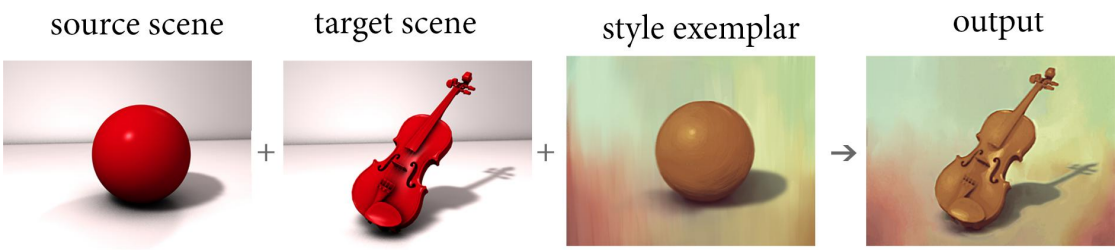


Figure 2.2: A simple scheme of the input and output images.

The target and source scenes need to be rendered as multi-channel images consisting of the LPE layers mentioned above. Along with the matching artistic style exemplar they form the complete input for the texture synthesis. The output is then the stylised target scene according to the artistic style (Fig. 2.3).

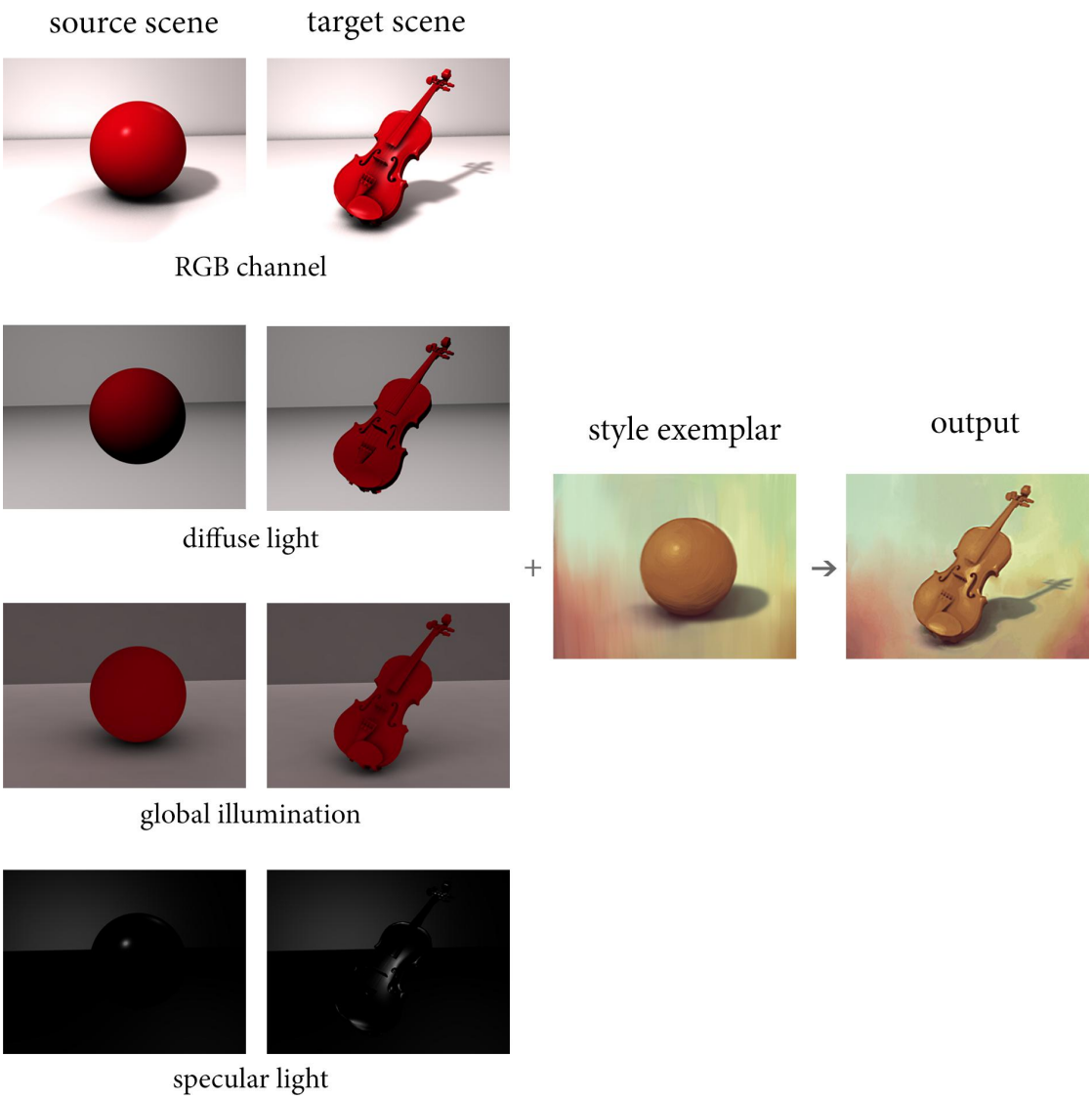


Figure 2.3: The scheme of StyLit work-flow. Input and output.

Chapter 3

Photoshop documentation

Adobe Photoshop plug-in module is a software program that extends the standard Photoshop program without changing the base application. Those modules can be updated independently by users to customise Photoshop functionality to their needs.

Despite the fact that Adobe Photoshop is possibly the most wide spread software for manipulating bitmap images, the official support for developers is surprisingly weak. There are a couple of documents to download for free directly from Adobe website but the most important documents regarding writing real plug-ins have not been updated for more than a decade. Today the extensions for Photoshop are most often written as scripts, also a good knowledge of Photoshop actions can cover a lot of automation processes. The most updated and useful information about programming for Photoshop is across platforms like Stack Overflow or Adobe Forum because the weaker the official documentation is the stronger the community gets and there are always experienced people willing to help.

3.1 Photoshop SDK

Adobe provides a Photoshop SDK package (Software development kit) [10] for free on their website consisting of six PDF documents none of which was released later than the year 2000 and sample codes in C++ for each type of the Photoshop plug-ins. All the types of plug-ins are listed and described in the first document to read: Photoshop API Guide.pdf. There are nine of them:

1. **Automation** modules provide access to all Photoshop scriptable events. They are further documented in Photoshop Actions Guide.pdf.

2. **Colour Picker** modules provide an interface for implementing different colour picker's in addition to Photoshop's colour pickers.

3. **Import** modules open an image in a new window. They can be used as an interface to scanners or frame grabbers, read images in unsupported or compressed file formats, or to generate synthetic images.

4. **Export** modules output an existing image. They can be used to print to Mac OS printers that do not have Chooser–level driver support, or to save images in unsupported or compressed file formats.

5. **Extension** modules allow implementation of session-start and session-end features, such initialising devices. They are called once at application execution, once at application quit time, and usually have no user interface.

6. **Filter** modules modify a selected area of an existing image. These modules are the plug-ins that the majority of Photoshop users are most familiar with.

7. **Format** modules, also called File Format and Image Format modules, provide support for reading and writing additional image formats.

8. **Parser** modules are similar to Import and Export modules, and provide support for manipulating data between Photoshop and other (usually vector) formats such as Adobe Illustrator.

9. **Selection** modules modify which pixels are chosen in an existing image and can return either path or pixel selections.

The type of plug-in most suited for my task would be the Automation module because the plug-in will more than anything serve to automate tasks that the artists would otherwise have to do by themselves. However getting through the documentation from the 90's was both tedious and frustrating as I came across a lot of problems with incompatibility. Since the Automation module provides access to all Photoshop scriptable events I decided to move straight to scripting itself as both the documentation and support from online forums seemed to be updated and well handled.

3.2 Photoshop Scripting

Photoshop scripting and HTML5 panels are widely popular these days and scripted extensions can help automate all processes within the Photoshop Object Model. Developers can chose from three possible scripting languages: Visual Basic Script for Windows OS, Apple Script for Mac OS or JavaScript which is multi-platform. The official documentation free for download directly from the Adobe website offers three very useful documents: Photoshop Scripting Guide [11], Photoshop JavaScript Reference [12] and JavaScript Tools Guide [13].

Photoshop Scripting Guide
is divided into two parts. In the first part the Photoshop Object Model and the basic overview of scripting are presented. The second part covers Photoshop-specific objects and components and provides code samples in all three languages, showing advanced techniques for scripting the Photoshop application.

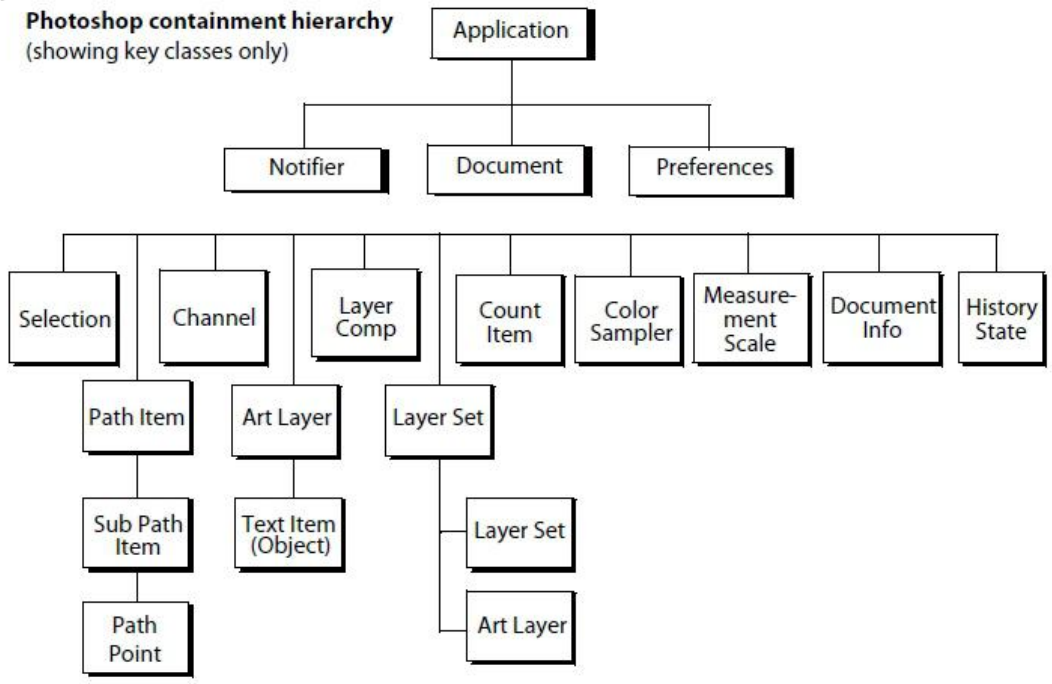


Figure 3.1: Photoshop Document Object Model - The hierarchical representation of the Photoshop application. Image from the Photoshop Scripting Guide.pdf

Photoshop JavaScript Reference
provides a detailed description of the Photoshop Object Model (Fig. 3.1). The Photoshop DOM consists of a hierarchical representation of the Photoshop application, the documents opened in it, and the components of the documents and allows users to access and manipulate them. For example, through the DOM a new document can be created, a new layer added to the existing document or the background colour of a layer can be changed. Most of the functionality available through the Photoshop user interface is available through the DOM. The Photoshop JavaScript Reference contains a list of all objects accessible through the DOM and their attributes as well as methods that can be used on them.

JavaScript Tools Guide
is a part of the Extend-Script Toolkit IDE installation. The document describes how to work with this development environment and with the modified version of JavaScript used for Photoshop scripting called Extend-Script.

3.2.1 Scripting tools

In addition to the documentation there are official tools available directly from Adobe that greatly facilitate plug-in programming or scripting.

Extend-Script Toolkit
This IDE is automatically installed with Photoshop up to the CS6 version. If the Photoshop application is running while using the Extend-Script Toolkit developers can immediately test and debug their scripts directly in Photoshop. This IDE simplifies orientation in the Photoshop object model and prompts functions or objects attributes.

Script Listener Plugin
Not all actions are accessible from the object model. However if the developer needs to automate an action that can be performed directly from the Photoshop user interface they can use the Script Listener Plugin. This plug-in, if running during the work in Photoshop, records all actions performed by the user and stores them in two log files. One written in JavaScript and the other in Visual Basic script. Those automatically generated scripts use objects from the Action Manager and the developer can modify them freely, however it is quite difficult to do so as the description of Action Manager object model is not very broad.

Adobe Configurator
Up to version Photoshop CS6 the user interface for scripted programs could be designed in Adobe Configurator. This application allows to map scripts on buttons and exports a folder with the designed panel. All the user needs to do in order to use it in Photoshop is to copy the folder with the panel into the Photoshop installation folder Plug-Ins and then open the panel in Photoshop through the tab Windows-Extensions.

Chapter 4

Implementation

4.1 StyLit plugin

Before I started designing the plug-in I got the StyLit library and a StyLit.cpp file handling the guiding channels loading available. After compiling and launching the StyLit.exe file the program loads four source channels containing LPE images of the rendered sphere on the table, four target channels containing the same LPE images as source channels but of the rendered scene to be stylised and one image of the artistic style exemplar. Those images had been prepared beforehand in the corresponding folders in the same directory as the StyLit.exe file. After performing the synthesis a stylised image of the target scene is created in the same directory.

With my plug-in the artists are able to create any number of guiding channels and run the synthesis directly from Photoshop without having to worry about manually exporting or importing images which facilitates the process significantly when considering the fact that usually several syntheses with different sets of guiding channels are performed before obtaining satisfying results. By operating all actions from Photoshop and following given hierarchy described in the next section the projects stay well-arranged, clear and comfortable to work with. I modified the StyLit.cpp file and parameterised the input loading, the rest are features of the plug-in itself.

The idea is that StyLit.exe runs minimised in the background and the user does not worry about it. When they finish creating the guiding channels in Photoshop and run the synthesis, the plug-in creates text files containing locations of the channel images in the same directory where the scripts and StyLit.exe are located. When StyLit detects the text files it reads the input files, performs the synthesis and creates the stylised image of the target scene which is detected by the plug-in and immediately loaded into Photoshop as a new art layer. The scripts, StyLit.exe and the text files with parameters are located in the Photoshop installation directory and the user does not worry about their actions. All they control and watch is their Photoshop project and everything is handled by the plug-in buttons.

4.2 User interface

The panel consists of six buttons (Fig. 4.1). The user controls the guiding channels management with *Create Channels*, *Add Channels* and *Clear Channels* buttons. They can create the artistic style on multiple layers using all features that Photoshop offers in particular adjustment layers, smart objects with filters or masks. The current style is saved with the *Create Style* button. Once the user has all guiding channels and the art style ready, they can create the stylised image by pressing the *Stylise* button. Within seconds the resulting image is loaded as a new layer and the user can continue to modify, change the style or the guiding channels or subsequently combine various results of the synthesis by for example masking selected parts of individual stylised renders together or by applying different blending modes. When the artist is satisfied with the results and the choice of the guiding channels and the style they can run a batch synthesis over an image sequence by pressing the *Run Video Batch* button.

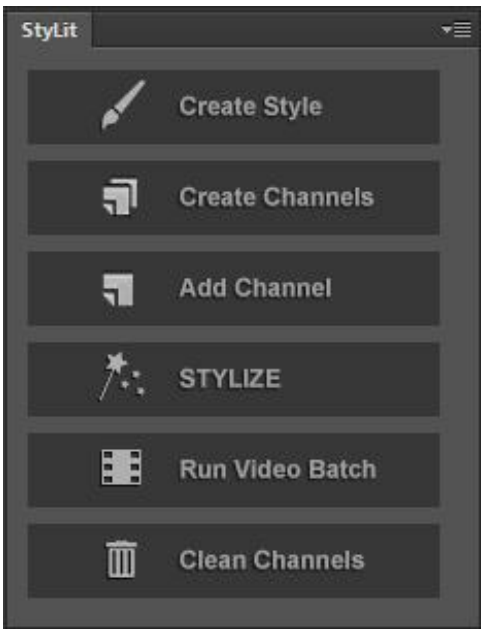


Figure 4.1: User interface of the StyLit plug-in

4.2.1 Create Style

This function literally photographs the current state of the Photoshop canvas, creates a folder *Style* right next to the PSD document and exports the content of the canvas as an image style.png. The reason for this functionality is simple. When creating a digital painting artists usually use an enormous amount of layers in order to be able to go back and modify individual parts of their piece. They use adjustment layers, masks, smart objects, groups etc. and they often hide layers they do not currently like, so when the final painting is finished, the hierarchy of its

layers could be quite large and complicated. StyLit, however, needs a single image of the artistic style for the synthesis so rather than making the artist struggle with merging selected layers of their artwork together or selecting which layers should be exported into one image I decided to make the *Create Style* button work like a camera that captures the current state of the canvas and exports its content into a PNG image. Also by storing the image in the corresponding folder right next to the PSD document the artist can easily check which style they are using when switching between styles or coming back to the project after a break.

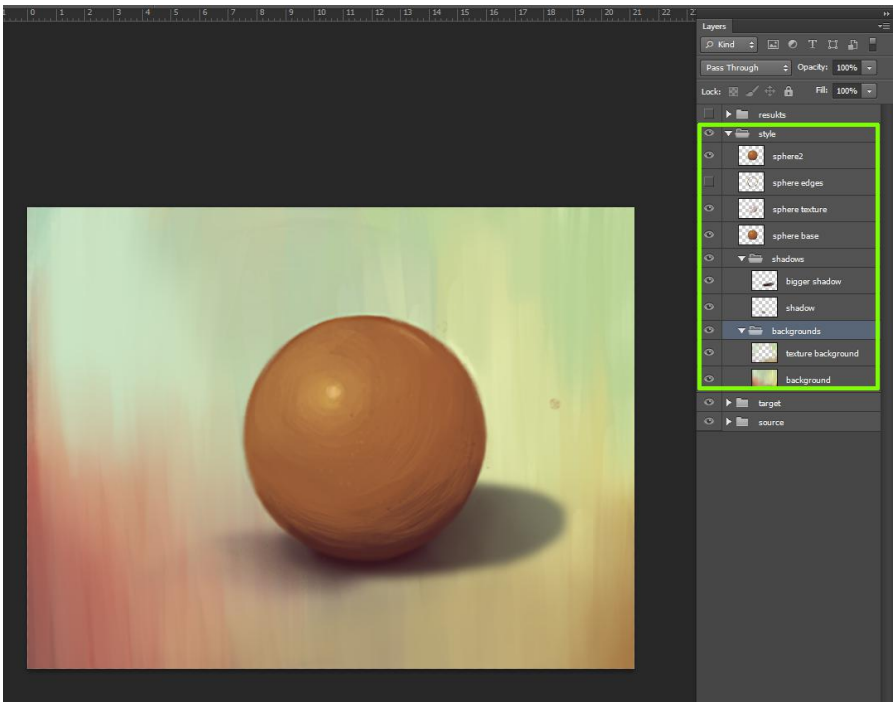


Figure 4.2: The layer hierarchy of a digital painting can be way larger than the one shown in this example.

