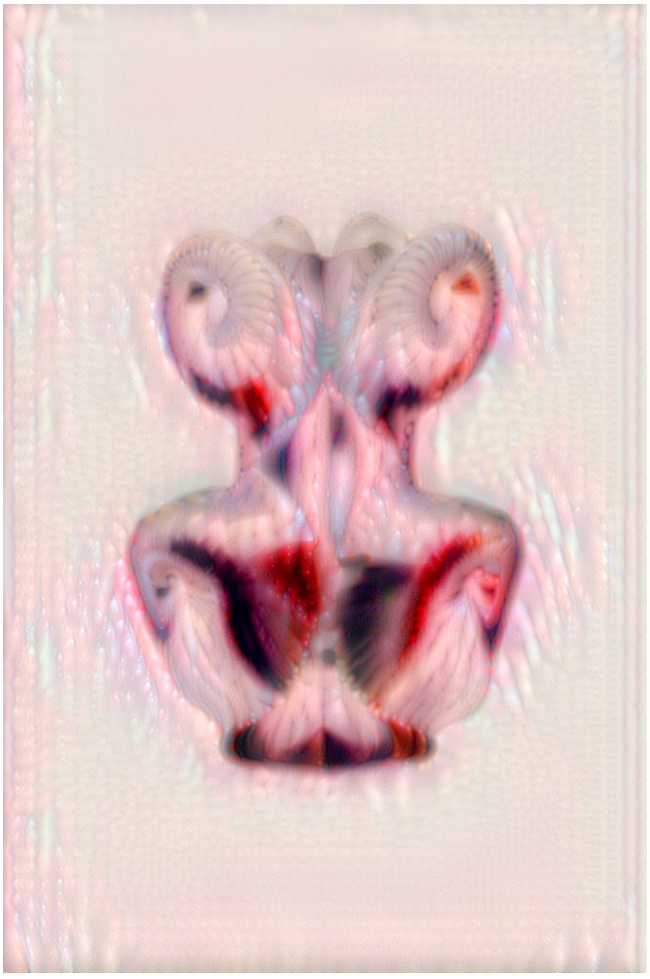
ART AND MACHINE LEARNING
CMU 2019 SPRING
PROJECT 1

SUBSTRATA



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DESCRIPTION

Concept:

Despite the biomimicry of early neural networks, the performance of recent AI systems improves in leaps and bounds as intelligent agents crushing human pros at various venues where epitomes of human intelligence are displayed. It's no longer sensible to anthropomorphize AIs not only because how their biological counterparts are dwarfed abysmally in comparison but also the logic underpinning their developments are more and more apathetic toward the neural substrates of a human brain. Our project explores this disheartening alienation between these two forms of intelligence by spotlighting what could be interpreted as one of its historical precedents in the recent past - an overcompensating trickery between the human body and its enclosure courtesy of the works by Iris van Herpen.

We see Herpen's answers to donning as along the lineage of discontent toward the deadpan aesthetic of early modernism. For Herpen, the Cartesian grid and analytic geometry are far from satisfactory when it comes to the encasement of the human torso and she resorts to parametric articulation and algorithmic genesis as if those scrutiny could bring the garment on par with its living host. Those nonlinear compartments oozing perfection thrive and populate on top of a mundane anatomy and overshadow the somatic narrative that has triggered their formulation in the first place. How did a strategy that purported to harmonize and reconcile end up estranging and antagonizing? The project articulates those concerns and frustrations not to reinvent but to backpropagate, to take a bold leap back to a dangerously literal understanding of Herpen's inception,in the form of a delusional remedy. We exploit the corrosive power of Style Transfer to corrupt Herpen's picture perfect ascetics with a brute answer to what makes us human, our flesh and blood.

