Textile-GAN: Texture synthesis based on aesthetic evaluation with generative adversarial networks

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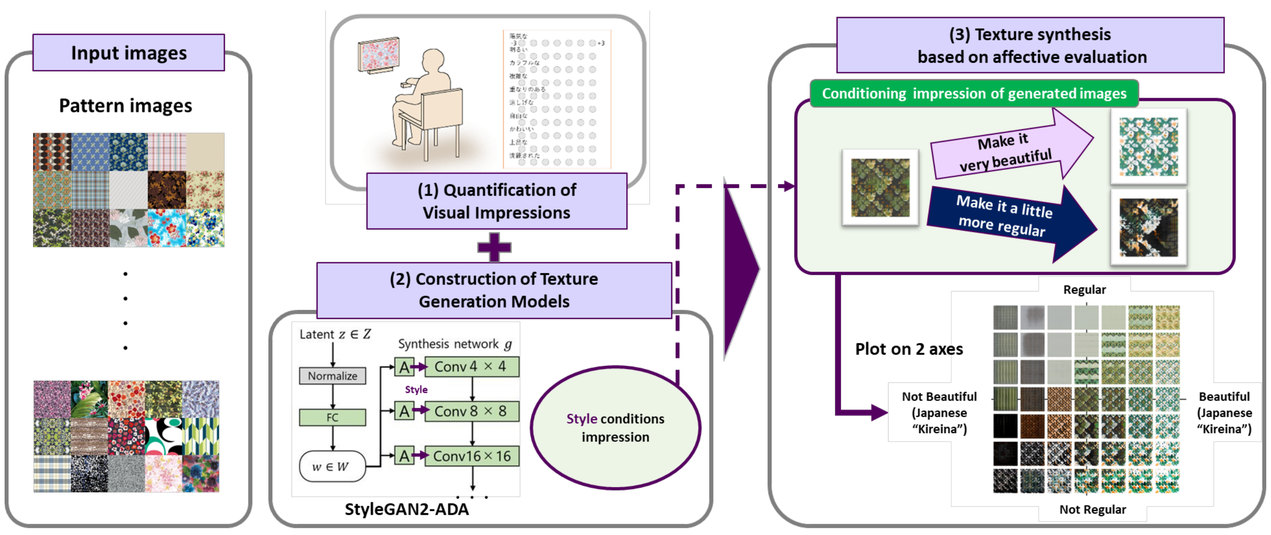
Introduction

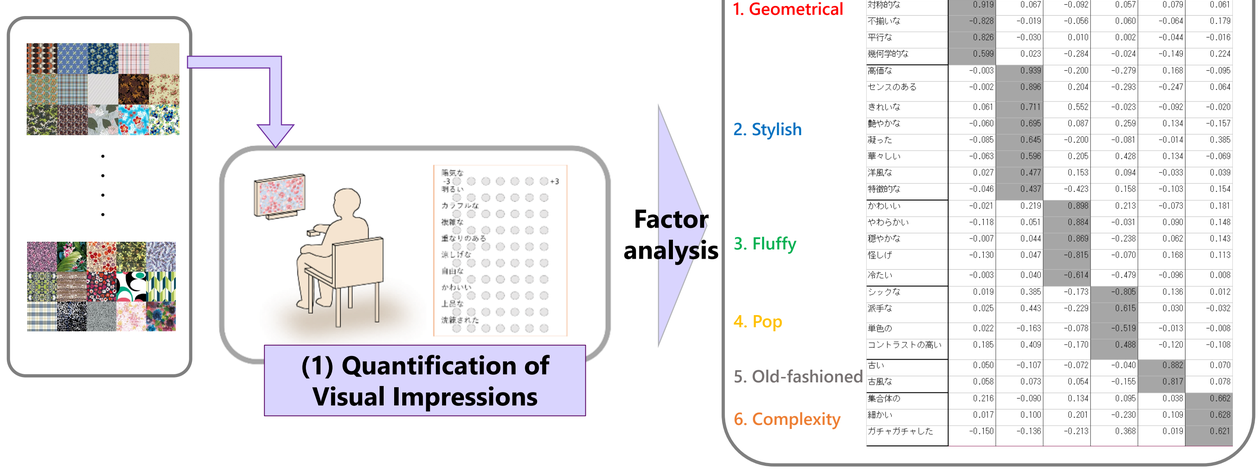
- Background
  - The promotion of design that respects each person's individuality
    - Reduction of human and resource costs
    - Increased individual and social well-being
  - In the field of product design, it is important to understand user needs and reflect them in products
    - Quantification of visual impressions (aesthetics)[1]
      - [1] Impression Estimation Model for Clothing Patterns Using Neural Style Features（Sunda et al., 2020）
  - Texture generation technology
    - No technology has been established to generate textures for garments with the desired impression.
    - Focus on GANs (generative adversarial networks)
- Purpose
  - Textile-GAN: a method for generating textures (patterns) with the desired aesthetic texture

