# CS 663: Digital Image Processing (Project Presentation)

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# Topic: Image Quilting for Texture Synthesis and Transfer

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# AIM

- Take a sample of texture, and generate an unlimited amount of image data which, while not exactly like the original, will be perceived by humans to be the *same texture*.
- Furthermore, it would be useful to be able to transfer texture from one object to another.
- The implemented algorithm synthesizes new texture by taking patches of existing texture and stitching them together in a consistent way.

# MOTIVATION FOR PATCH-BASED APPROACH

- In one-pixel-at-a-time synthesis algorithms, most complex textures have very few pixels which  actually have a choice of values that can be assigned to them.
- Most pixels have their values totally determined by what has been synthesized so far.
- The above effect, commonly seen in structured textures, persists to a lesser extent even when the texture is more stochastic.
- This motivates to take element of synthesis as a patch rather than a single pixel.

# ALGORITHM*

1. Go through the image to be synthesized in raster scan order in steps of one block (minus the overlap).
2. For every location, search the input texture for a set of blocks that satisfy the overlap constraints (above and left) within some error tolerance. Randomly pick one such block.
3. Compute the error surface between the newly chosen block and the old blocks at the overlap region. Find the minimum cost path along this surface and make that the boundary of the new block. Paste the block onto the texture. Repeat

## User controlled parameters: Block size, overlap size

** Cited from the above paper*

# Minimum Error Boundary Cut

$$E_{i,j} = e_{i,j} + \min(E_{i-1,j-1}, E_{i-1,j}, E_{i-1,j+1})$$

where, i, j is row and column number

, $e_{i,j}$ is error surface computed as L2 norm of difference between pixel values

- The position of the min. value in the last row of E will indicate the end of the minimal vertical path through the surface.
- Back-tracing gives the path of the best cut through the overlap region

# TEXTURE TRANSFER

- If we modify the synthesis algorithm by requiring that each patch satisfy a desired correspondence map, C, as well as satisfy the texture synthesis requirements, we can use it for texture transfer.
- The correspondence map is a spatial map of some corresponding quantity over both the texture source image and a controlling target image.
- For texture transfer, image being synthesized must respect two independent constraints:
  a) the output is a legitimate, synthesized example of the source texture
  b) that the correspondence image mapping is respected.
- Hence, we modify the error term by the use of an ‘alpha’ parameter which determines the tradeoff between the texture synthesis and the fidelity to the target image correspondence map.