Technique:

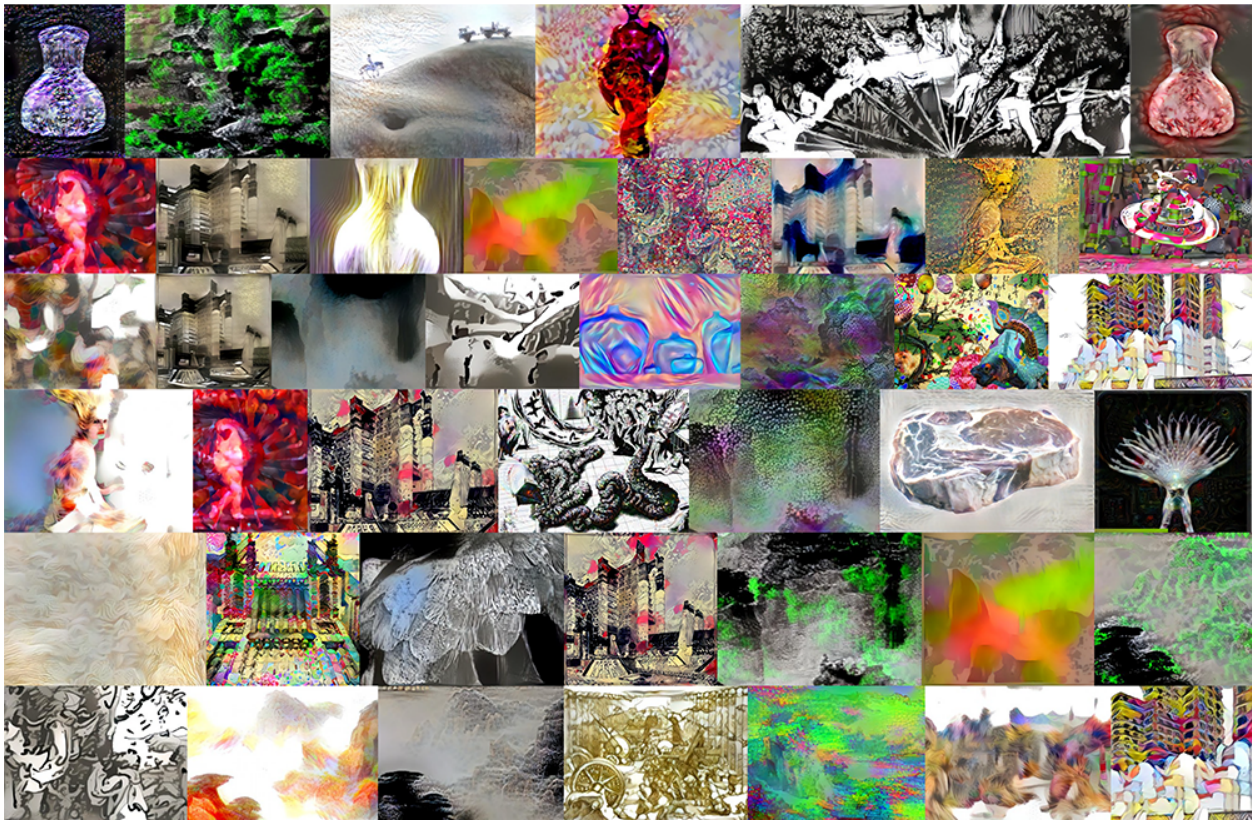
Online Generator:
We used ***deepdreamgenerator.com*** for guerrilla research, heuristic establishment as well as concept development. (See "Process" section in this report for details.)

Preprocessing:
We used ***Photoshop*** for input image preprocessing. This step enabled us to optimize certain aspects of the input image for better results. (See "Process" section in this report for details.)

Style Transfer:
We used ***style_transfer_keras.ipynb*** in the course AMI to conduct image synthesis. We explored different ways of parameter tuning. (See "Process: Program Tweaking" section in this report for details.)