Proposed Method



(1) Quantification of Visual Impressions (aesthetics)

- Impression evaluation experiment using crowdsourcing
  - Participants: 1,188
  - Stimuli: 4,036 pattern images
  - Evaluation words: 28 impression words
  - Procedure: 7-point Likert scale
- Factor analysis
  - 6 factors were extracted



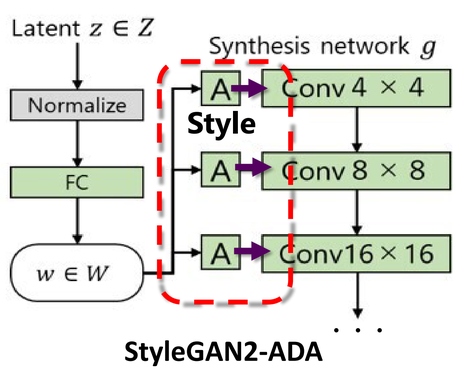
	第1因子	第2因子	第3因子	第4因子	第5因子	第6因子
規則的な	0.951	-0.026	0.026	0.027	0.021	0.096
均等な	0.935	-0.058	0.102	0.007	0.059	0.087
対称的な	0.919	0.067	-0.092	0.057	0.079	0.061
不揃いな	-0.828	-0.019	-0.056	0.060	-0.064	0.179
平行な	0.826	-0.030	0.010	0.002	-0.044	-0.016
幾何学的な	0.599	0.023	-0.284	-0.024	-0.149	0.224
高価な	-0.003	0.939	-0.200	-0.279	0.168	-0.095
センスのある	-0.002	0.896	0.204	-0.293	-0.247	0.064
きれいな	0.061	0.711	0.552	-0.023	-0.092	-0.020
鮮やかな	-0.060	0.695	0.087	0.259	0.134	-0.157
凝った	-0.085	0.645	-0.200	-0.081	-0.014	0.385
華々しい	-0.063	0.596	0.205	0.428	0.134	-0.069
洋風な	0.027	0.477	0.153	0.094	-0.033	0.039
特徴的な	-0.046	0.437	-0.423	0.158	-0.103	0.154
かわいい	-0.021	0.219	0.898	0.213	-0.073	0.181
やわらかい	-0.118	0.051	0.884	-0.031	0.090	0.148
穏やかな	-0.007	0.044	0.869	-0.238	0.062	0.143
怪しげ	-0.130	0.047	-0.815	-0.070	0.168	0.113
冷たい	-0.003	0.040	-0.614	-0.479	-0.096	0.008
シックな	0.019	0.385	-0.173	-0.805	0.136	0.012
派手な	0.025	0.443	-0.229	0.615	0.030	-0.032
単色の	0.022	-0.163	-0.078	-0.519	-0.013	-0.008
コントラストの高い	0.185	0.409	-0.170	0.488	-0.120	-0.108
古い	0.050	-0.107	-0.072	-0.040	0.882	0.070
古風な	0.058	0.073	0.054	-0.155	0.817	0.078
集合体の	0.216	-0.090	0.134	0.095	0.038	0.662
繊細な	0.017	0.100	0.201	-0.230	0.109	0.628
ガチャガチャした	-0.150	-0.136	-0.213	0.368	0.019	0.621

(2) Construction of Texture Generation Models

- Construction of texture generation models using StyleGAN
  - Version of StyleGAN：StyleGAN2-ADA
    - GAN using style transfer technology (**Style**)
    - High-resolution images can be generated
- Methods