4.2.2 Create Channels

Whether the artist uses guiding channels produced by the multipass rendering in a 3D modelling software or they create their owns, they always need to divide and store them in two groups (folders for Photoshop layers are called groups) within the Photoshop project hierarchy: *source* - images of the source scene, usually a sphere on the table, and *target* - images of the target scene. The channels in pairs need to have the same name. Organising layers into groups comes natural for most Photoshop users and when using the multipass rendering to obtain the guiding channels the pairs are named the same by default so the only aspect the artist needs to pay attention to is the name of the groups. If this hierarchy exists in their Photoshop project, they simply press the *Create Channels* button. If any of the required hierarchy does not work the way it should, the plug-in will display an

alert message with guidance on how to fix those issues. Therefore the artist does not need to worry about destroying their project. The *Create Channels* function gradually runs through both groups and exports each layer as a PNG image into a folder of the same name as the group they belong to, in the directory where the PSD document lies. The exported channels do not need to be used for the synthesis, that is decided by the user when running the stylisation but it is useful and effective to create those images in advance and have them available at any time.

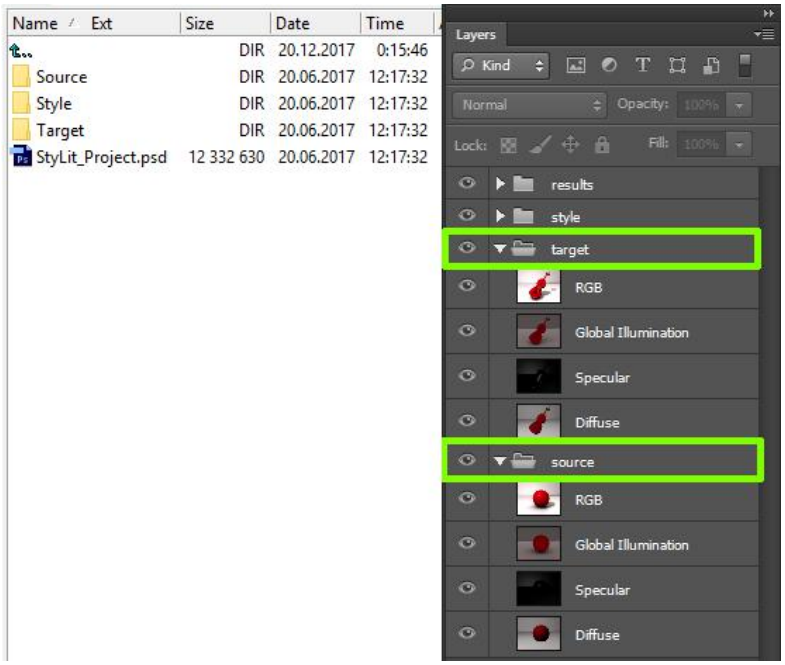


Figure 4.3: The Photoshop layer hierarchy on the right and the corresponding file hierarchy on the left.

4.2.3 Add Channel

If the artist additionally creates a new pair of guiding channels, they can export them individually using the *Add Channel* function. Again, they must sort the images into the *source* and *target* groups in Photoshop. Then they select the two new layers and press the button. The selected layers are exported into appropriate folders as PNG images and are available for the synthesis along with the rest of the previously created channels. This method of storing channels as images is useful for when the user closes the project and returns to it later, they do not need to create the channels again, the images remain in the folders next to the PSD document.

4.2.4 Clear Channels

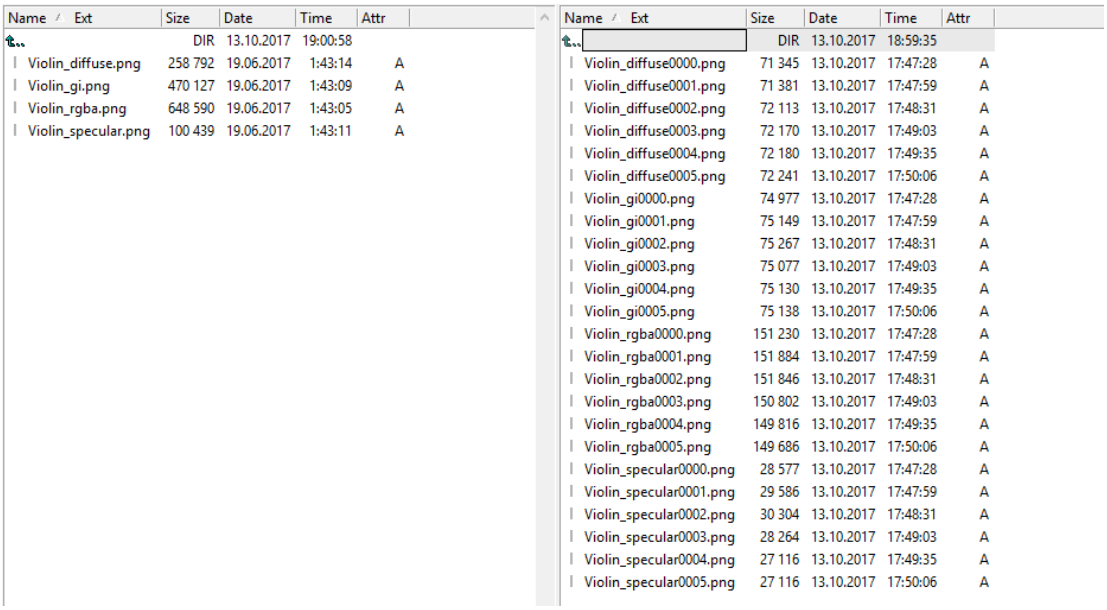
When the artist decides to create a completely new set of channels or to change the existing ones, they can, of course, manually delete the content of the *source* and *target* folders in the file system but if they want to do it by one click, they can use the *Clear Channels* button which clears those two folders automatically from Photoshop. It only deletes the PNG images, the layers in the Photoshop hierarchy will remain unchanged which is important because the new set of channels could be created by modifying the old ones and it would be unfortunate if they disappeared.

4.2.5 Stylise

After the artist exports their guiding channels and the artistic style it is time to choose which of the channels are to be used for the synthesis. This is handled by the visibility feature, a little icon in the form of an eye next to each layer. The artist simply hides those layers that they do not want to be used for the current synthesis. That way they can experiment with different channel combinations without having to export them each time they create a stylised image. The stylisation takes a few seconds, resulting in a new image of the stylised target scene being loaded into the current Photoshop document.

4.2.6 Run Video Batch

This button when pressed stylises an animation. The source channels and the artistic style stay the same as with the single image stylisation, it is the target channels that are animated and come in a set of frames. It is important to test the stylisation on a single frame beforehand and choose which guiding channels should be used for the synthesis. Then it is all about the file system hierarchy not the Photoshop project. The *Source* folder contains PNG images of guiding channels of a single frame of the sphere on the table scene. The *Target* folder contains PNG images of guiding channels of multiple frames of the target scene. When stylising for example five frames, the stylisation is performed five times, one after another, each time using the same source guiding channels but different frame of the target guiding channels. So the naming or more precisely the order of the images is important for the plug-in to pair them up correctly. When rendering the scenes using a 3D software the artist does not need to care about anything, the images are named and numbered by default and the order of the channels is preserved (4.4). All the artist needs to do is to render in multipass the source scene into the *Source* folder and then render an animation of the target scene into the *Target* folder. When the *Run Video Batch* button is pressed, the synthesis is performed and a sequence of stylised images is loaded into the Photoshop project. The aim was to make this process as easy for the artist as possible without requiring any additional marking of the layers or naming of the channels. The detailed description of how to stylise an animation is in the video tutorial 02_3D_animation_stylisation.mp4 attached to this document.



Name	Ext	Size	Date	Time	Attr
..		DIR	13.10.2017	19:00:58	
Violin_diffuse.png		258 792	19.06.2017	1:43:14	A
Violin_gi.png		470 127	19.06.2017	1:43:09	A
Violin_rgba.png		648 590	19.06.2017	1:43:05	A
Violin_specular.png		100 439	19.06.2017	1:43:11	A

Name	Ext	Size	Date	Time	Attr
..		DIR	13.10.2017	18:59:35	
Violin_diffuse0000.png		71 345	13.10.2017	17:47:28	A
Violin_diffuse0001.png		71 381	13.10.2017	17:47:59	A
Violin_diffuse0002.png		72 113	13.10.2017	17:48:31	A
Violin_diffuse0003.png		72 170	13.10.2017	17:49:03	A
Violin_diffuse0004.png		72 180	13.10.2017	17:49:35	A
Violin_diffuse0005.png		72 241	13.10.2017	17:50:06	A
Violin_gi0000.png		74 977	13.10.2017	17:47:28	A
Violin_gi0001.png		75 149	13.10.2017	17:47:59	A
Violin_gi0002.png		75 267	13.10.2017	17:48:31	A
Violin_gi0003.png		75 077	13.10.2017	17:49:03	A
Violin_gi0004.png		75 130	13.10.2017	17:49:35	A
Violin_gi0005.png		75 138	13.10.2017	17:50:06	A
Violin_rgba0000.png		151 230	13.10.2017	17:47:28	A
Violin_rgba0001.png		151 884	13.10.2017	17:47:59	A
Violin_rgba0002.png		151 846	13.10.2017	17:48:31	A
Violin_rgba0003.png		150 802	13.10.2017	17:49:03	A
Violin_rgba0004.png		149 816	13.10.2017	17:49:35	A
Violin_rgba0005.png		149 686	13.10.2017	17:50:06	A
Violin_specular0000.png		28 577	13.10.2017	17:47:28	A
Violin_specular0001.png		29 586	13.10.2017	17:47:59	A
Violin_specular0002.png		30 304	13.10.2017	17:48:31	A
Violin_specular0003.png		28 264	13.10.2017	17:49:03	A
Violin_specular0004.png		27 116	13.10.2017	17:49:35	A
Violin_specular0005.png		27 116	13.10.2017	17:50:06	A

Figure 4.4: When stylising an animation the order of the guiding channels is important. Left column is the Source folder, right column is the Target folder where each of the guiding channels consists of six frames. The order of the target guiding channels is the same as of the source guiding channels.

4.3 User manual

In this section I provide a detailed description of how to install and work with my plug-in. The folder StyLit containing all required files and scripts is attached to this document.

4.3.1 Installing the Panel

Copy the folder `StyLit` to
`C:\ProgramFiles\Adobe\AdobePhotoshopCS6(64Bit)\Plug-ins\Panels`
If the folder `Panels` inside the folder `Plug-ins` does not exist, create it.

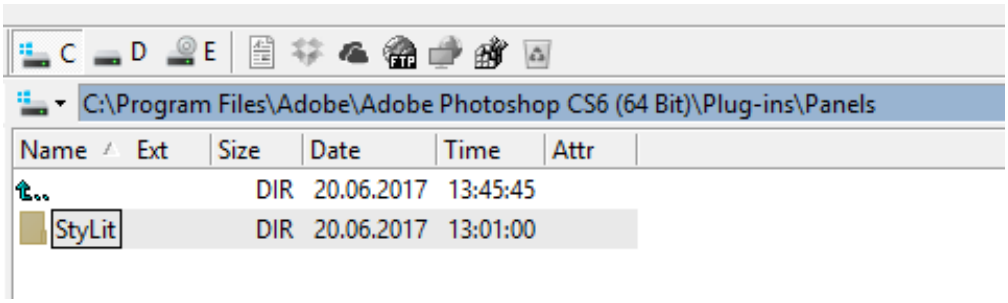


Figure 4.5: Location of the panel.

Launch Photoshop CS6, go to `Window - Extensions` and select the StyLit panel.

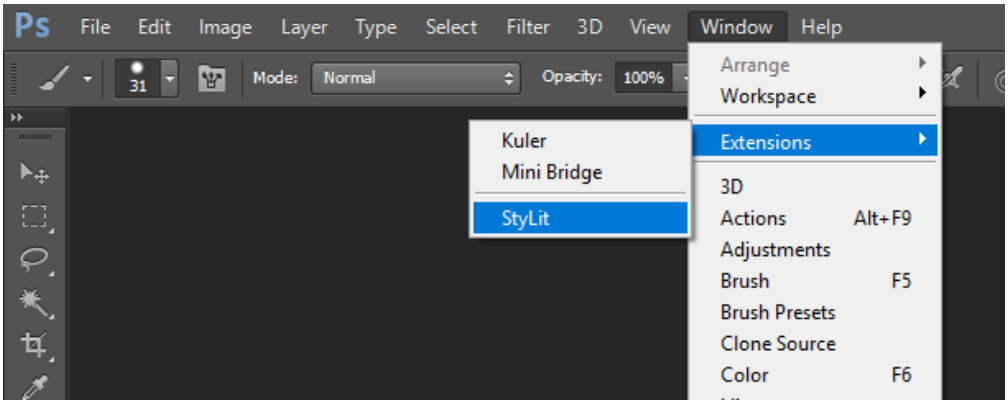


Figure 4.6: Location of the plug-in in Photoshop

Before stylising your renders in Photoshop, launch stylit.exe first. The location is: `C:\...\Panels\StyLit\content\StyLit.assets\res\stylit.exe`
There will be a black window, minimise it and move back to Photoshop to begin the stylisation.

4.3.2 Example of a 3D render stylisation

Attached to this document there is a folder *Examples*. If you open the Basic3D.psd file in Photoshop you can see that the layer hierarchy is already set. There are four groups: source, target, style and results. In the source group there are guiding channels of the sphere on the table render. In the target group there are guiding channels of the 3D render you want to stylise, in this case a violin. In the style group there are layers with a digital painting of the sphere representing our artistic style. The stylised images are stored in the results folder.

In order to create the stylised image of the violin follow these simple steps:

1. Click the *Create Channels* button. This will export each layer of the *source* and *target* groups as a PNG image into corresponding folders next to the Basic3D.psd file. If you want to add a separate pair of the guiding channels later you can select the two layers from the *source* and *target* group and press the button *Add Channel*

2. Prepare your style by painting on a new empty layer placed over the sphere render. Use any number of layers, masks, adjustment layers etc. Make sure that the painted sphere and its shading is carefully aligned with the 3D sphere. You can always go back and modify the style if you are not satisfied with the stylised result. Many issues can be fixed by aligning the painting more accurately with the source render. When you are finished, press the button *Create Style* which exports the current visible canvas as a PNG image into the folder *style*. That way you do not need to worry about merging the visible layers of your painting into one layer or selecting the layers to be

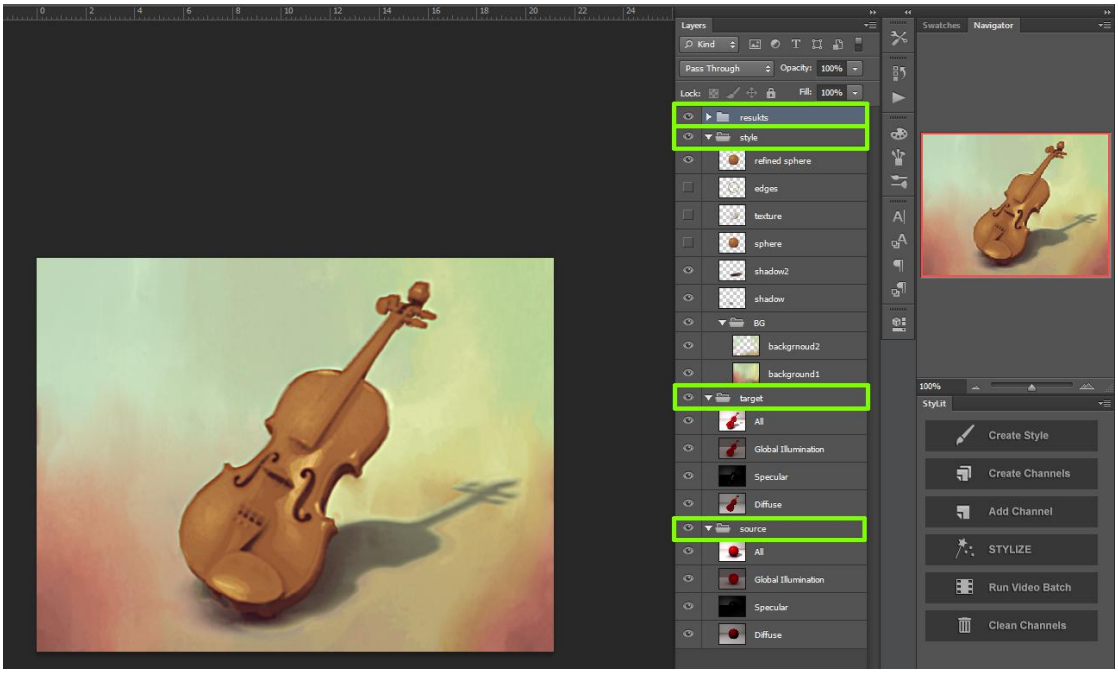


Figure 4.7: Layer hierarchy of the 3D_Basic.psd file.

exported as the artistic style. Simply arrange your painting on the canvas and press *Create Style*.

3. Before running the synthesis make sure to choose which guiding channels you want to use for this particular run. You do that by hiding the layers in the *source* group that you do not want to use. The corresponding paired layers from the *target* group will be eliminated as well. To run the synthesis simply select the results folder to make sure the stylised image will appear there and press the *Stylise* button. Then wait a few seconds for the result and repeat the process with modified setting of guiding channels if necessary.