Process:

First Round Experiment (Guerrilla Research with Online Generator):



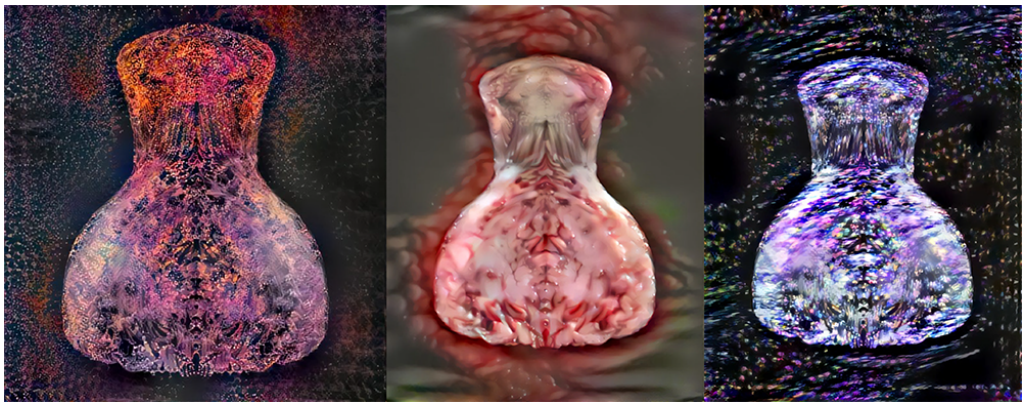
Since there are no guarantees for success given the faint predictability of this pipeline of visual synthesis, we first sketched cursively with the online generator. We run random trials with an assortment of images trying to make sense of the style transfer algorithm.

Developing Heuristics for Prescriptions:

Scant intuition and criteria exists for us to establish a thoroughly seasoned experimentation before any trials and feedbacks. However, during the first round of guerrilla experimentation we were able to develop several heuristics that informed our later selection of images for input:

- Content and style sharing similar complexity will have better outcome.
- Homologous inputs yield more integrated results.
- Figure/ground compositions could affect synthesis.
- Subordinate visual structures in content images also directs texture formulation.
- Content and style that command visual cues at different spatial frequencies pair well.

Second Round Experiment (Concept Development with Online Generator):



As a rule of thumb, in subsequent experiments we utilized style images with distinctive texture signature, such as points cloud. As for content, we opt for content images that have simple color palette but also have enough detail to support the population of style features. Beside the visual effect, we discussed the paradoxes in the age of AI in light of the ***Symposium***. Listed here are the paradox thematic pairs we explored in this round of experiments:

1. *Digital and Analog Representation of the World*

Content: Chinese Shan-shui (Impressionistic Representation: how human perceive the world)
Style: Point cloud (Infinitesimal Pixelation: how computer sample the world)

2. *Seismic Force Versus Swarms of Modernization*

Content: Chinese Shan-shui
Style: Urban landscape of high rises(Concrete Jungle)

3. *The Born and the Made*

Content: Glass (Artificial Material)
Style: Raw brain (Human Organs)

4. *Minimalist and Maximalist Interpretations of Future*

Content: Futurism architecture drawing (An Architectural Caprice of Early Industrialization)
Style: White model (Style Deprivation)

Third Round Experiment (Moving from Online Generator to Course AMI):

After some positive experience with the online generator we moved on to the course AMI, however with the same inputs the course AMI surprised us with results that are different from the online generators'. Before we further dive into the .ipynb, we did interjectural experiment to see whether we could manipulate and improve the result with preprocessing.

Preprocessing:

Before adjusting the code, we run several trial through Photoshop. we adjusted the color pallet and try to find the outcome that met our expectation. The preprocess experiment also provide designer's more idea on what parameter in the code might affect the outcome.

In code, we zero-center each color channel by subtracting the mean RGB value and unify the size of content and style image.

Program Tweaking:

Loss function adjustment.

