Image Quilting for Texture Synthesis and Transfer

N8EN11D Projet Traitement d'image / Image Processing project

Figure 1: On the left, an example of texture generation from an input texture using the Quilting algorithm. On the right, another application of the algorithm to transfer an existing texture to another image.

1 Introduction

Texture synthesis is the process of generating a larger texture from a given exemplar in a way that preserves its visual characteristics. Traditional methods operate at the pixel level, but these approaches often struggle to maintain global structures and coherent texture patterns. Patch-based texture synthesis methods, such as the one presented by Efros and Freeman in their paper "Image Quilting for Texture Synthesis and Transfer" [3], address these limitations by copying and blending small texture patches instead of synthesizing individual pixels.

In this project, you will implement the Image Quilting algorithm, which uses overlapping patches and the Minimum Error Boundary Cut method to stitch them together seamlessly. The goal is to gain hands-on experience with texture synthesis and evaluate the effectiveness of the algorithm using quantitative metrics.

2 Project Objectives

1. **Implementation**
   - Implement the Image Quilting algorithm as described in the paper, using any programming language of choice (C++, Python, or MATLAB).
   - Ensure the implementation is well-structured and modular, with appropriate function decomposition.
   - Use the same parameters as described in the paper and allow for flexible input handling. The implementation should work with any given image and a set of user-defined parameters.
   - *While not required, you can optimize their implementation with parallelization techniques* e.g.*, OpenMP for C++,* ***parfor*** *for MATLAB* etc.*) only if you are already familiar with such methods. The main focus should be on correctness and evaluation.*

2. **Evaluation and Analysis**

   - To test and evaluate the implementation you can use standard texture datasets like the "Brodatz Texture Dataset" [1] or the "MIT Vision Texture (VisTex) Dataset" [4] or the "CuRRET Reflectance and Texture Database" [2].
   - To assess the quality of the synthesized textures, evaluate the results using **quantitative metrics**. A possible approach could be measuring the similarity between (patches of) the synthesized texture and (patches of) the original texture with metrics such as **Structural Similarity Index** (SSIM) [6] (*c.f.* OpenCV's implementation [5]) or other metrics such as Learned Perceptual Image Patch Similarity (LPIPS) [7].

References

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