4.3.3 Example of a 3D animation stylisation

Open the file Animation.psd from the *Examples* folder attached to this document. Before stylising an animation it is strongly advised to test the artistic style and the guiding channels on a single frame. The layer hierarchy in the example project is the same as when stylising a single 3D render however for running the video batch function it is useless. All that matters after you have polished and exported the artistic style and chosen which guiding channels deliver the best results is the content of the *source* and *target* folders next to the Animation.psd file. The images in those two folders in the example project were rendered using Maxon Cinema 4D (Fig. 4.9). When setting the multipass render for rendering the source and target scenes, select only those channels that you decided to use for the synthesis during the testing and render them as PNG images not a PSD file. The source scene is not animated so each of those channels is rendered in one frame however the target

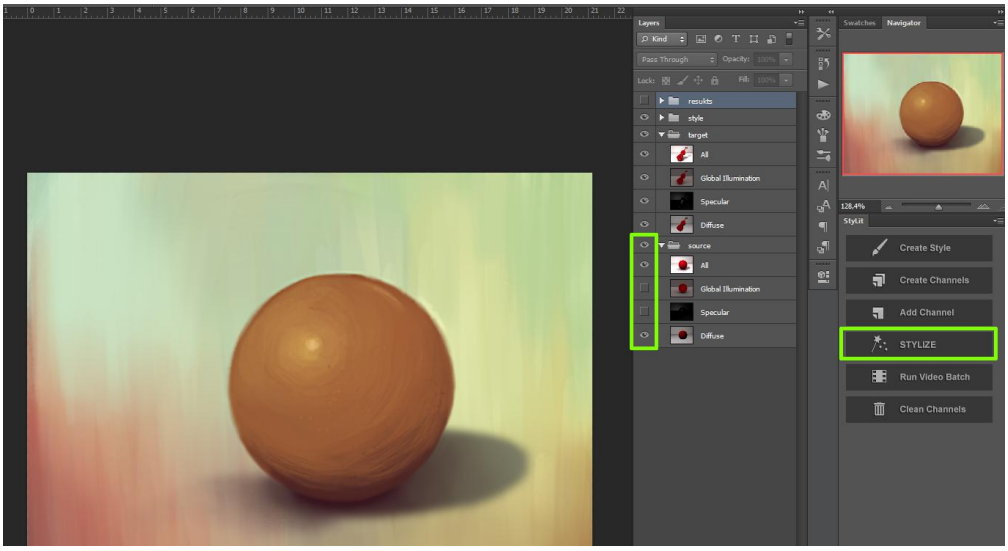


Figure 4.8: You can choose which channels should be used for the current stylisation run by simply modifying the visibility of the channels in the source group.

scene consists of six frames so each of the target channels has six numbered images. The order of the source channels goes as follows: diffuse, global illumination, rgba image and specular. This order no matter how many frames there are in the target scene needs to be preserved in the target guiding channels as well. It ensures that the channels will be paired up correctly during the synthesis without any additional help. Rendering the guiding channels in a 3D modelling software names the images according to the required pattern, so to stylise the animation after preparing the file system hierarchy simply press the button *Run Video Batch* and wait for the six stylised images to appear in the *results* group in the Photoshop project.

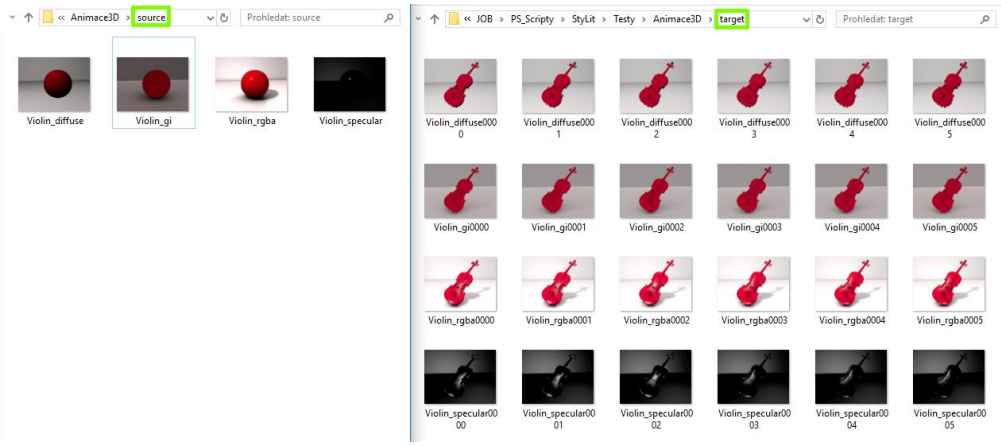


Figure 4.9: Content of the source and target folders next to the Animation.psd file. Always preserve the order of guiding channels in both folders when stylising an image sequence.

Chapter 5

Results

In this chapter I will present the results of implementing the Photoshop plug-in that uses StyLit [3] to stylise 3D renders according to an artistic exemplar. Working with StyLit in the Photoshop environment made the whole stylising process efficient and comfortable, I could easily change the selection of guiding channels for each run of the synthesis and compare different results very quickly thanks to the user interface of the plugin. Having the possibility to create my own channels or modify the classic ones from the multipass render gave me freedom to experiment and come up with numerous new use-cases that could simplify or even open new opportunities for creative work to all kinds of digital artists.

The following examples of StyLit use-cases are complemented with detailed video tutorials as well as PSD files attached to this document.

5.1 3D render stylisation using a sphere painting

The first example is the classic 3D render stylisation using a sphere painting.The possibility to add any number and kind of guiding channels helped to control the synthesis and deliver the best results possible.

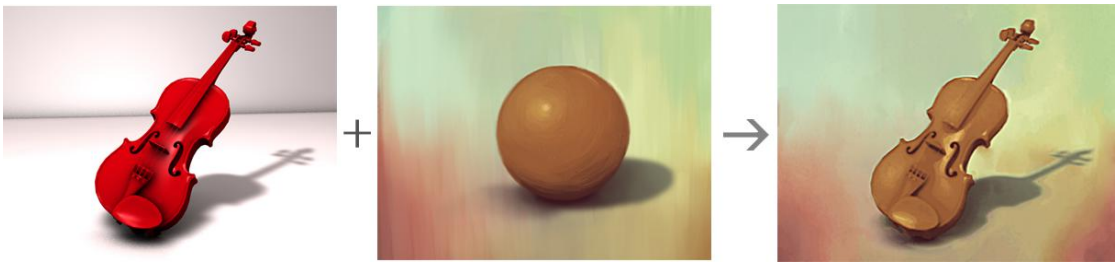


Figure 5.1: Violin stylisation in Photoshop using the StyLit plugin.

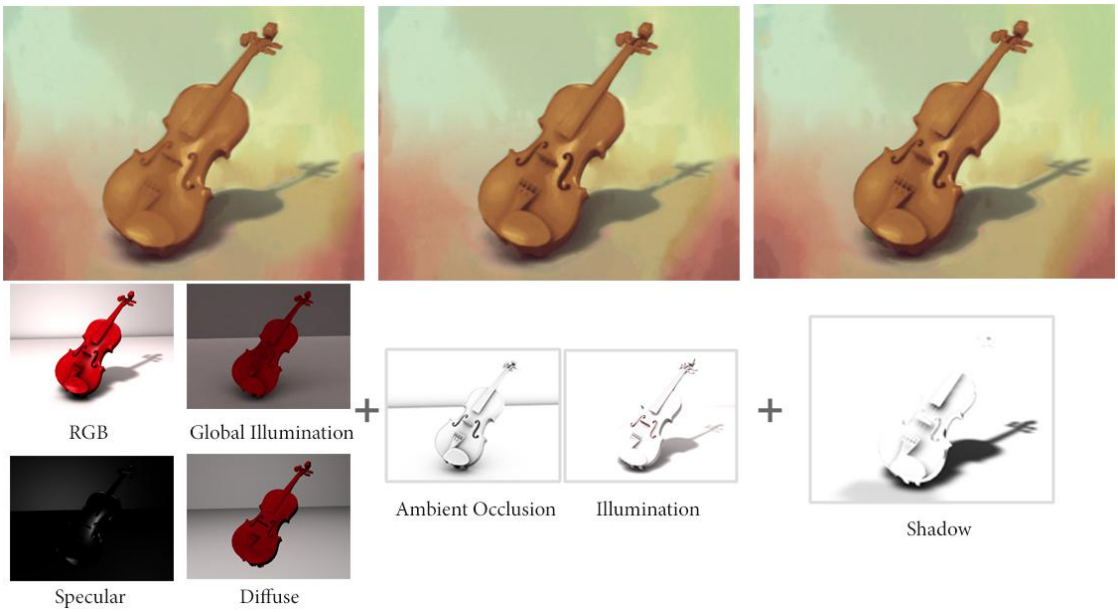


Figure 5.2: Adding more guiding channels generated through multipass rendering helps to control the synthesis. Adding ambient occlusion and illumination channels improved the shading of the violin, particularly the typical f-shaped holes in the front desk. Adding a shadow guiding channel made the shadows look more accurate and pronounced.

The classic use-case of stylising a render of a 3D model is fairly simple, however in real world the 3D scenes any potential artist would like to stylise never contain a single model and if so, the model is most certainly composed of several materials. In this example I stylise a scene with chess figures. The only difference when stylising a scene with multiple materials is that there are more spheres in the source scene, according to the number of materials, and the artist has to prepare an artistic style for each material as well as an example of any material blending that will occur in the target scene. Without the example of the material joins the appearance of their stylised version is not guaranteed.

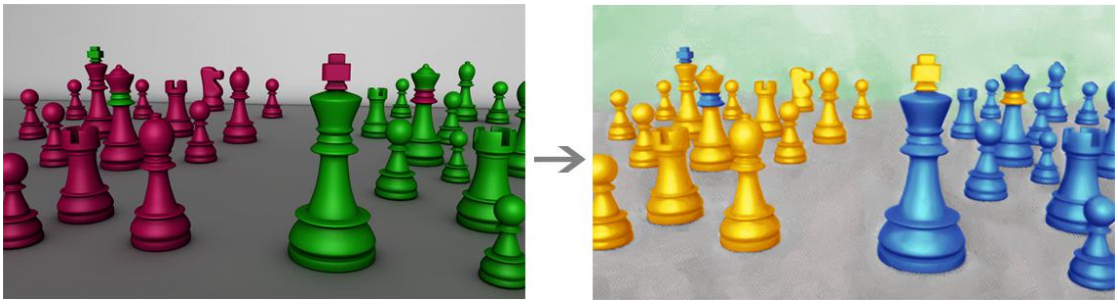


Figure 5.3: Stylising a 3D scene with two materials.

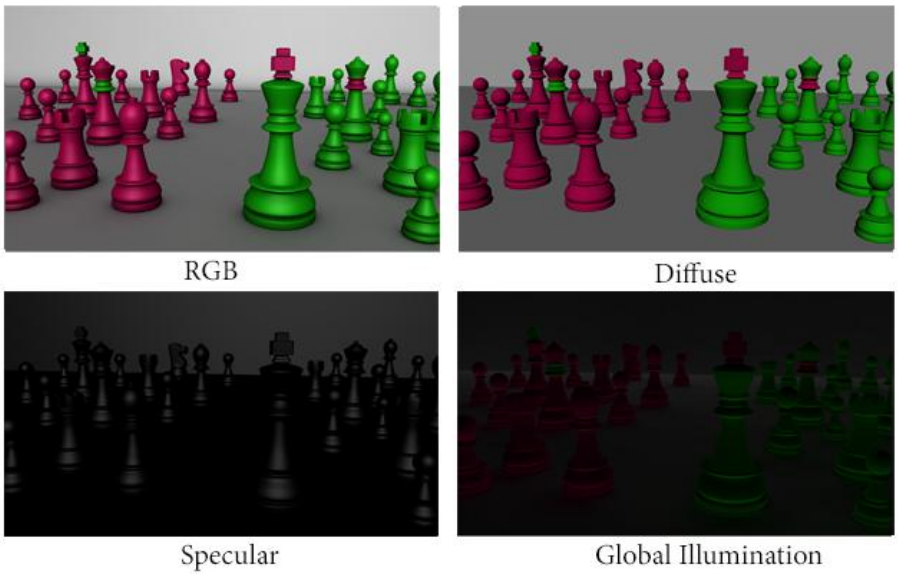


Figure 5.4: Target guiding channels contain two different kinds of chess figures. Each kind has its own material but the kings and queens are composed of both materials in order to demonstrate the stylisation of material blending.

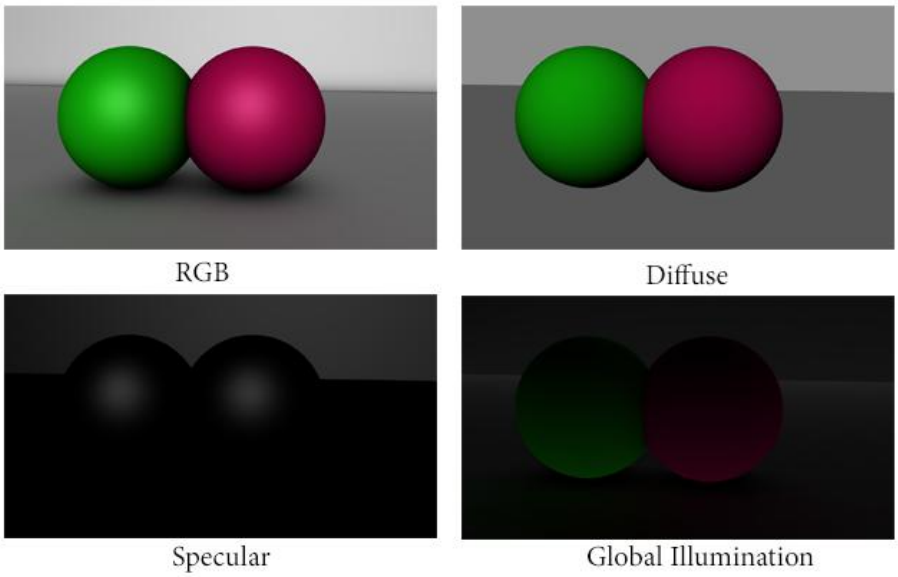


Figure 5.5: Source guiding channels contain two spheres with corresponding materials used in the target scene. The spheres collide one into another because an example of the material joins must be given for more faithful style transfer.

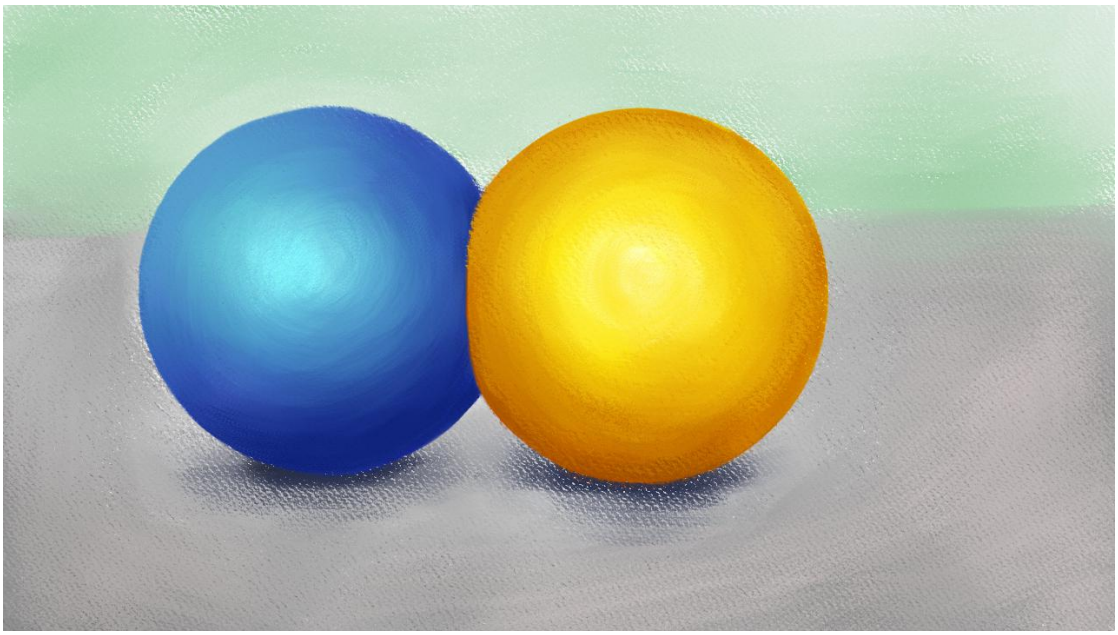


Figure 5.6: The artistic style.

Figure 5.7: Stylised scene with chess figures.

Figure 5.8: Close up of the material blending. The artistic style of the join transfers into the stylised image.

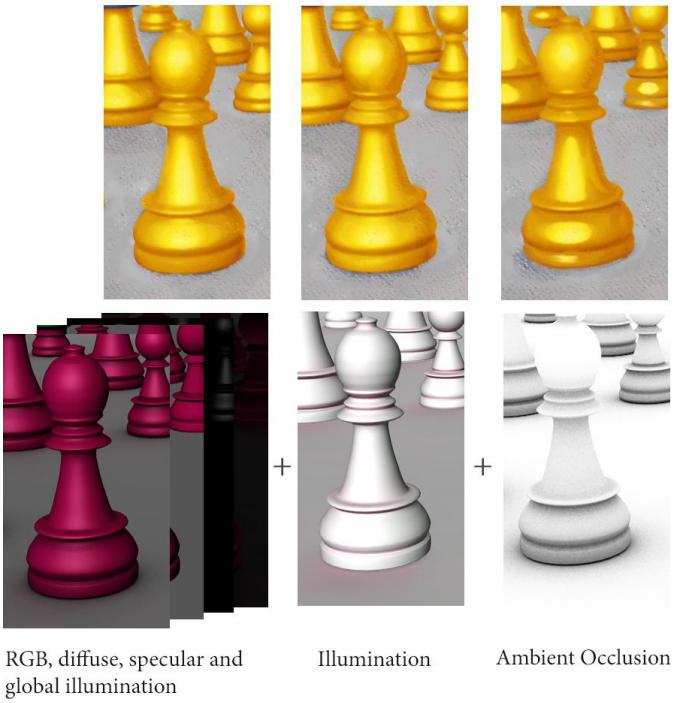


Figure 5.9: Another example of how adding more channels can change the stylised image. Here the illumination channel helps with the shading of the chess figures however adding the ambient occlusion channel changes the appearance of the material to look very reflective. That might be welcome or not, the important thing is that the choice is up to the artist who has full control over the selection of the channels.