We adjust the loss function to allow more flexibility and control of our final output.

$$\hat{y} = argmin_y \, \lambda_c \sum_j l_{feat}^{\Phi,j}(y, y_c) + \lambda_s \sum_J w_J l_{style}^{\Phi,J}(y, y_s) + \lambda_{TV} l_{TV}(y)$$

where $\lambda_c + \lambda_s + \lambda_{TV} = 1$ and $\sum_J w_j = 1$

The loss function from the original paper just uses one convolutional layer as the style layer and another as the content layer. We allow using more than one convolutional layers as the content and the style image layer. Furthermore we assign weights style layers because empirical evidence [2] shows that different convolutional layers yield significantly difference results so that we can tailor those weights components to get what we exactly want. Finally, in the original implementation the three λ does not sum to 1, and we normalize all λ's to make the final loss function more like a linear interpolation of different loss components.

Interface improvement.
We modify the notebook cells so that we can change parameters in one cell and better monitor and organize our experiment results.

Besides that, we tried to load a deeper CNN, inception-v3. However the p2.xlarge is not sufficient to run this model. So we give up and stick to VGG19.

Parameter Tuning:

Given the strong geometric pattern of our content image, we find out to make λ_c a little smaller yields more satisfactory results. A big λ_c will hold the lines and structures in content image and thus when another style comes in, the final output turns to be rather messy. A weaker content signal can let the coming style fuse in more naturally. The λ_c of our final results is around 0.1 and strictly below 0.4.

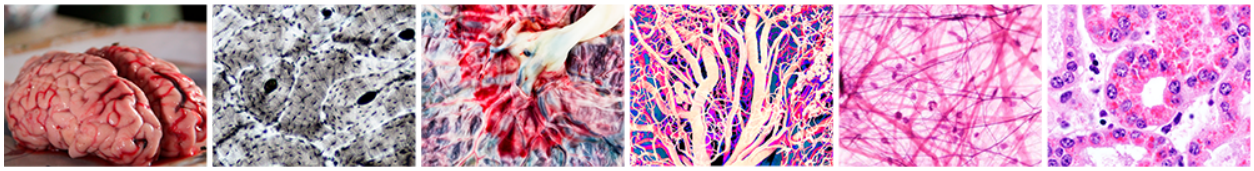
We assign more style weights to lower level convolutional layers. It is because the lower level convolutional layers deal with smaller regions in the style image, and we want a relatively small receptive field when applying the style to our content image instead of making each small region in the content image to swallow a big area in style image.

Fourth Round Experiment (Thematic Consolidation):

With all those directions we could possibly take we walked through each of them again taking into consideration: aesthetic novelty, fidelity, conceptual maturity, and pertinence. We finally decided to go with the *'Iris van Herpen Dresses"-"Body Microscopic Images"* pair.