# RESULTS

TEXTURE SYNTHESIS

Input image

Block size=60, overlap size=10

Input image

Block size=64, overlap size=30

Input image

Block size=60, overlap size=10

Input image

Block size=100, overlap size=30

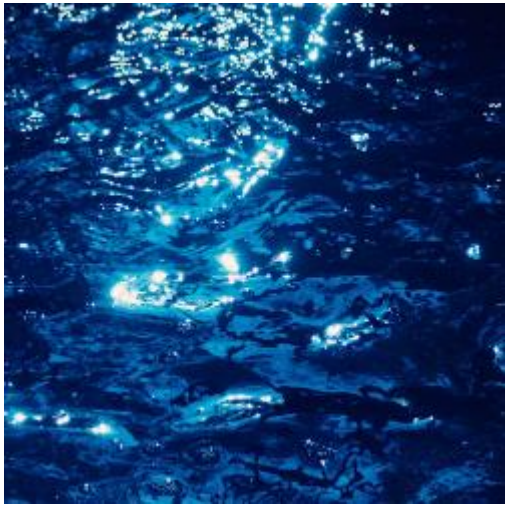
Input image

Block size=60, overlap size=10

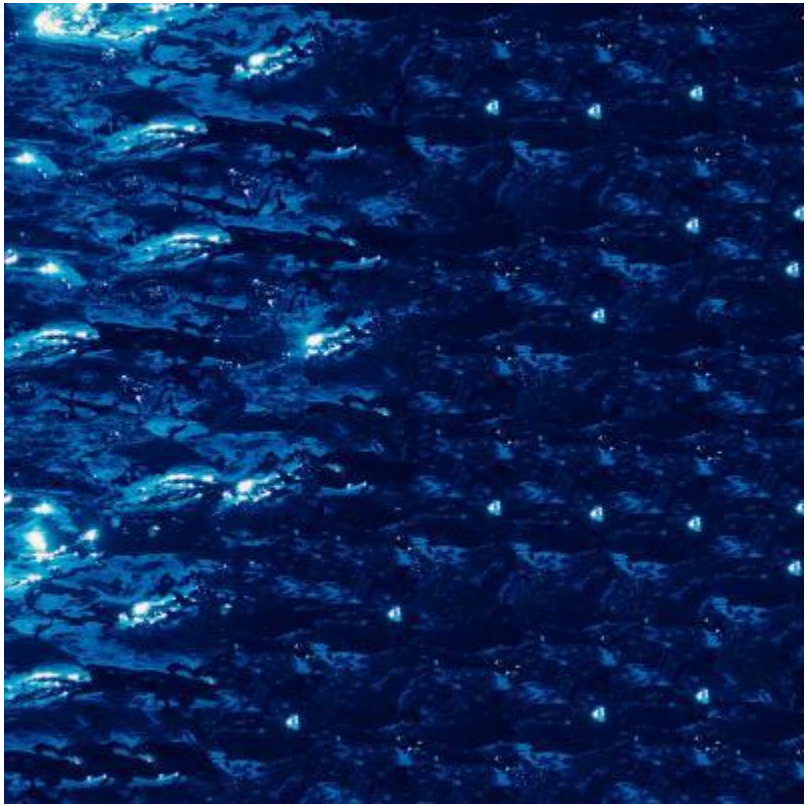
Input image

Block size=100, overlap size=30

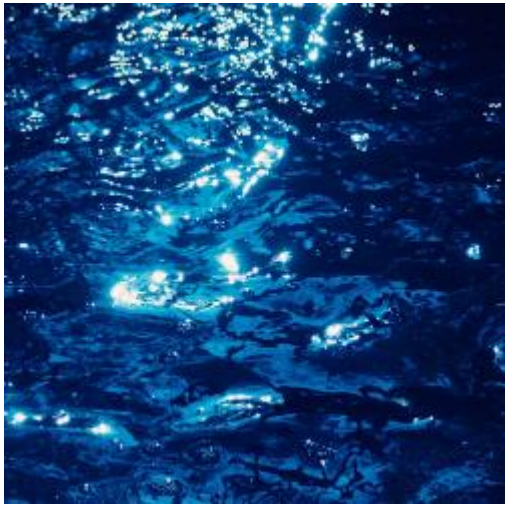
Input image



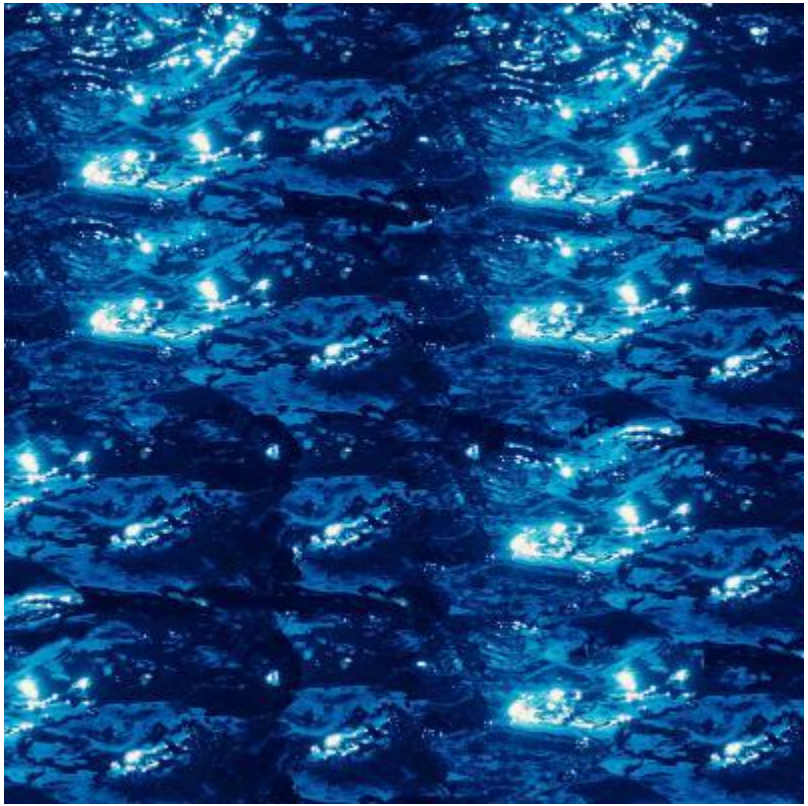
Block size=60, overlap size=10



Input image



Block size=150, overlap size=50



Input image

Block size=100, overlap size=30

Input image

Block size=60, overlap size=10

# RESULTS

TEXTURE TRANSFER