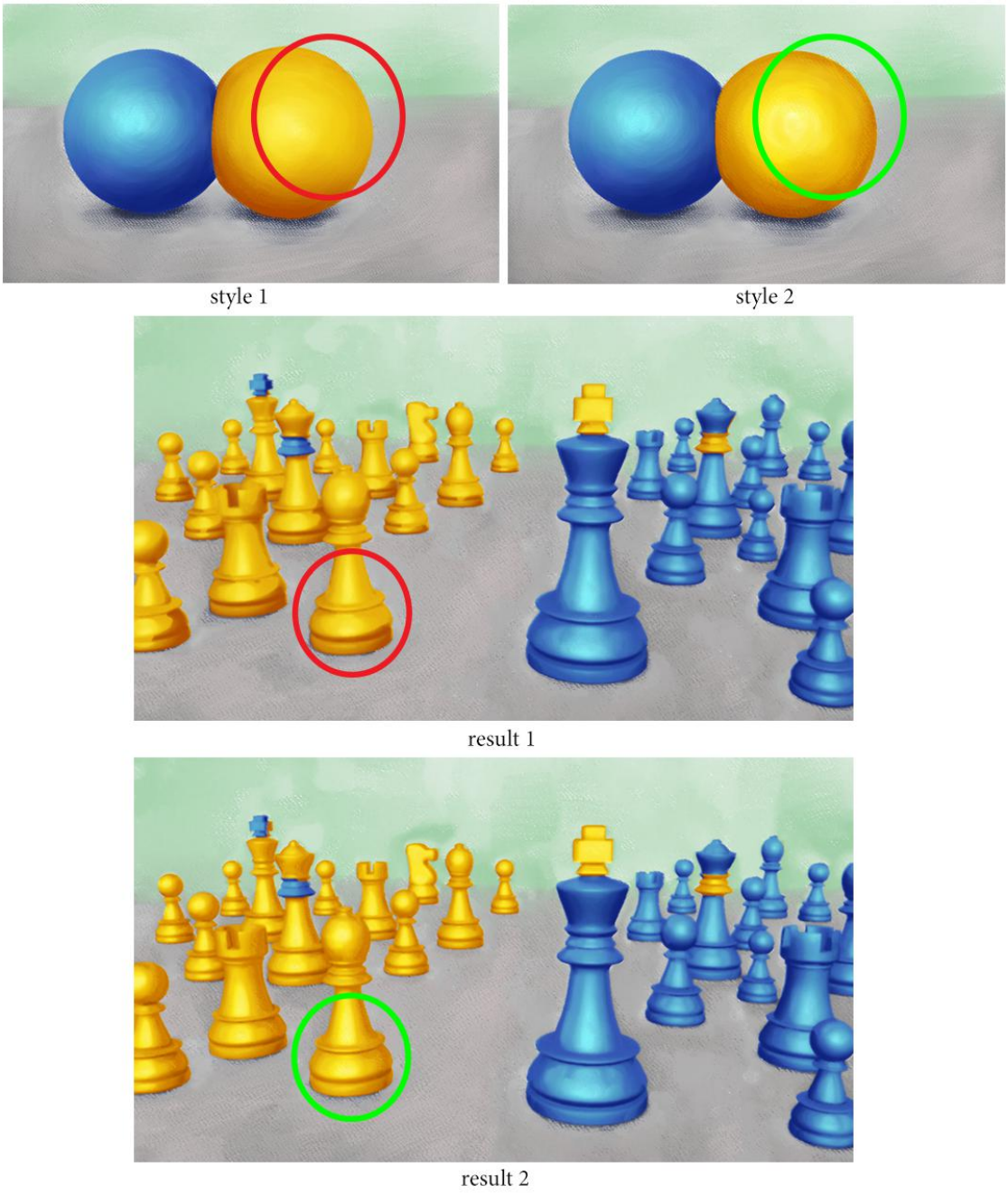


Figure 5.10: Painting the style exemplar accurately is essential, the shading of the sphere and lighting of the whole scene has to match the source channel perfectly. Connecting StyLit with Photoshop made any modifications very easy to do. The artist can paint their sphere in layers and store each important feature such as lights, shadows or the sphere and the background separately being able to modify them comfortably later without the need to repaint the whole image. Here is an example of how using an inaccurate style (1) can ruin the final image. The changes made to the style (2) were quick and the result is significantly better.

5.2 3D render stylisation using a natural texture

A successful guided texture synthesis has been performed by DiamantI et al. [2015] [14] where a natural texture of a bush is used to stylise a 3D render of the Stanford bunny with guiding channels consisting of alpha, normals and gradient (5.12). Although StyLit was designed to use a hand-painted style as texture, I reconstructed the Stanford bunny stylisation using a natural texture and the LPE images to demonstrate that this kind of style transfer is also possible in StyLit with great results.

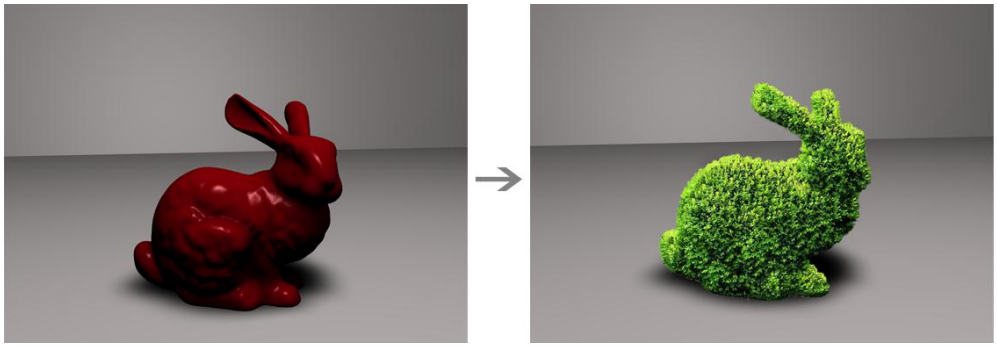


Figure 5.11: Stylising the famous Stanford bunny with natural texture. The lighting from the target scene is preserved and the texture of the model in the result looks natural without excessive repetitiveness.

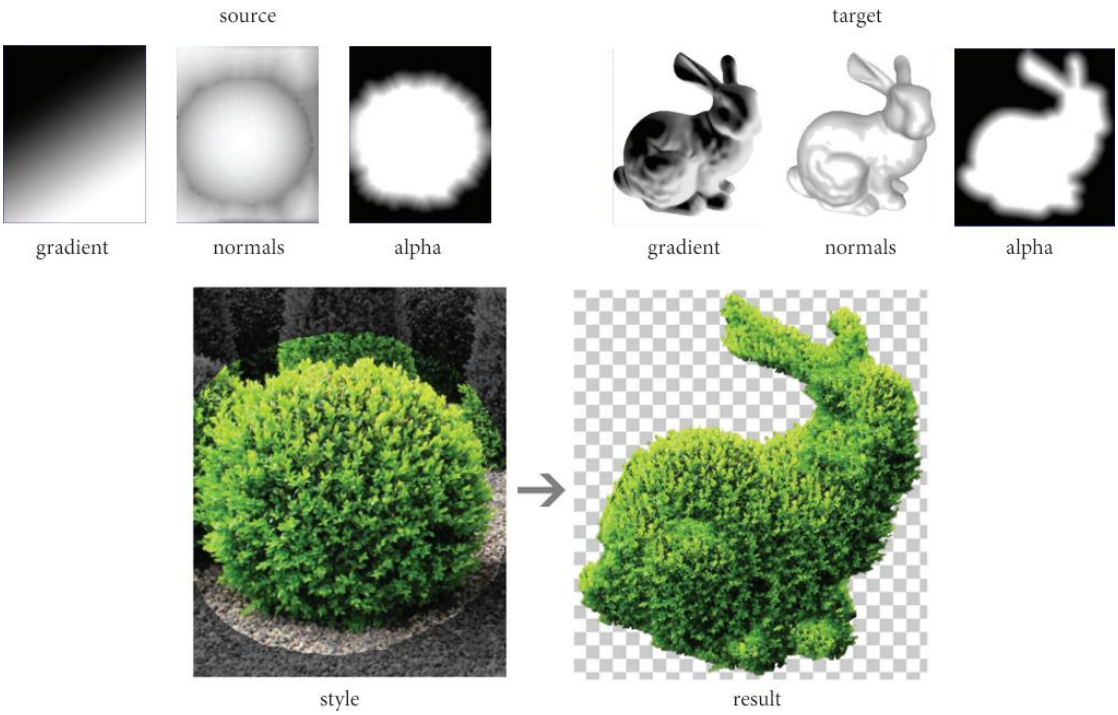


Figure 5.12: Result by DiamantI et al. [2015] [14].

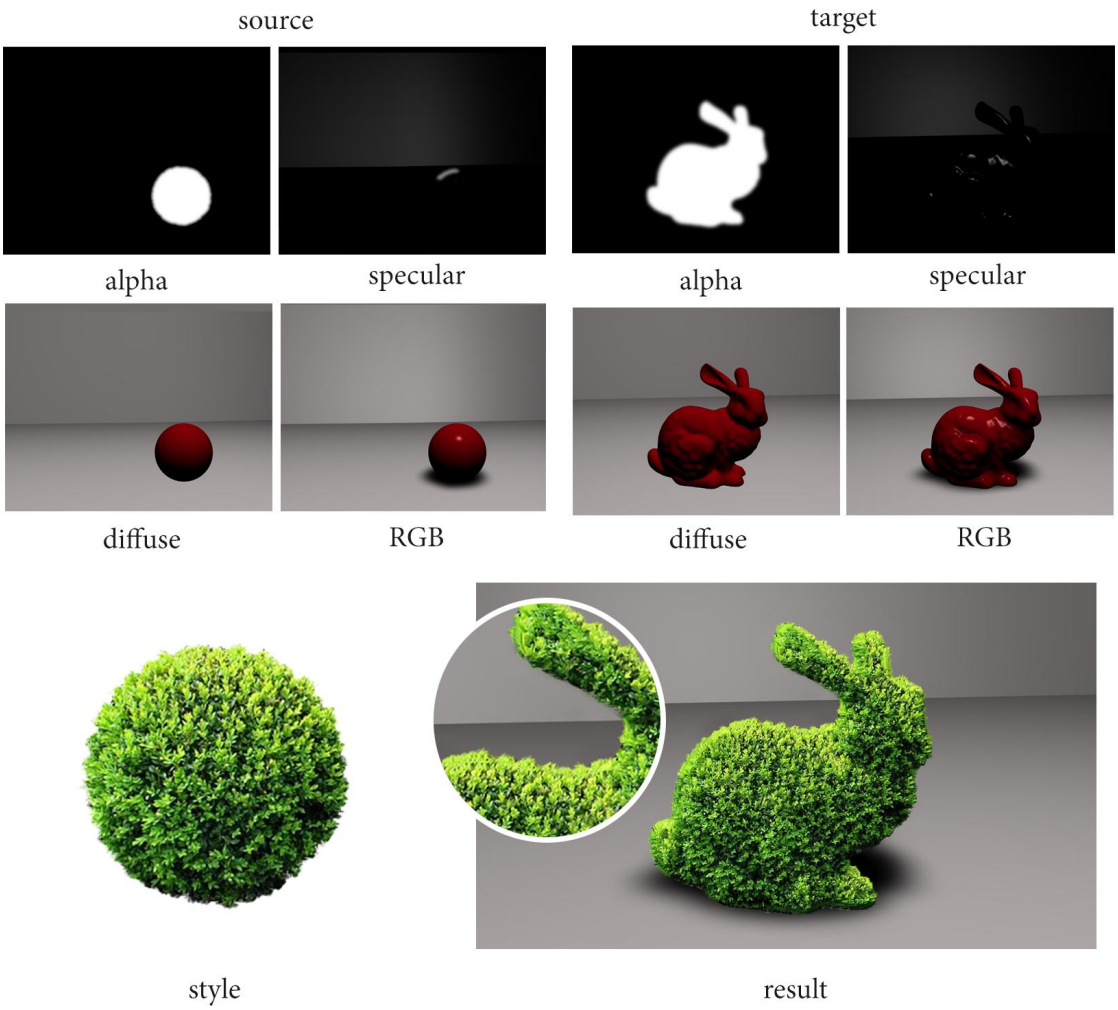


Figure 5.13: Thanks to the spherical shading of the texture classic source channels with the sphere on the table can be used for the synthesis therefore taking the light propagation in the scene into the account and preserving the natural shading of the bunny. The key is that the style always has to mimic the lighting effects of the source scene. In this case I had to adjust the lighting in the source scene according to the lighting of the bush texture. I used alpha as a guiding channel to stylise the model on a transparent background, keeping the grey table from the target scene. By applying Gaussian blur to both source and target alpha channels the fluffy edge with little leaves from the texture is transferred to the edge of the bunny making the overall result look like a natural bush in a bunny shape.

5.3 3D render stylisation using a known artistic style

In order to stylise a target 3D render with an existing painting using the LPE guiding channels we would need a 3D version of that painting as our source scene. However modelling for example Van Gogh's Starry Night would be everything but time saving and saving time and making work easier for artists is our goal. So I took a different approach by transferring the style of the mentioned Starry Night on a 3D render using guiding channels based on luminance rather than light propagation in the scene.

Figure 5.14: To be able to compute the light propagation in the scene and use the guiding channels containing separate illumination effects we need a 3D representation of both target and source scene. The style usually mimics the source scene with the sphere on the table. But when the artistic style already exists we need to either create its faithful model in 3D or create our own guiding channels and guide the synthesis with for example luminance.

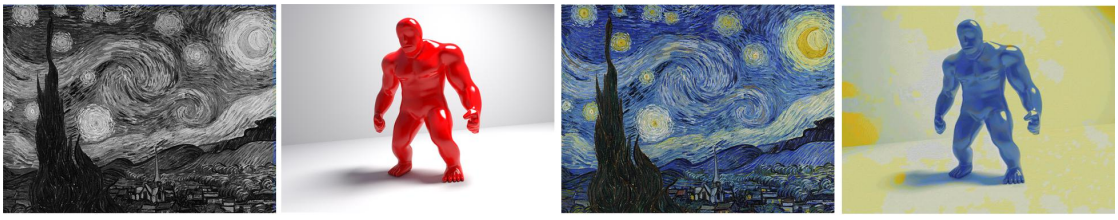


Figure 5.15: As the target guiding channel I used only the RGB image of the Golem render. I created my own source channel by using a grey-scale version of the paining. Note that the histogram of the source channel can affect the overall result and gives a lot of space for customisation. The synthesis with those two channels, however, does not transfer the artistic style, only colours.

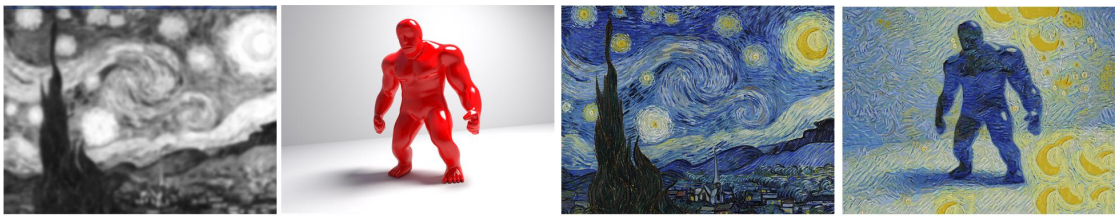


Figure 5.16: Applying Gaussian blur to the source channel allows the rich texture of the artistic style transfer on the 3D render. The resulting image shows Van Gogh's brush strokes, yet there are yellow spots in the background which some artists might welcome others might want to get rid of.

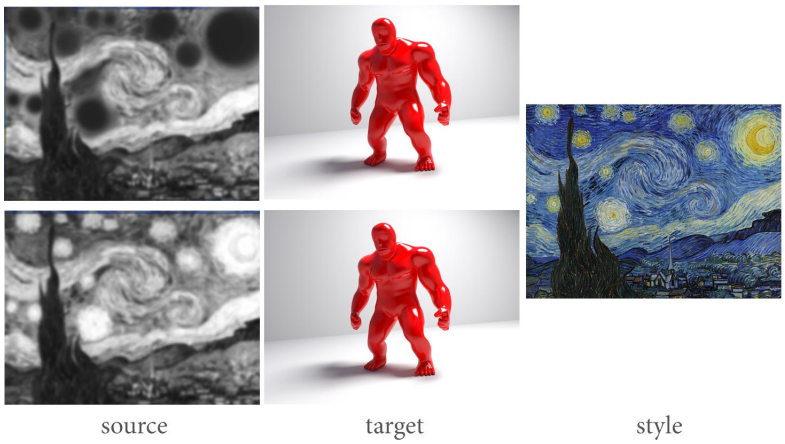


Figure 5.17: In order to get rid of the yellow spots in the background another set of channels was applied. The new source channel has the stars on the sky masked out with the shade of grey that does not appear in the target background.

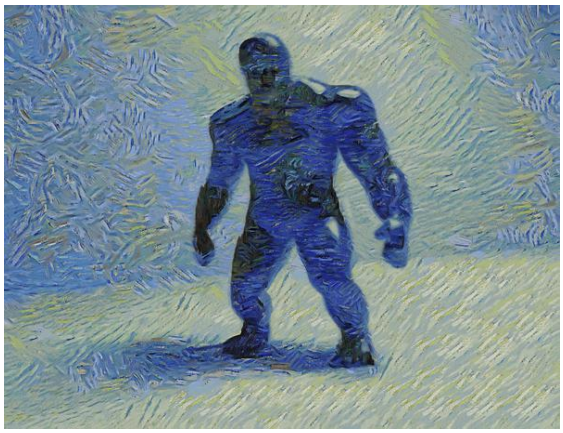


Figure 5.18: The result of stylising the 3D Golem render and Van Gogh's Starry Night painting.

Figure 5.19: More results of stylising various 3D renders with famous paintings by Van Gogh, HenrI Matisse and Pablo Picasso.

5.4 Photograph stylisation

Stylising a photograph with an existing painting is a very popular problem, filters with such feature are being added nowadays to apps like Instagram or Snapchat and earlier-mentioned Prisma or DeepArt are welcomed by the general public as they allow people to create very exciting portrait images resembling art. However those approaches are mainly based on the deep convolution neural networks and the results are very unpredictable often not respecting very faithfully the original artistic style. That could be accepted or overlooked by people using those apps for fun, however if preserving the artistic style is essential those methods can not be trusted. Thanks to the possibility of guiding the texture synthesis performed by StyLit, photographs can also be stylised using an arbitrary artistic style. The stylisation is guided by luminance just like in the previous example, that way the artist can control how the photograph will be stylised. (Fig. 5.21).