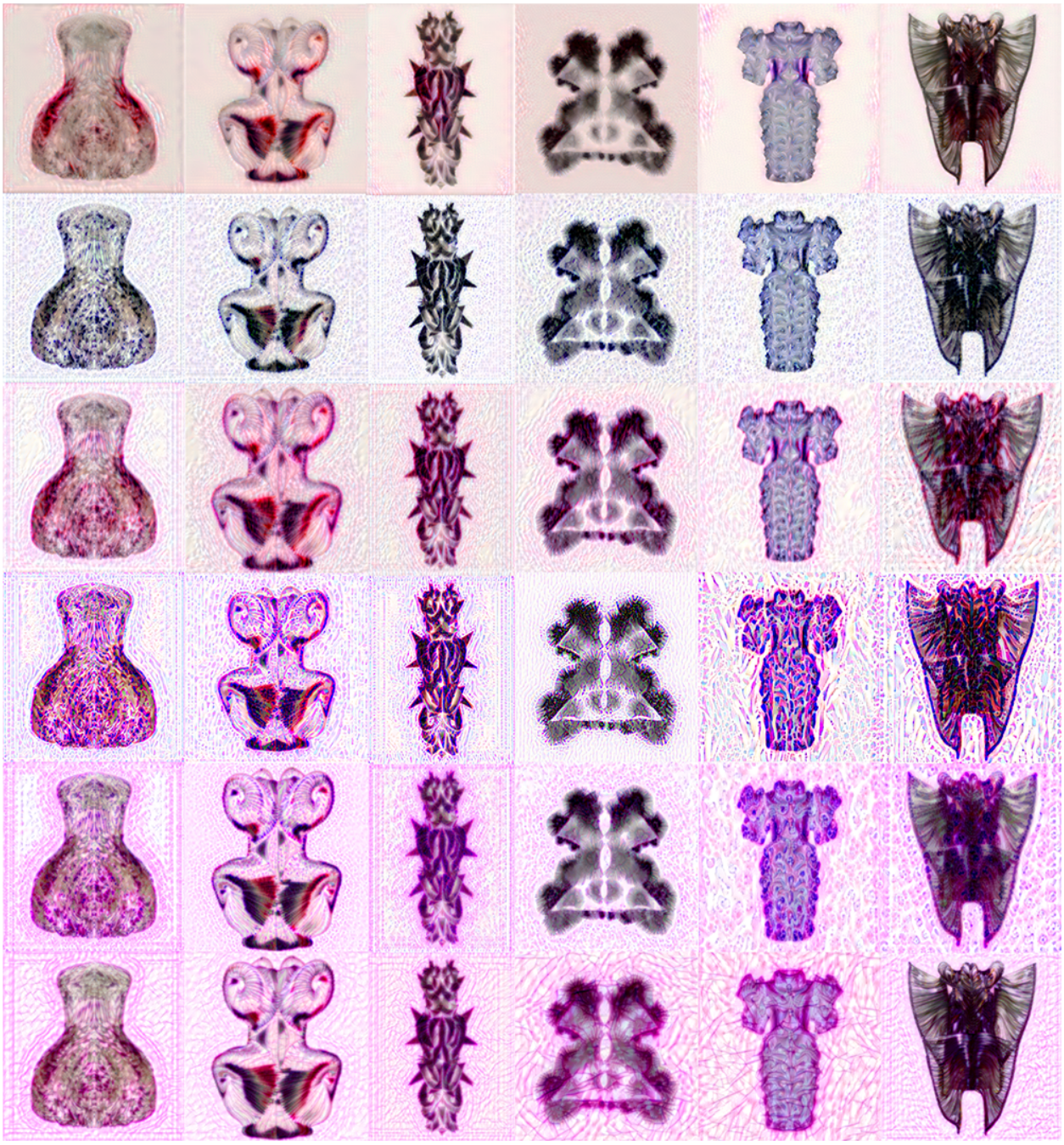
Content Images:

Style Images:



Result:

Our original selection of seven dresses and six microscopic images of the body yield in total forty two different combinations. Human experimenter then applied post hoc evaluation regarding the aesthetic and fidelity of these outcomes. Most satisfactory pairs are further reproduced with fine tuned parameters.



Reflection:
Our final collection consists of four pairs of the original forty two varieties. The couples and the rationale for their win-out are as follows:

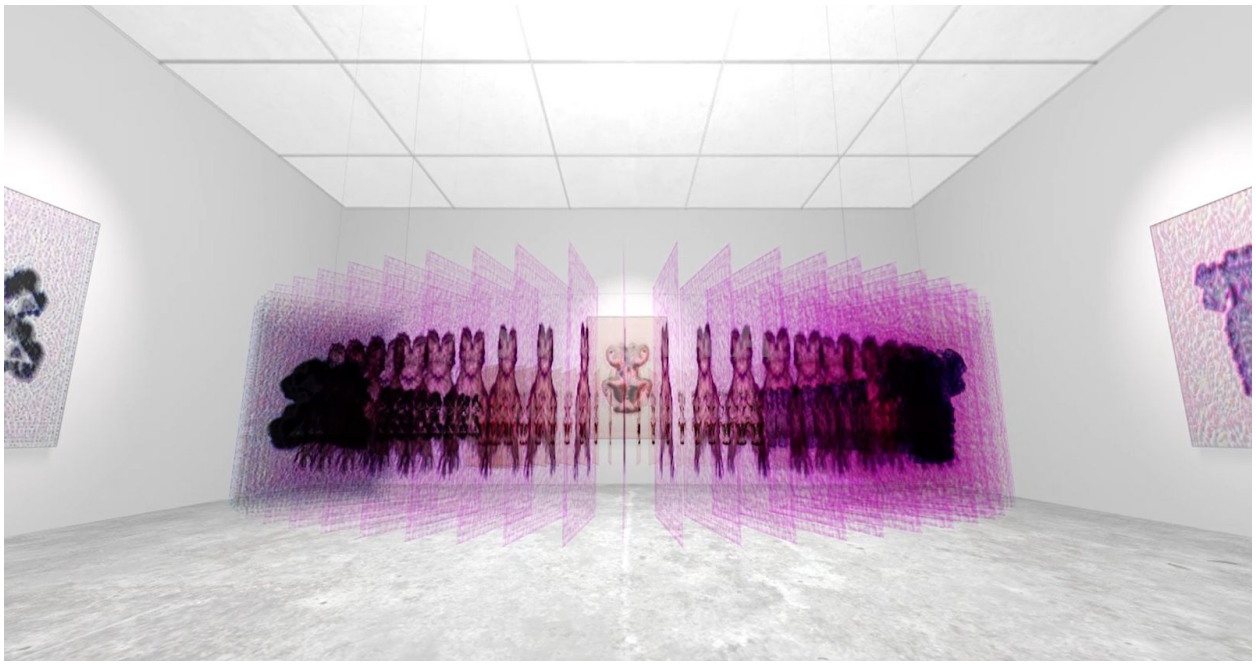
Dress No.2 ❤ *Brain*: The two sources of input grow into each other seamlessly as the sulcus coagulates around the “horns of the satyrs”.

Dress No.3 ❤ *Bone:* Bone gives rise to a colorway that excels among this sanguine ensemble. The synergy surprisingly connotes an eerie sense of winter with salt and pepper and fractal pines. It’s the semantically most saturated candidate of all.

Dress No.5 ❤ *Placenta:* As we mainly sought the convergence of content and style signature within the subject matter, in this trial the iterations revitalized the underdeveloped real estate with features that complement the figure image, revealing a figure/ground relationship we didn’t pay much attention to.

Dress No.7 ❤ *Tissue:* The semantic scaffold of the content image directs the texture strokes to form layers upon layers of marine tremors.

Mock Exhibition Setup:



Four best images were selected from the outcome collection for the mock exhibition which aims to provide a possible immersive experience. The central installation reveals the iteration process of the style transfer.

Reference:
[1] https://towardsdatascience.com/practical-techniques-for-getting-style-transfer-to-work-19884a0d69eb
[2] IRIS VAN HERPEN: TRANSFORMING FASHION, High Museum of Art, NOVEMBER 7, 2015–MAY 15, 2016
https://www.high.org/exhibition/iris-van-herpen/
[3] J. Johnson, A. Alahi, and L. Fei-Fei. Perceptual losses for real-time style transfer and super-resolution. 2016.

CODE: https://github.com/zxyao/10615/tree/master/proj1

RESULT: https://github.com/zxyao/10615/tree/master/proj1/final_results

CONTRIBUTION:

Yixiao Fu:

- Concept development
- Preliminary sketches
- Experiment design and run
- Mock exhibition design and virtual runthrough
- Report draft
- Presentation

Yi-Chin Lee:

- Concept development
- Preliminary sketches
- Experiment design and run
- Process documentation
- Report draft
- Presentation

Jiyuan Li:

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- Preliminary sketches
- Experiment design and run
- Report draft
- Presentation

Zixiao Yao:

- Concept development
- Preliminary sketches
- Program modification and parameter tuning
- Report draft
- Presentation