Input images : 4,036 pattern images

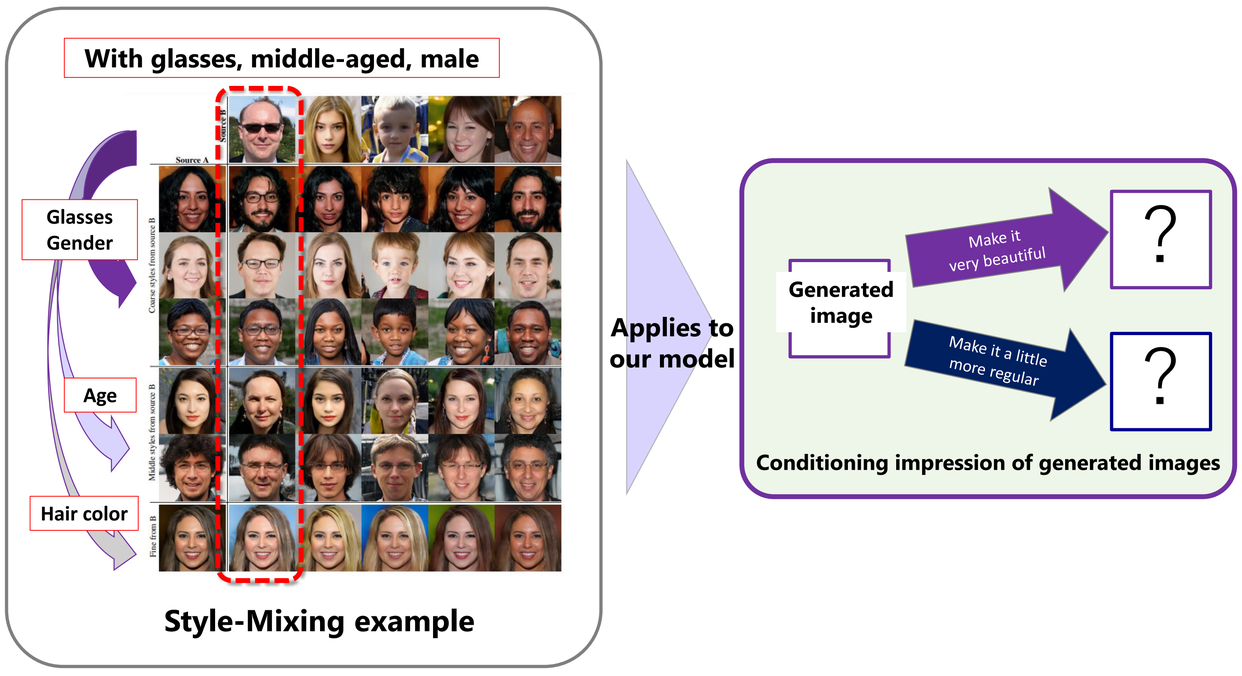
impression values representing the degree of conformity to each impression word in (1) experiment



Impression conditioning of generated images by Style is inferred to be possible

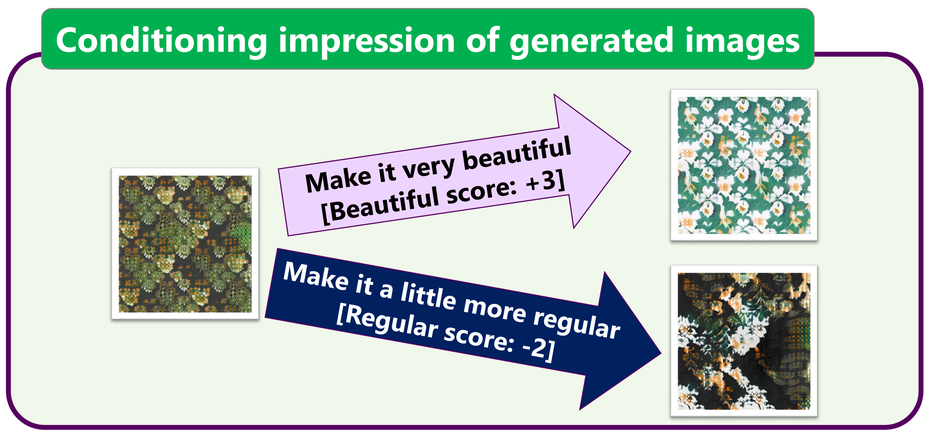
- The expressive power of **Style** in StyleGAN
  - "Style Mixing"
    - Mixable image features by **Style**
    - Ex.) Human faces (age, gender, with or without glasses, hair color)