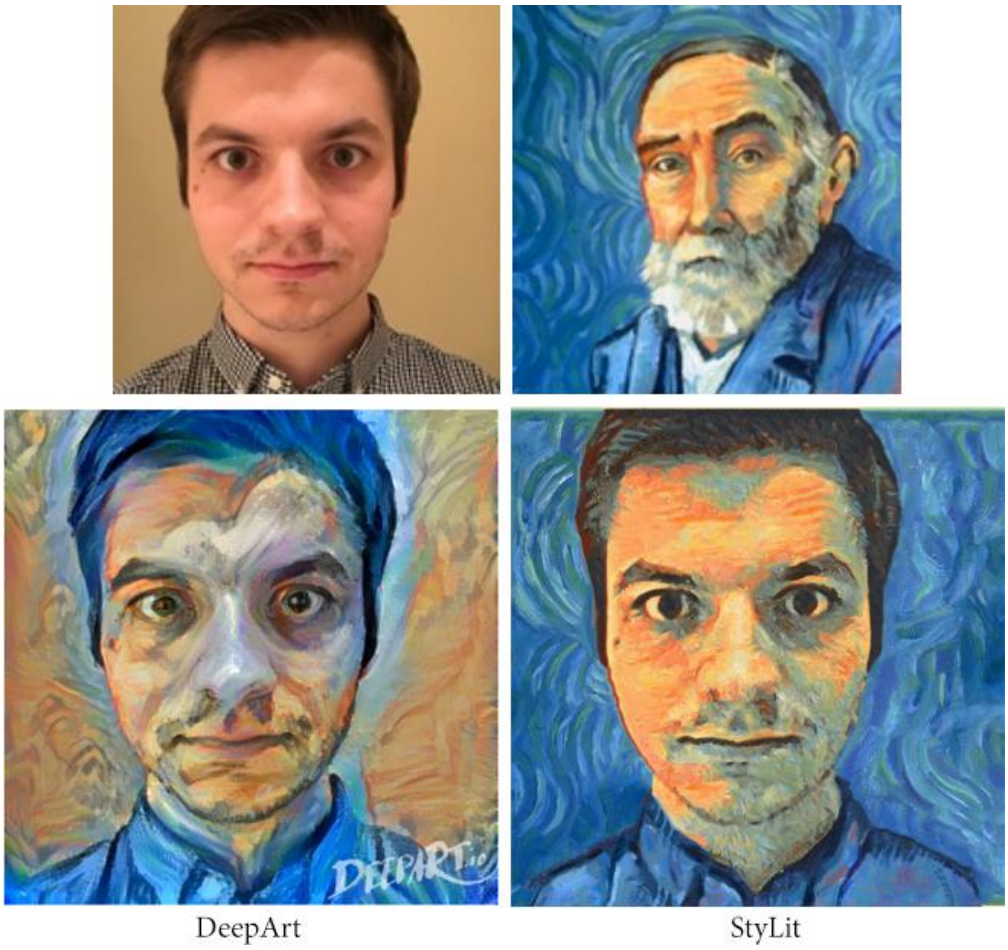


Figure 5.20: a result by DeepArt compared to StyLit. However creative the stylised image by DeepArt may look like, the style is not transferred correctly as the colours of the background and skin tones do not correspond with the original painting. With StyLit's guided synthesis the artist can use customised guiding channels to make sure the artistic handwriting is transferred faithfully.

Figure 5.21: The source guiding channel is a blurred greyscale version of the style. The intensity of the Gaussian blur applied can either emphasise or suppress the brush work of the painting in the resulting image. The target channel is a greyscale version of the photograph to be stylised. Here is an example of how a simple local levels modification of the target channel can change the overall appearance of the stylised image.

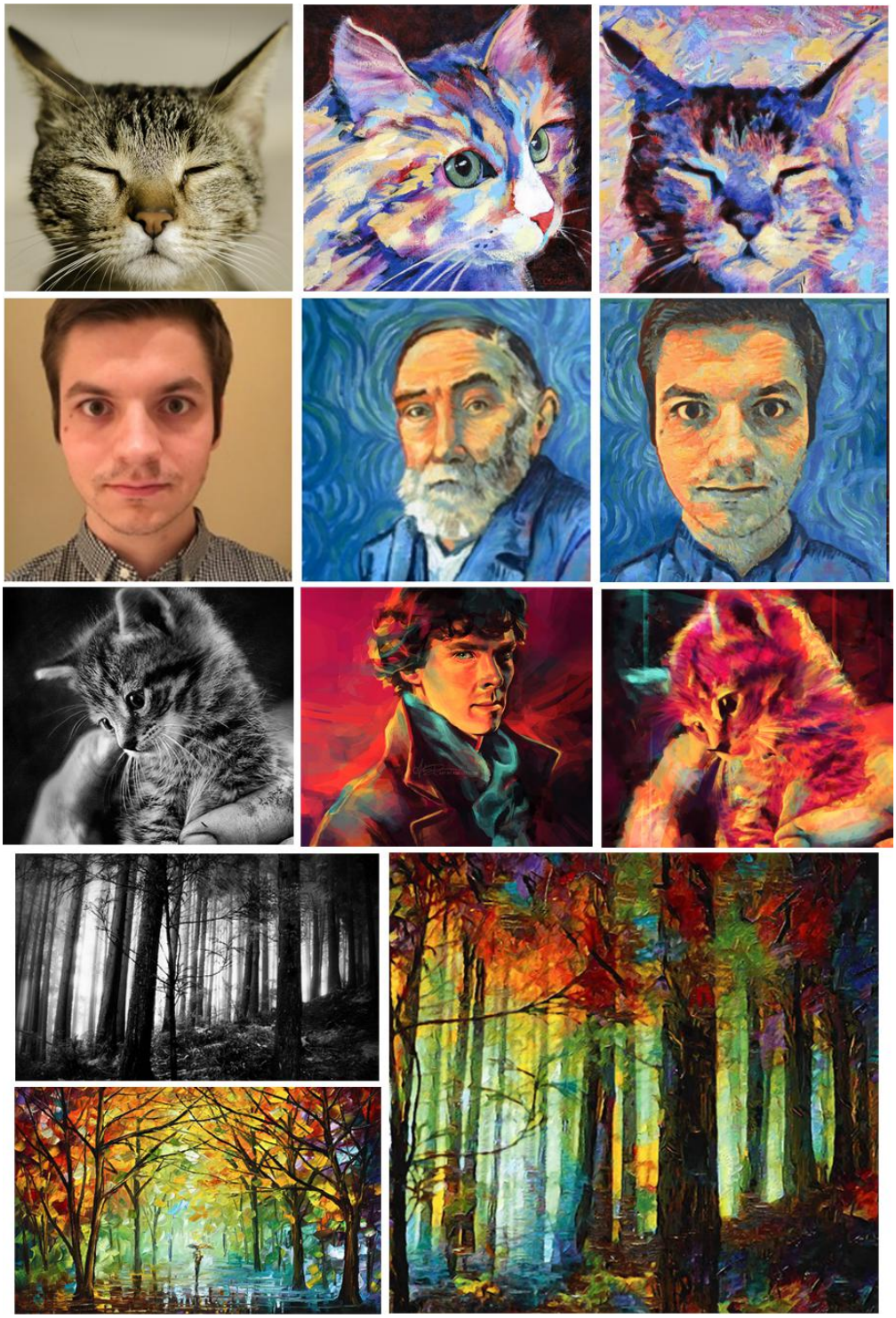


Figure 5.22: More results of Photograph stylisation in StyLit. The paintings: Cat Caution by Carolee Clark, Gottlob Frege by Renee Bolinger, Sherlock by Alice X. Zhang and Autumn in the forest by Leonid Afremov.

5.5 Greyscale painting colourisation

Colourising a painting is a struggle for every artist who tries to pass a greyscale painting for a coloured one with minimal effort. Not because it would be difficult to achieve, it is in fact fairly easy but the results of using standard techniques are hardy satisfying. Yet colourisation of a greyscale painting is often performed as it is much easier to paint in greyscale rather than in colour and whether the artist in need to colourise their painting is a beginner trying to skip a few steps in the learning process or a professional trying to save time, simply painting over the grey image on a blending mode *colour* is not good enough.

Figure 5.23: a) A demonstration of the standard colourising result. The best way to achieve this is by painting a gradient or eye-dropping the colour from a photograph of a face to get some dimension and plasticity and then painting in the colour mode over the greyscale image. However the skin tones are always rather muddy, the texture of the brush strokes gets washed out and the biggest disadvantage is that the result of such technique never reaches the colourful richness of a real painting. b) StyLit delivers much better results, introducing new textures, preserving skin tones and giving the painting an overall natural appearance of a real coloured painting.

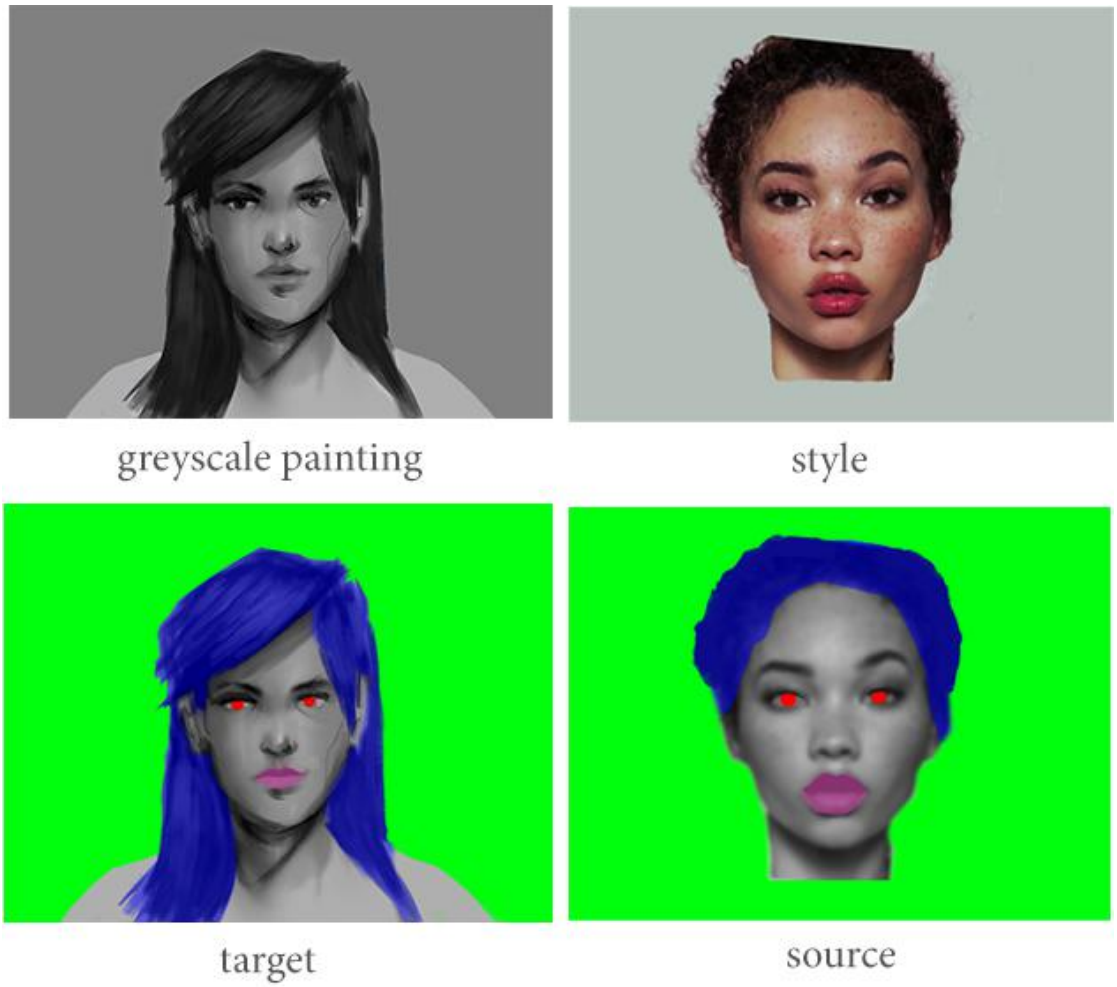


Figure 5.24: The artist first needs to find a good reference picture of a face that will be used as a style for the synthesis. The key are the guiding channels. They are very similar to those of the photograph stylisation however this time the synthesis is guided not only by luminance but also by colour. It is always guided by the user, therefore the mistakes caused by colour-guided synthesis can be avoided. There is a colour ID pass added to the standard greyscale target channel and the greyscale blurred source channel. With the colour ID pass the artist can mark the most important features of the face such as eyes, mouth and hair and make sure that the right parts of the style will be transferred on the corresponding parts of the target.

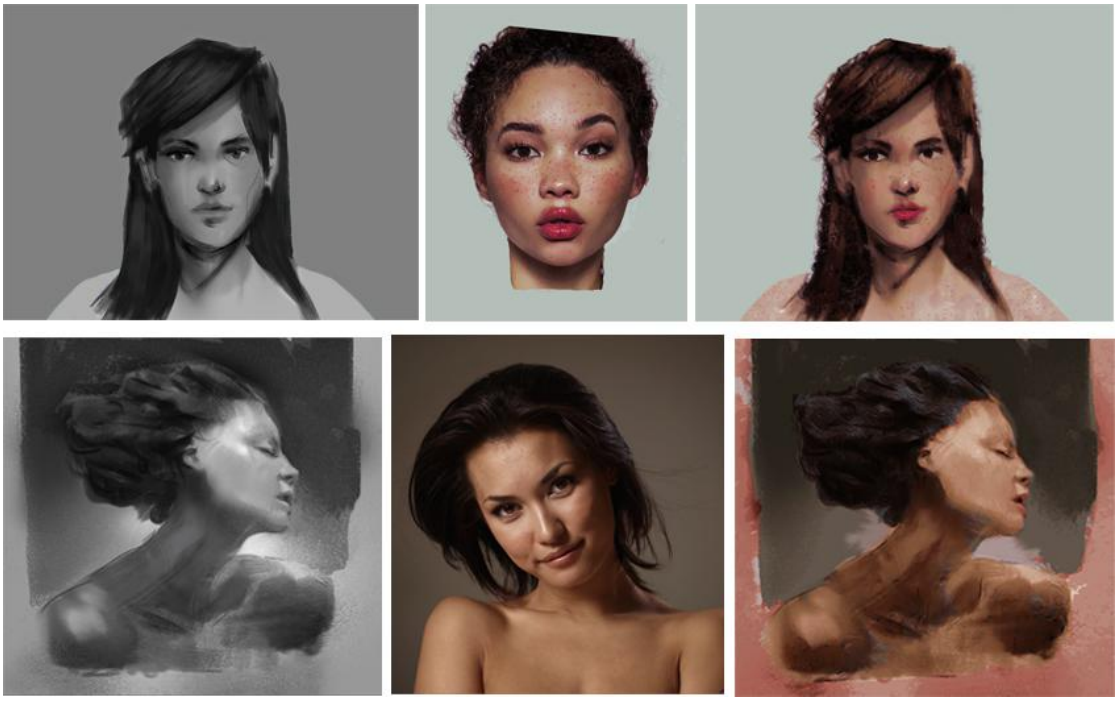


Figure 5.25: Results of the painting colourisation by StyLit. Both paintings and guiding channels were made by Jakub Javora.

5.6 Sky stylisation

The Photoshop brushes available free for download give amazing possibilities to sketch whole scenes within seconds which is a tremendous help for concept artists or matte painters. With cloud brushes for example an entire sky can be designed in a few click.

Figure 5.26: With custom nature brushes an image of a realistic sky can be done in seconds.

The only shortcoming of this otherwise quick designing process are the colours.

The real sky can turn so many beautiful shades and the brushes are of one colour only therefore those fast designs from using nature brushes whether they are clouds, fire or trees can never achieve such colourful richness as photographs of the same elements. Photoshop offers a function *Match Colours* that can transfer the colour palette from one image to another. That would be the ideal solution for colourising a black and white sketch of a sky if it worked. However the *Match Colours* function could be useful when trying to fit a cut piece of a photograph into a new environment, although there are more sophisticated methods to do so as well, it is completely useless for colourising a greyscale photograph as the colours from the reference picture do not transfer faithfully onto the black and white design. StyLit delivers great results and the artist can always control how their designs are stylised by customising the guiding channels.

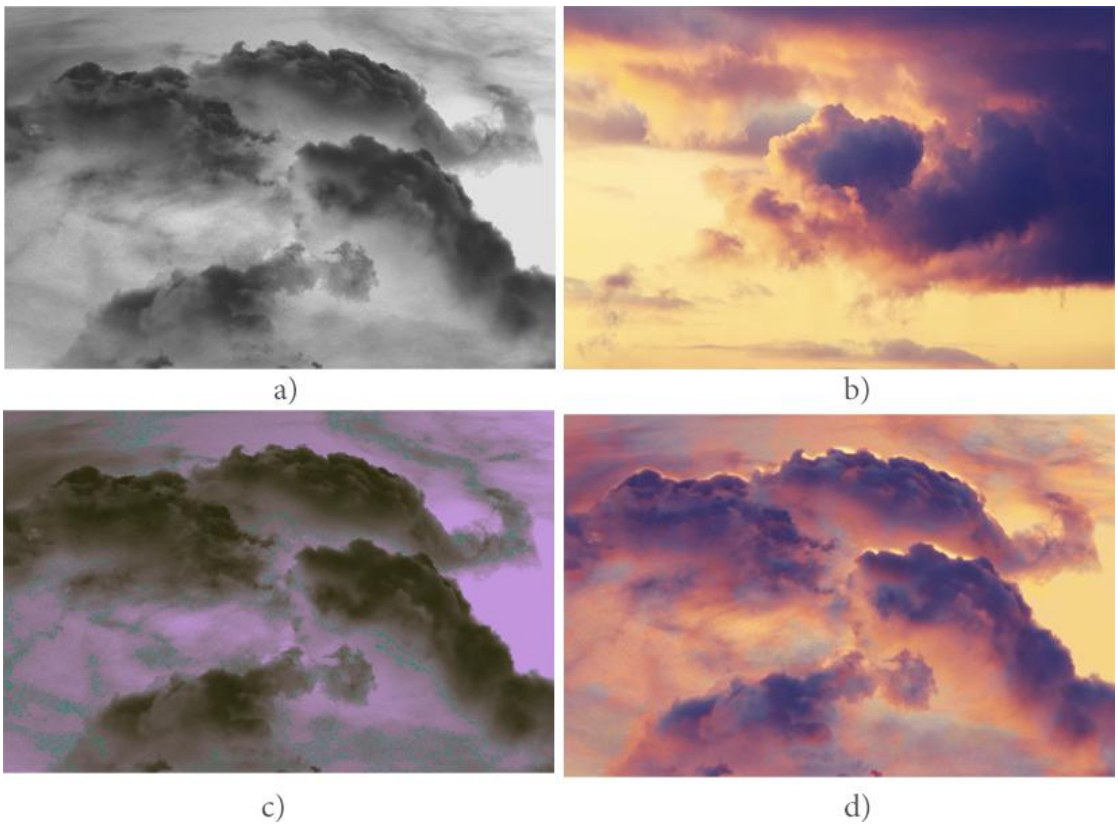


Figure 5.27: a) A black and white design of a sky using cloud brushes in Photoshop, b) A picture of a real sky with desired colour palette for the design, c) result of using the Match Colours function in Photoshop, d) result with StyLit using custom guiding channels.

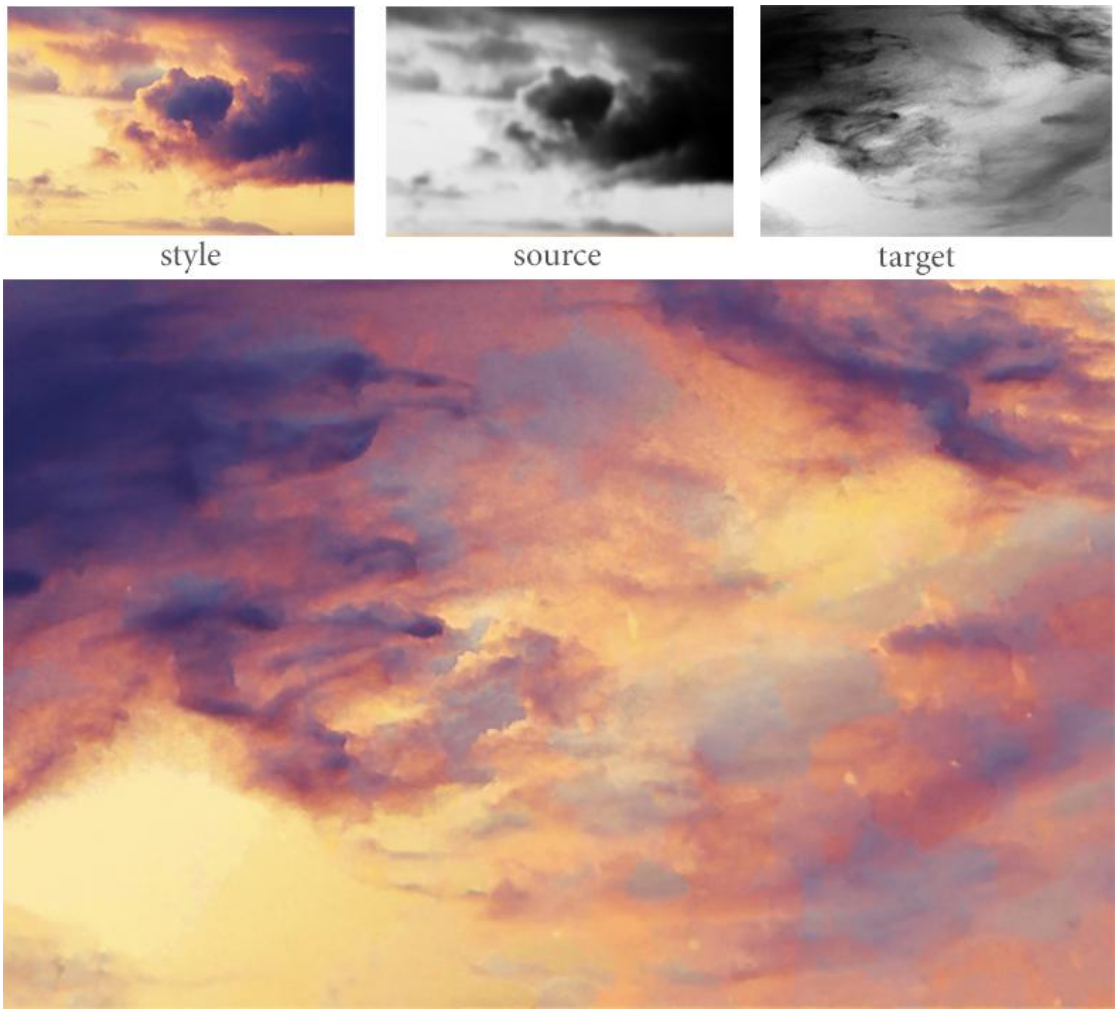


Figure 5.28: Customising the guiding channels: by blurring out the source channel artists can modify the level of abstraction transferred to their photo-realistic design and achieve an oil painting vibe in their stylised image. Concept artist often create their images by painting over 3D renders or photographs. Designing their landscapes with Photoshop brushes and colourising them with StyLit could speed up their process and give them more space for creativity.

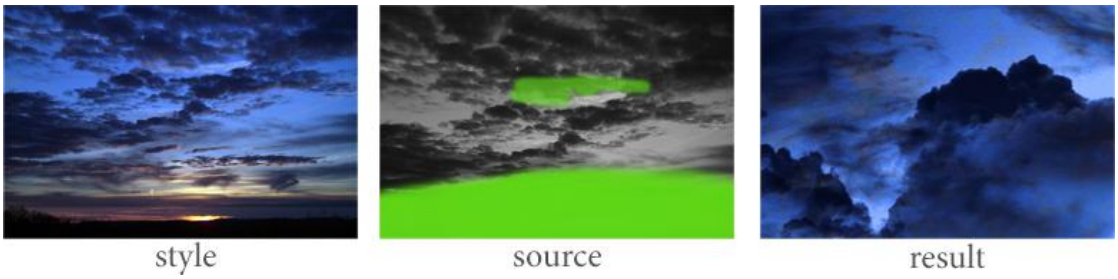


Figure 5.29: Customising the guiding channels: masking the source channel to make sure the unwanted colours from the style do not transfer into the result.

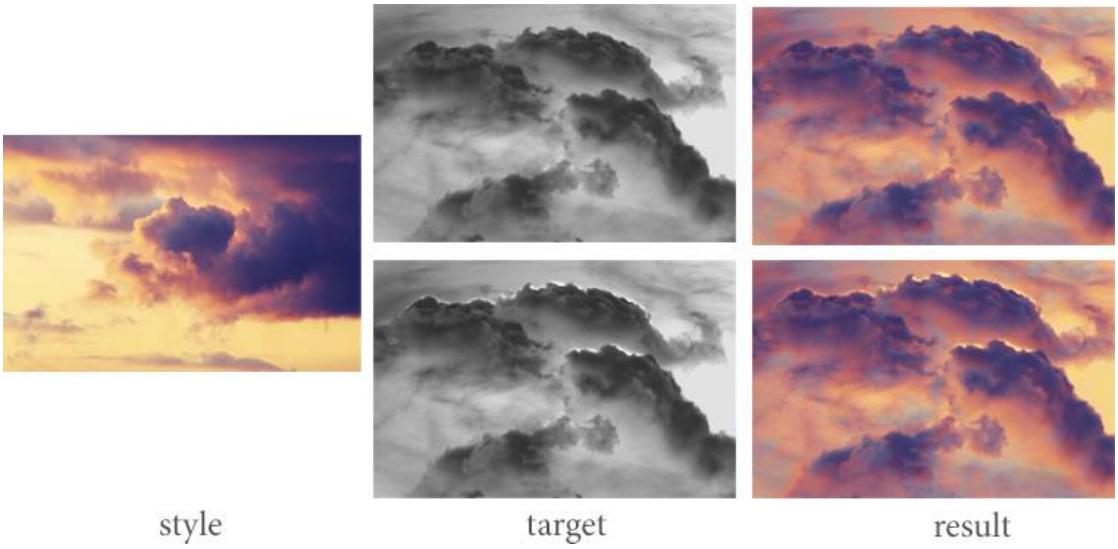


Figure 5.30: Customising the guiding channels: locally brightening the target channel to achieve a natural light ring around the clouds. This could not be achieved with the same result by simply brightening the first stylised image because by modifying the target channel different colours are used to stylise that part of the image.

Figure 5.31: Another example of a stylised sky from a simple greyscale sketch.

5.7 Stylisation of natural elements

Sometimes even the custom Photoshop brushes are not enough and the artist needs to fill certain area of their image with a texture of an element such as water, fire, clouds etc. An easy way to do so is to choose a photograph of the desired texture, create two alpha channels as a guidance for the synthesis and use StyLit to stylise the image.

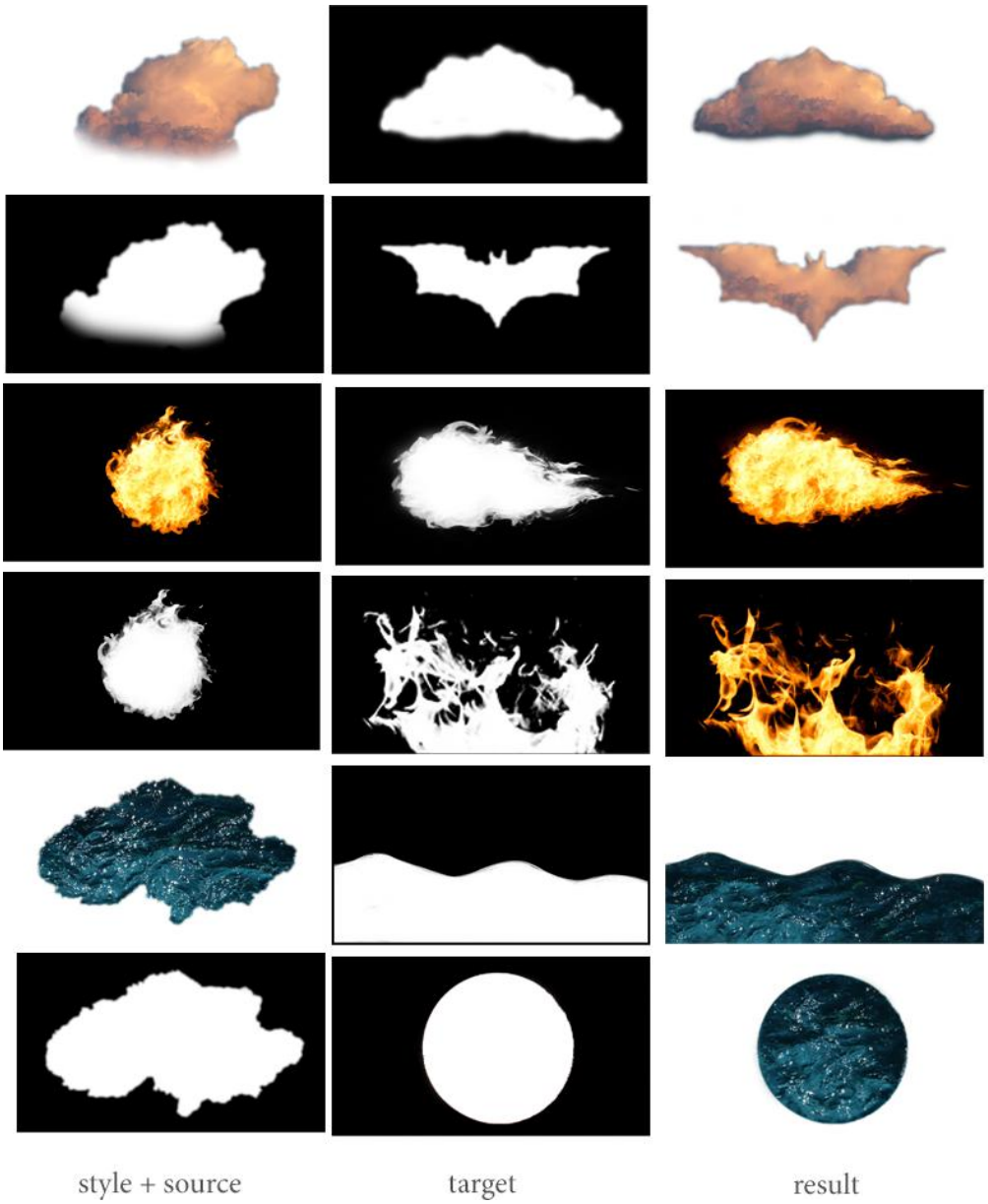


Figure 5.32: Filling an area with an arbitrary texture or a natural element can be as easy as painting a white spot on a black background - the target channel for the synthesis.

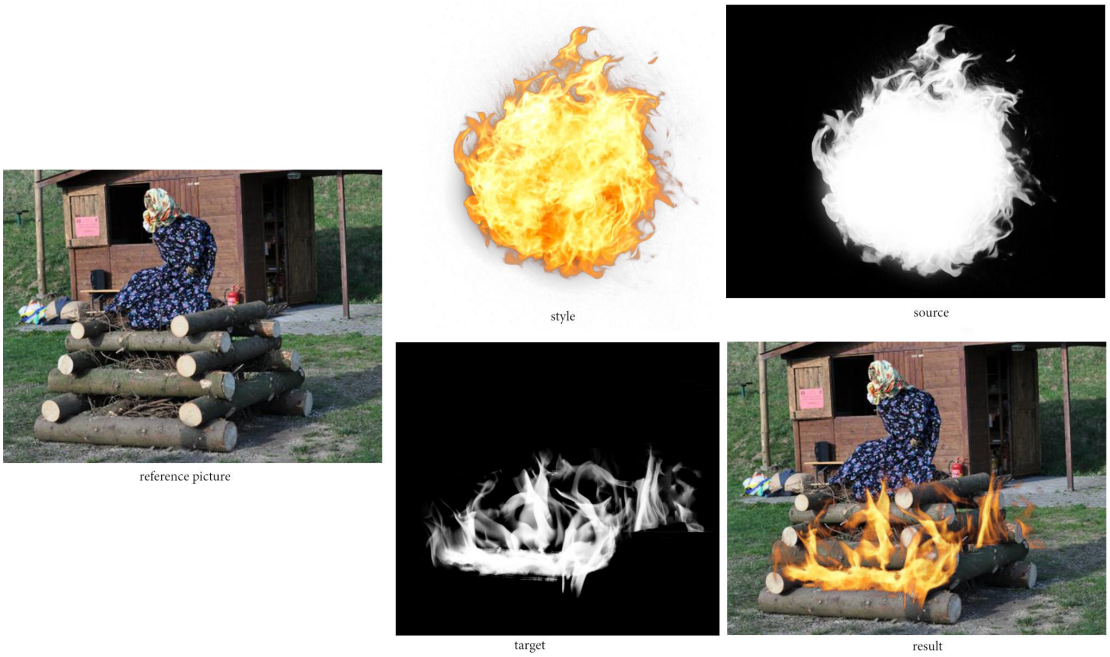


Figure 5.33: Designing natural elements of an unconventional shape and colour manually would be very difficult, with StyLit it is fairly easy. Customised Photoshop brushes available for free on artistic portals such as DeviantArt.com are very helpful when designing the alpha channel of the desired shape and the final image can be finished within a couple of minutes.

Figure 5.34: Example of cloud synthesis using two alpha images as source and target guiding channels.

5.8 StyLit for photomanipulation

Generating seamless textures using only the alpha image as the target guiding channel might not be enough for a more complex photomanipulation or matte painting work. To get more control over the resulting image, new guiding channels must be added. Inspired by the work of DiamantI et al. [2015] [14] I tried using different kinds of black and white gradient to simulate the light direction of the source and of the target as well as to manage scale of the texture which is essential because scale can be that one little factor that helps the audience to tell a photomanipulation from a real picture.

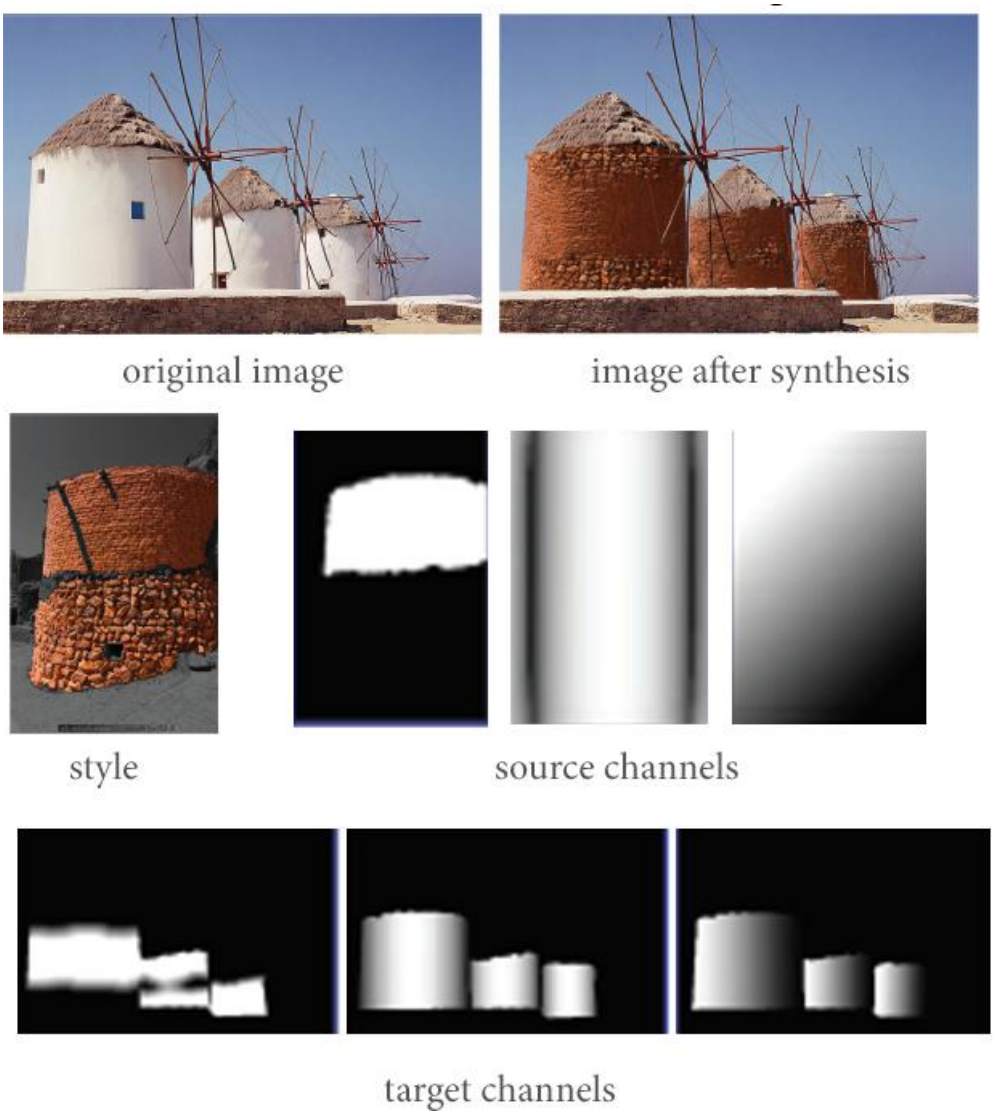


Figure 5.35: DiamantI et al. [2015] [14] used three guiding channels for their natural texture synthesis. An alpha channel, normals for light direction and gradient for scale.