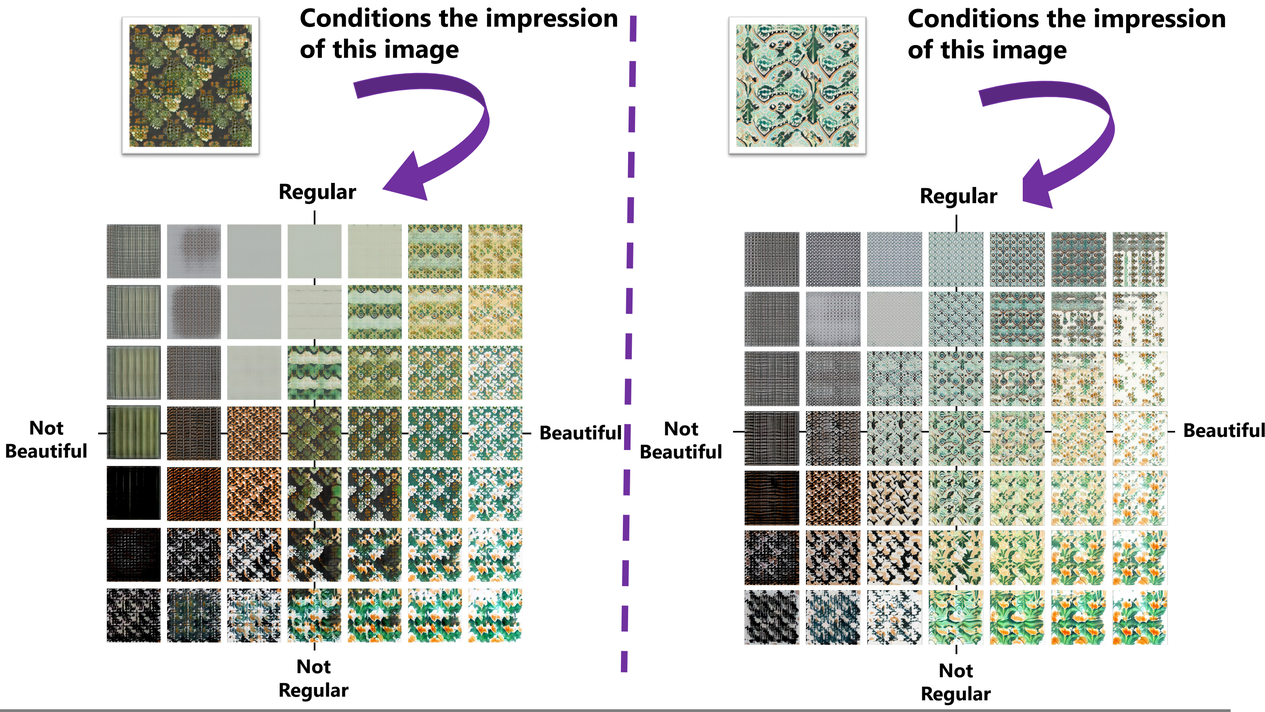
Estimated to be highly expressive in the conditioning of pattern images



(3) Texture synthesis based on affective evaluation

- Conditioning of generated images
  - Evaluation words: "Regular," "Beautiful"
    - "Not very regular" ~ "Very regular"
      "Not very beautiful" ~ "Very beautiful"
      7-point Likert scale [score: -3 ~ +3] in (1) experiment





Conclusion

- Propose a method for generating textures (patterns) with the desired aesthetic texture
  - Quantification of visual impressions using construction models
  - Impression conditioning of generated images by Style
- Future study
  - Evaluate and improve the generated images' quality and condition them
    - Repeatability of the generated pattern image
    - Analysis of whether the evaluation terms are correctly reflected