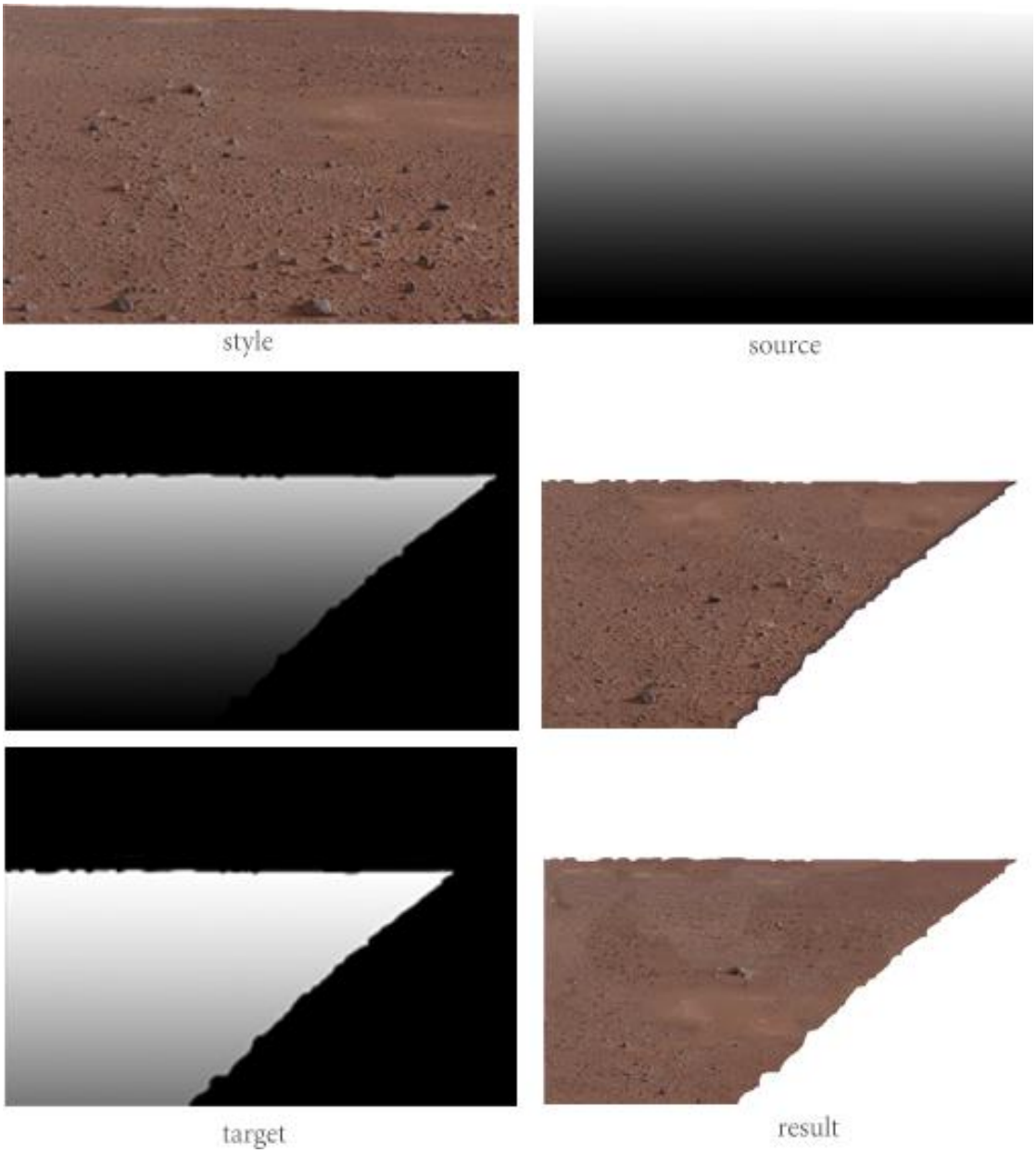


Figure 5.36: Using gradient to control the texture synthesis: In addition to the classic alpha channel I created the gradient guiding channels to control the scale of the texture. By setting the full range gradient for the source channel and then making the gradient for target either lighter or darker I determined what part of the original style will be used for the stylisation. With the darker gradient the resulting image is composed mostly of patches from the bottom of the original texture, containing more stones while with the lighter gradient the result is composed of patches from the top of the texture where the sand is smoother and lighter.

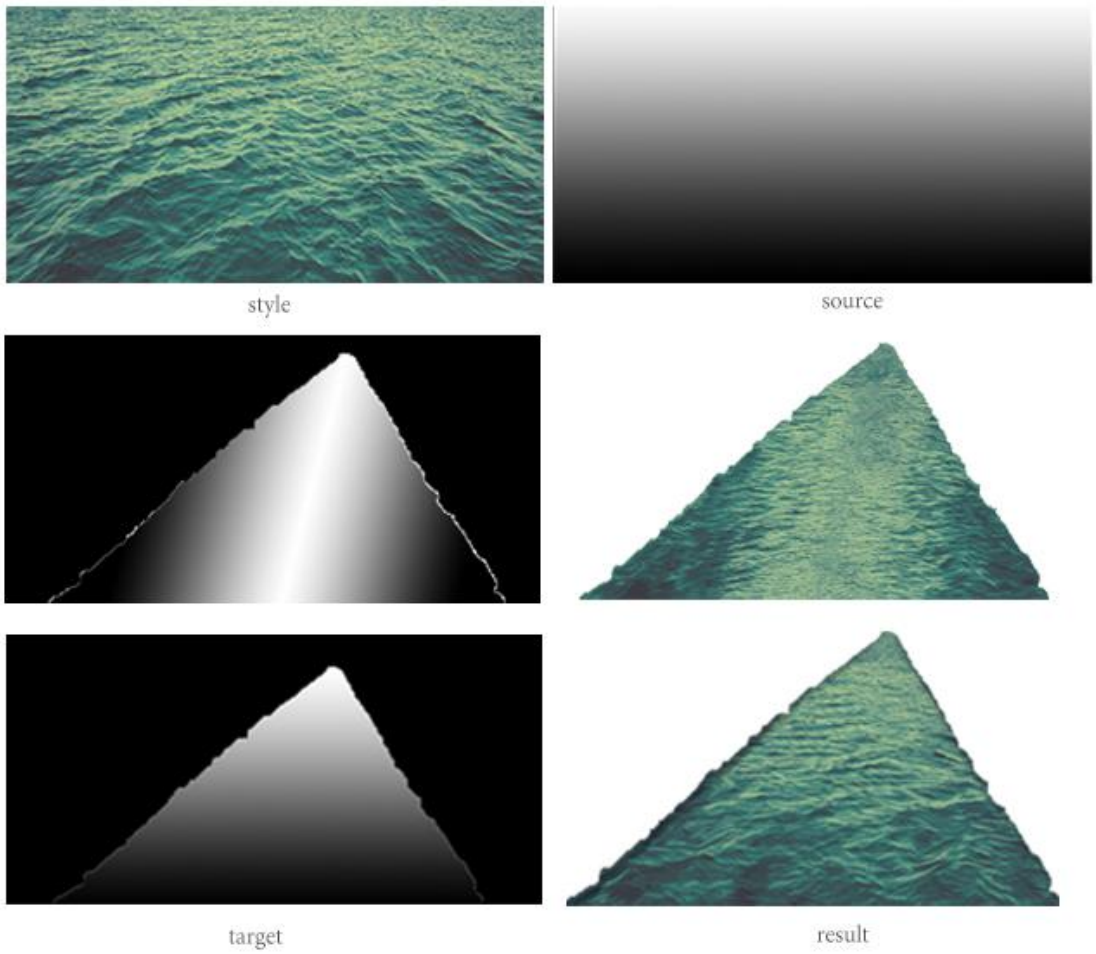


Figure 5.37: Using gradient to control the texture synthesis: Choosing the right gradient in addition to the alpha channel can be essential in order to make the resulting texture look natural. While linear gradients such as the one used at the bottom row mainly control the vertical or horizontal scale of the texture, radial or reflected gradients simulate light direction and control shading of the texture. This could be very helpful when generating textures for round objects, however in this case the reflected gradient used in the middle row resulted in a very synthetic-looking-like river. Playing around with different range or angle of the gradients gives endless options to the artist and there is always a way to get the desired result.

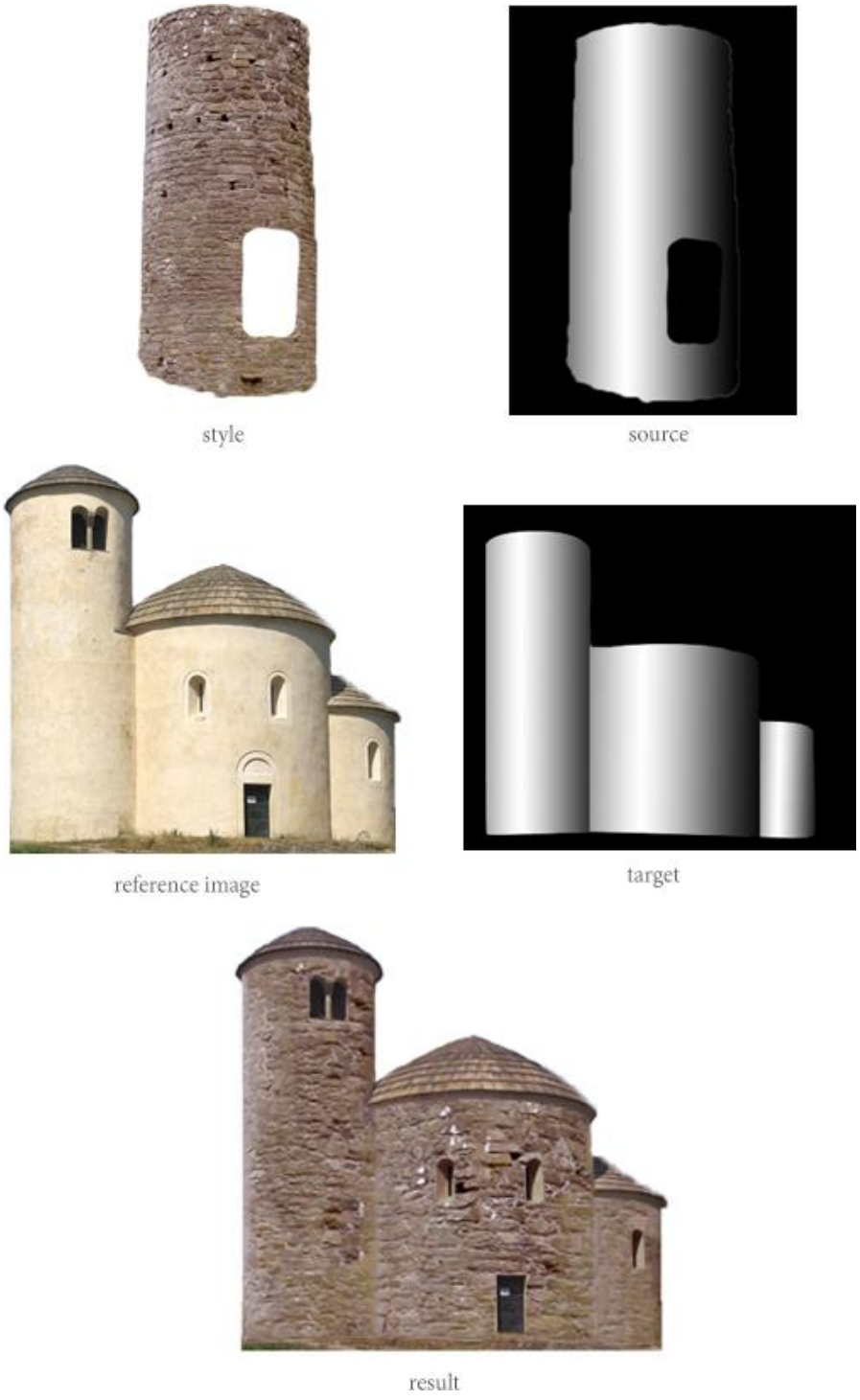


Figure 5.38: When trying to use gradient channels for light direction it is important to pay attention to the source channel first. The gradient in the source channel should mimic as accurately as possible the shading of the original texture. Then creating an arbitrary gradient for the target channel will result in a synthesised texture shaded accordingly. In this example I wanted to use the generated texture on the walls of the white rotunda, so in my target channel I try to mimic the shading of that building to make sure the texture looks naturally.

reference image

final result

Figure 5.39: The result of creating a photomanipulation with StyLit. I used alpha and different kinds of gradient as the guiding channels. On the top of the textures shown above I also used a grass texture to generate grass clumps over the gravel part of the image using the same technique as in the the stylisation of natural elements with only one alpha channel as a guidance for the synthesis.

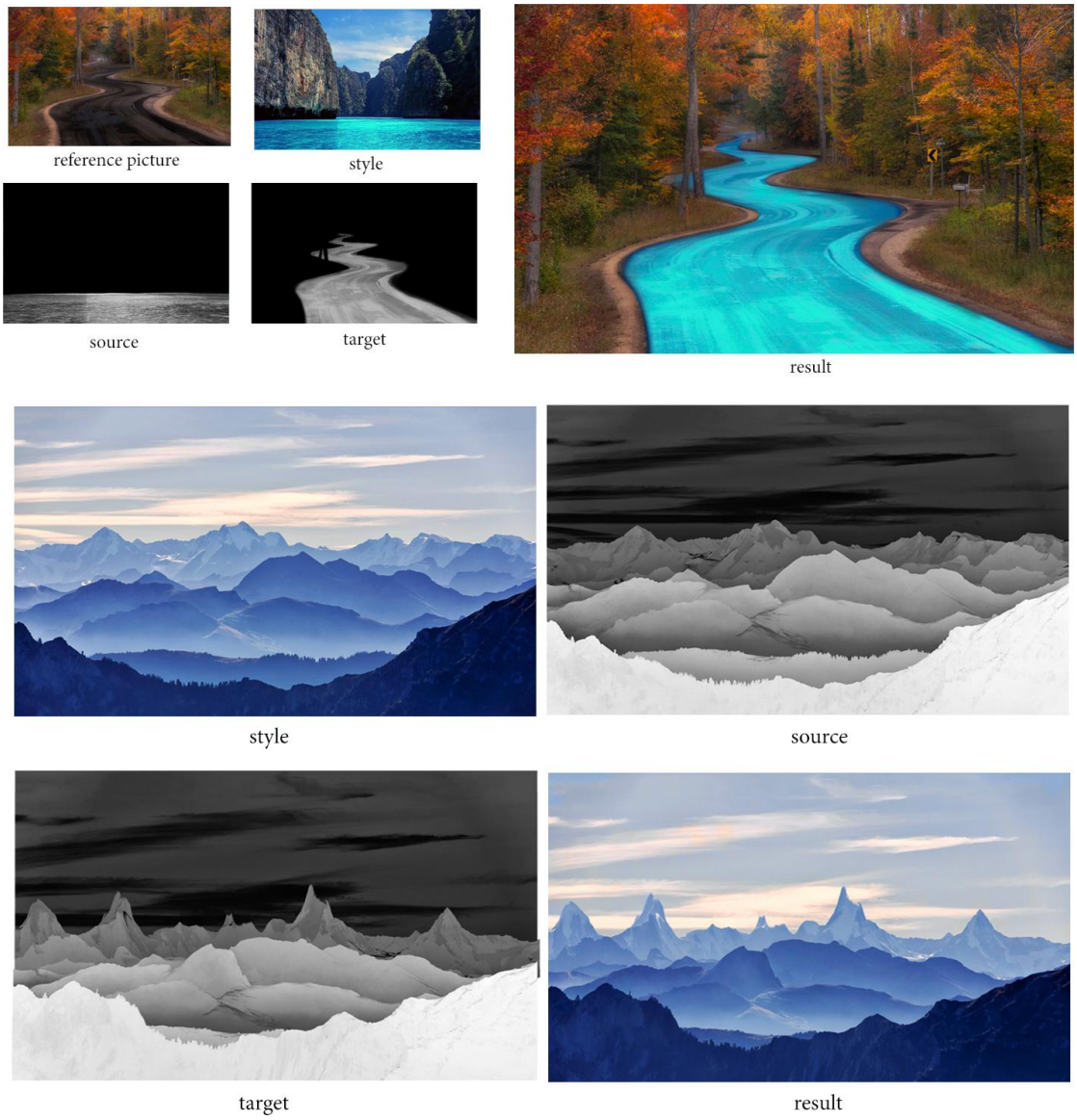


Figure 5.40: Another way to manipulate an image is to use greyscale versions of the reference image and style as guiding channels. Using the Liquify tool often creates artefacts and washes out the original texture of the image. By applying Liquify on the greyscale channel and then running the StyLit synthesis the image is transformed without any distoritions.

5.9 Map stylisation

Designing a map is a tedious process on its own, let alone giving the map an artistic vibe. Creating a map with StyLit can be as easy as preparing guiding channels with a precise ID pass, similar to those in the greyscale painting colourisation and then painting colourful spots in the place of wanted map elements.

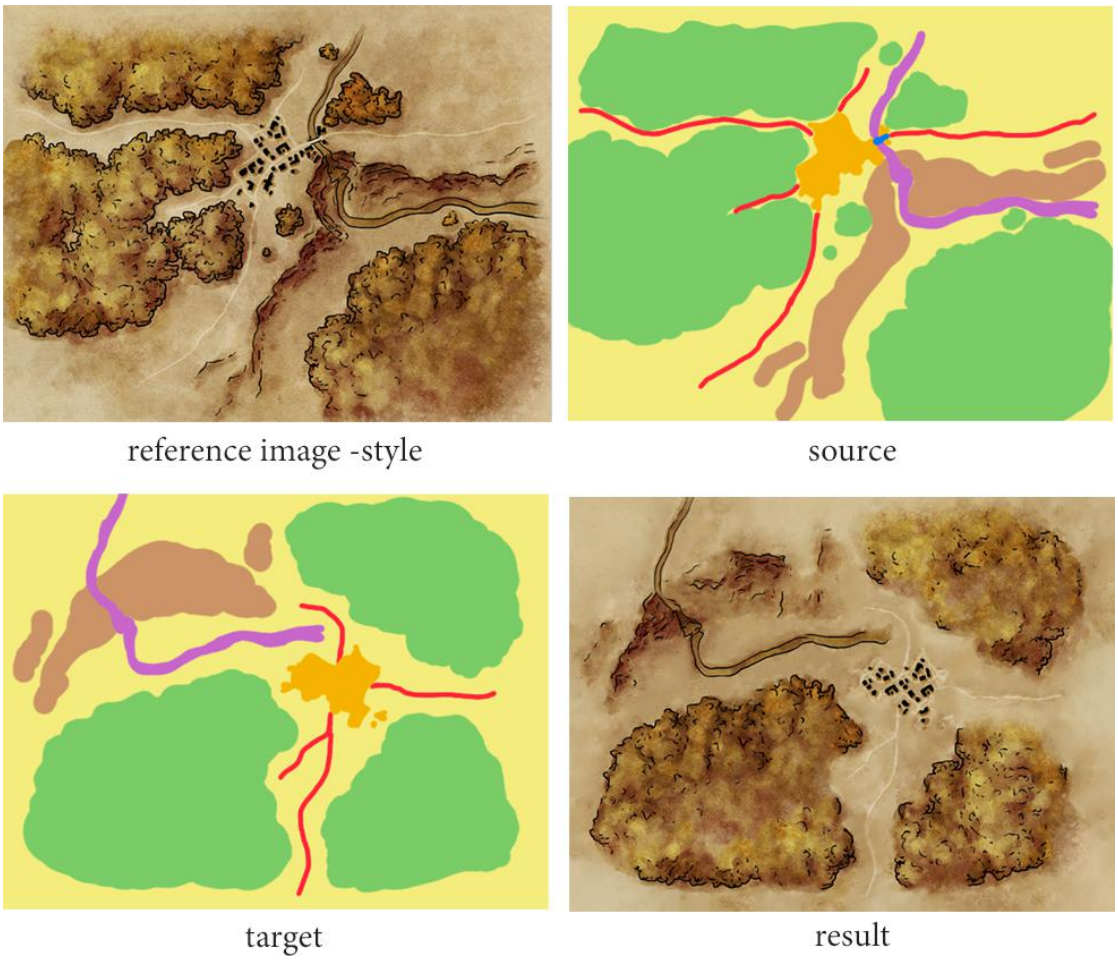
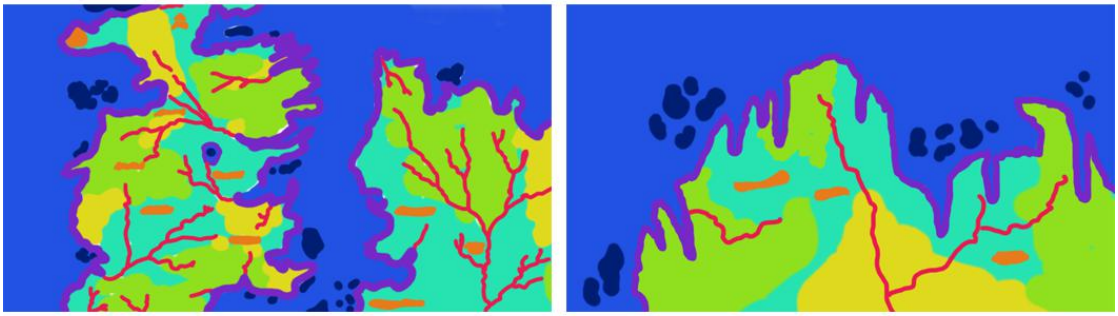


Figure 5.41: Designing a map with StyLit: the source channel must be created carefully, the artist chooses elements that they want to use in their own map and covers them with ID colours. For example here the green colour represents the bushes, yellow is the city etc. Creating a map is then extremely easy, the artist simply sketches an image with different colours, each representing a certain element from the reference picture and StyLit generates the stylised map within seconds for them.

style



source target

result

Figure 5.42: Another example of a simple map design with StyLit.

5.10 Painting with textures

Similar approach as to the maps stylisation can be used to design any image with arbitrary texture. Combining the technique of colour ID pass and blurring to allow a certain level of abstraction gives artists freedom to quickly transform images according to their creative needs.

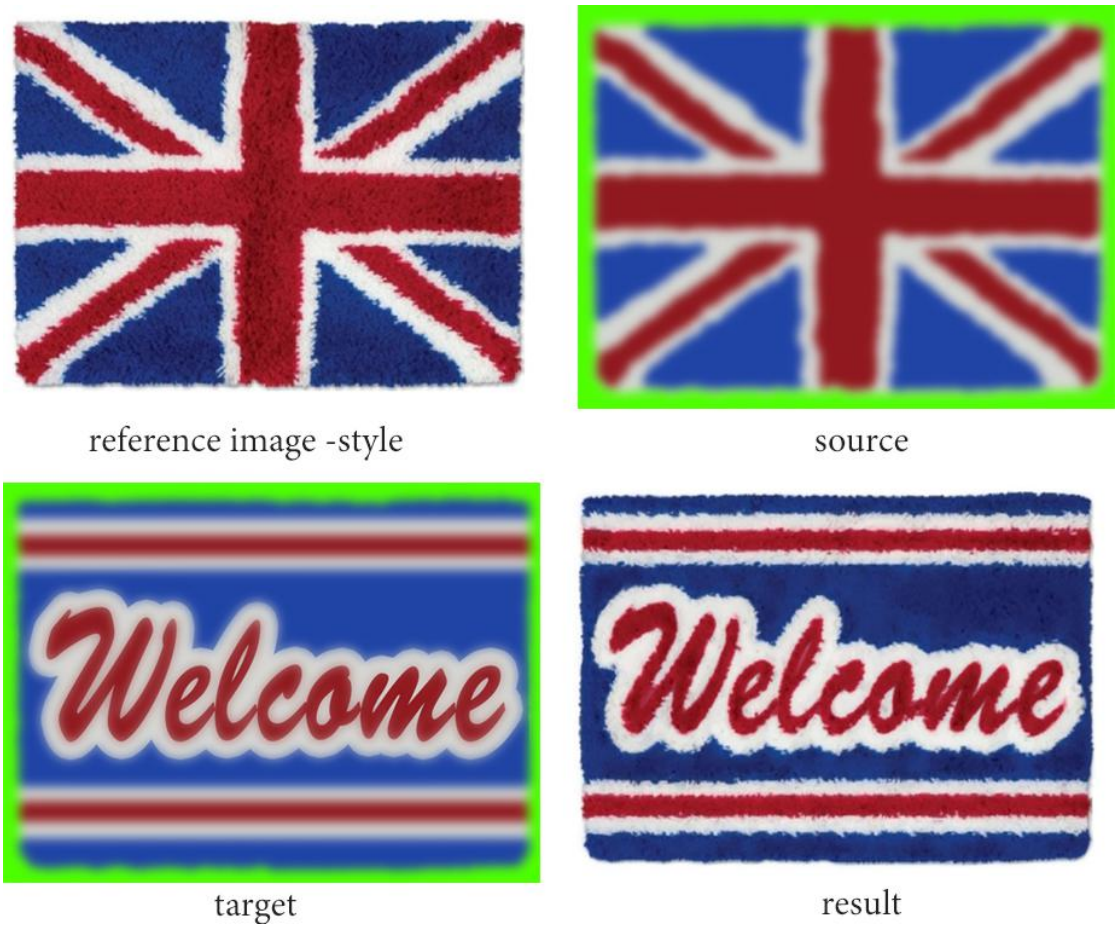


Figure 5.43: Painting with texture: Designing the resulting image in Photoshop using classic tools such as clone brush or copying and warping would take a lot of time to avoid repetitiveness and even then the final image might not look as good as the one generated by StyLit. Here the artist simply creates a source channel with ID pass similarly to the previous example and then sketches their desired design with those colours. In this example using different intensity of Gaussian blur on both source and target channels enables the fluffy edges of the texture to transfer into the final image where needed.

5.11 Limitations

In the paper Synthesis of Complex Image Appearance from Limited Exemplars by DiamantI et al. [2015] [14] the authors present a method to synthesise a transition between two materials without an example of the transition. They use two pairs of guiding channels. The first pair is an alpha channel for both source and target scenes, the second pair is a simple black and white image distinguishing between the two materials for the source scene and a linear black and white gradient determining how the two materials should transition for the target scene (Fig. 5.44). The result is a smooth purple transition between pink and blue colours. When I tried this exact technique in StyLit, I was never able to get the purple colour in the result if it was not present in the exemplar image. StyLit performs a patch-based synthesis and it takes the texture directly from the artistic style exemplar being unable to create anything that is not present in the style, which could be considered a limitation among many benefits of this technique, that were described earlier in this work.

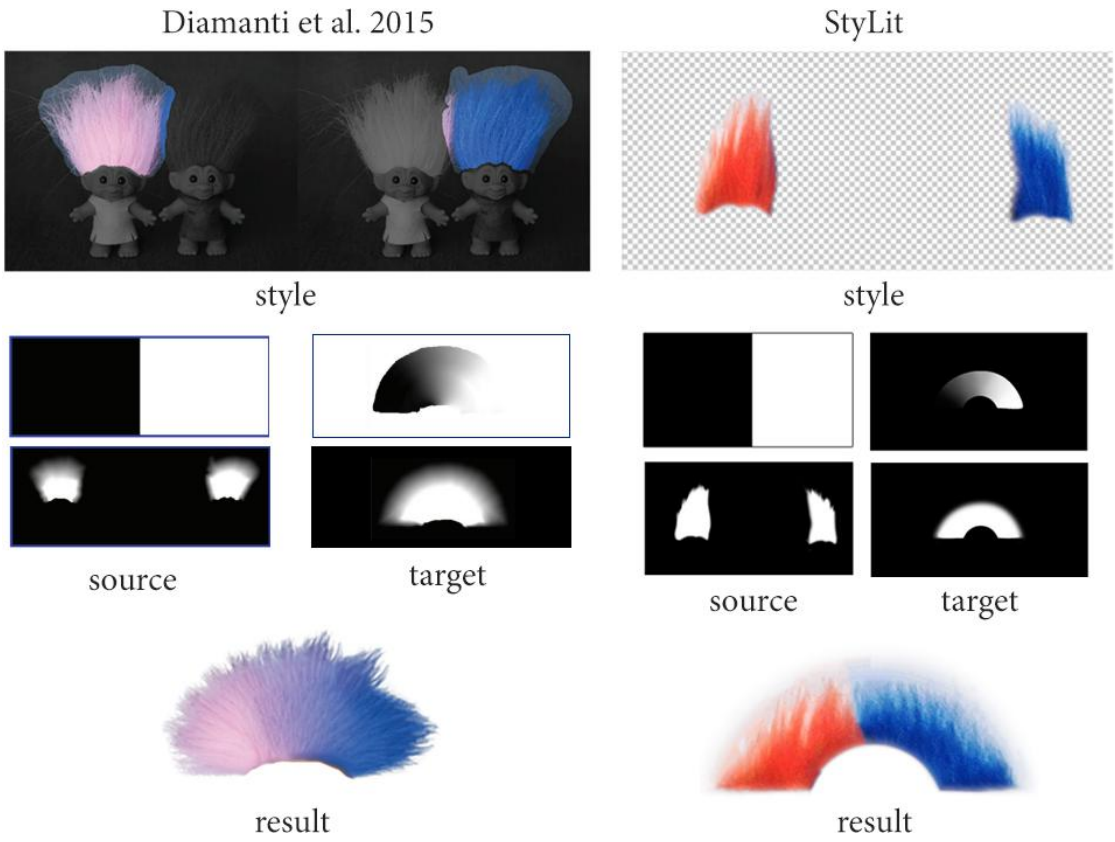


Figure 5.44: Comparison of the synthesis result between DiamantI et al. [2015] [14] and StyLit by Fišer et al. [2016] [3]

However when choosing the right guiding channels and a style with an example of the materials join the results can be much smoother. In the previous example there are no greyscale colours in the source channel so there is nowhere to take the texture from when texturing the black and white gradient in the corresponding target channel. I customised the example for StyLit and chose a style exemplar where the transition between materials exists. Instead of the black and white gradient channel I used coloured ID pass to distinguish between the two different materials and applied Gaussian blur on the join between them which created a small gradient in both source and target channels. The results can be seen in Fig. 5.45.

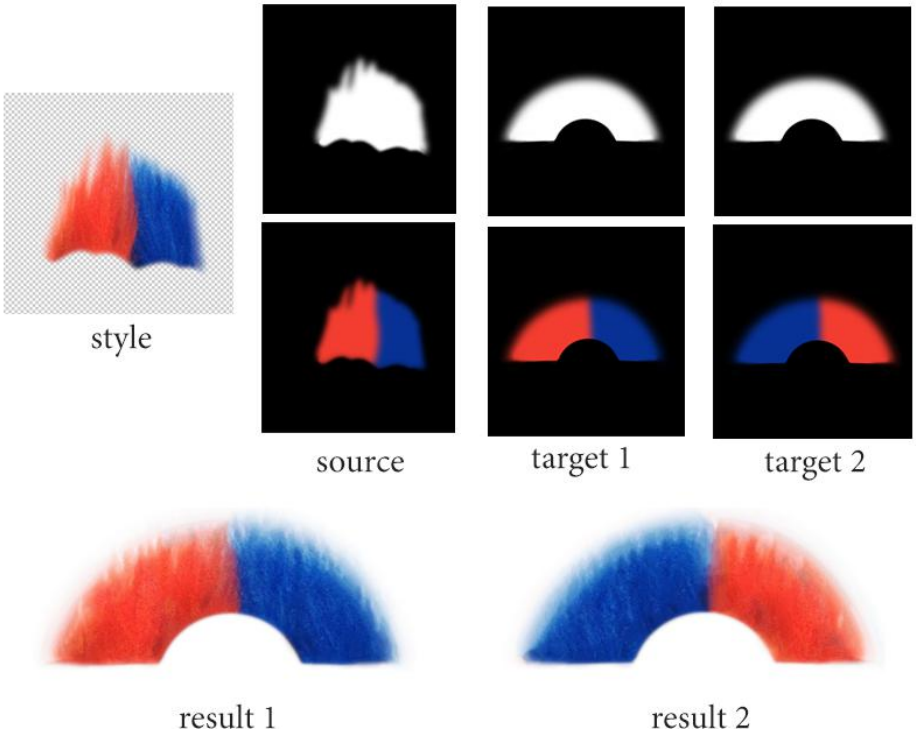


Figure 5.45: Results after adjusting the guiding channels. When the order of the colours in target is the same as in the style, red first, blue second, the material transition in the result matches the style. However when the order of the colours in the target channel is reversed, the transition in the resulting image is rather harsh again because there is no blue to red gradient in the corresponding source channel nor it is in the exemplar image, the reversed transition does not exist so it cannot be created.

Chapter 6

Conclusion

In my work I implemented a plug-in that enables artists to work with StyLit in the Photoshop environment and comfortably use all its features to make their work efficient. Through the plugin artists can use any number of guiding channels for the synthesis which opens new possibilities for StyLit's usage. Apart from stylising 3D renders into artistic styles, which is the original and main purpose of StyLit, I came up with numerous new use-cases for potential users and showed that StyLit could be a helpful tool not only for animators and 3D artists but also for concept artists, matte painters or photomanipulators. I provided a set of 25 example PSD files demonstrating how each of those use-cases work and a set of 11 narrated video tutorials explaining in great detail each step of the process. I showed how StyLit could work in real production and how helpful it could be to all kinds of digital artists. One thing that did not work out as planned was the short animated film that would be stylised in StyLit and produced by Anifilm. Unfortunately they did not obtain the licence to use StyLit from Adobe yet so that short film is a matter for the future.

6.1 Future work

In the future I would love to continue to work with StyLit and test the video version of the plug-in in real production by creating a short traditionally animated film in it.

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Acronyms

LPE Light Path Expressions

SDK Software Development Kit

DOM Document Object Model

PSD Photoshop Document

Contents of enclosed CD

- `Examples` ..... the directory with the sample PSD projects
  - `3D_Advanced` ..... violin stylisation
  - `3D_Basic` ..... golem stylisation
  - `3D_Famous_Paintings` ..... Van Gogh, HenrI Matisse and Pablo Picasso
  - `3D_Natural_Textures` ..... Stanford bunny stylisation
  - `Alpha_Channel` ..... itylising on transparent background
  - `Animation` ..... image sequence stylisation
  - `Natural_Elements` ..... fire, clouds and water
  - `Colourisation` ..... painting colourisation
  - `Guided_Content_Aware` ..... forest road and landscape manipulation
  - `Maps` ..... two artistic map stylisations
  - `Paint_by_Texture` ..... transforming a textured image
  - `Photographs` ..... face, cats and forrest
  - `Photomanipulation` ..... complex photo manipulation scene
  - `Sky` ..... numerous sky stylisations
  - `Two_Materials` ..... chess scene with two materials
- `src` ..... the directory of source codes
- `StyLit_Plugin` ..... the directory containing the plug-in
  - `StyLit` ..... the plug-in
  - `Readme.pdf` ..... User Manual
- `text` ..... the thesis text directory
  - `thesis.pdf` ..... the thesis text in PDF format
- `Video_Tutorials` ..... the directory with the narrated tutorials
  - `01_3D_render_stylisation.mp4`
  - `02_3D_animation_stylisation.mp4`
  - `03_Photograph_stylisation.mp4`
  - `04_Using_alpha_channel.mp4`
  - `05_Painting_colourisation.mp4`
  - `06_Sky_stylisation.mp4`
  - `07_natural_elements_stylisation.mp4`
  - `08_StyLit_for_photomanipulation.mp4`
  - `09_3D_stylisation_natural_texture.mp4`
  - `10_3D_render_stylisation_older_version.mp4`
  - `11_3D_stylisation_famous_painting.mp4`