Multiresolution Sampling Procedure For the Analysis And Synthesis Of Texture Images

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The Problem:
We are developing new techniques for treating input texture images as probability density estimators from which we can sample new textures, with similar appearance and structural properties.

Motivation:
The goal of texture synthesis is to generate a new image from an example texture, such that the new image is *sufficiently different* from the original yet still appears as though it was generated by the *same underlying stochastic process*. If successful, the new image will differ from the original, yet have perceptually identical texture characteristics.

Previous Work:
Recently several attempts at developing such techniques have been successful in limited domains. Most notably Heeger and Bergen [1], who iteratively resample random noise to coerce it into having particular multiresolution oriented energy histograms.

Approach:
The approach presented here uses the results psychophysical models to provide constraints on a statistical sampling procedure. In a two-phase process, the input texture is first analyzed by measuring the joint occurrence, across multiple resolutions, of several of the features used in psychophysical models. In the second phase, a new texture is synthesized by sampling successive spatial frequency bands from the input texture, conditioned on the similar joint occurrence of features at all lower spatial frequencies. By rearranging textural components at locations and resolutions where the discriminability is below threshold, new texture samples are generated which have similar visual characteristics. Several results of this method are shown in Figure 1.

Difficulty:
The goal of texture synthesis is to generate a texture which is both random and perceptually identical to the original texture. To do this the synthesized texture must appear to have been generated by the same underlying physical process as the original. However, this process is unknown and the success of synthesis depends upon its ability to discover it.

Impact:
From this research new models of probabilistic texture generation have developed. These suggest underlying image representations which can be used in computer vision and image database technology.

Future work:
New texture discrimination techniques, which is a large component of general image recognition, can be developed as a result of this research.

Research Support:
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References:

[1] Heeger, D. J. and Bergen, J. R.1995. Pyramid based texture analysis/synthesis. In *Computer Graphics*, pages 229–238. ACM SIGGRAPH.

[2] De Bonet, J. S.1997. Multiresolution sampling procedure for analysis and synthesis of texture images. In *Computer Graphics*. ACM SIGGRAPH.

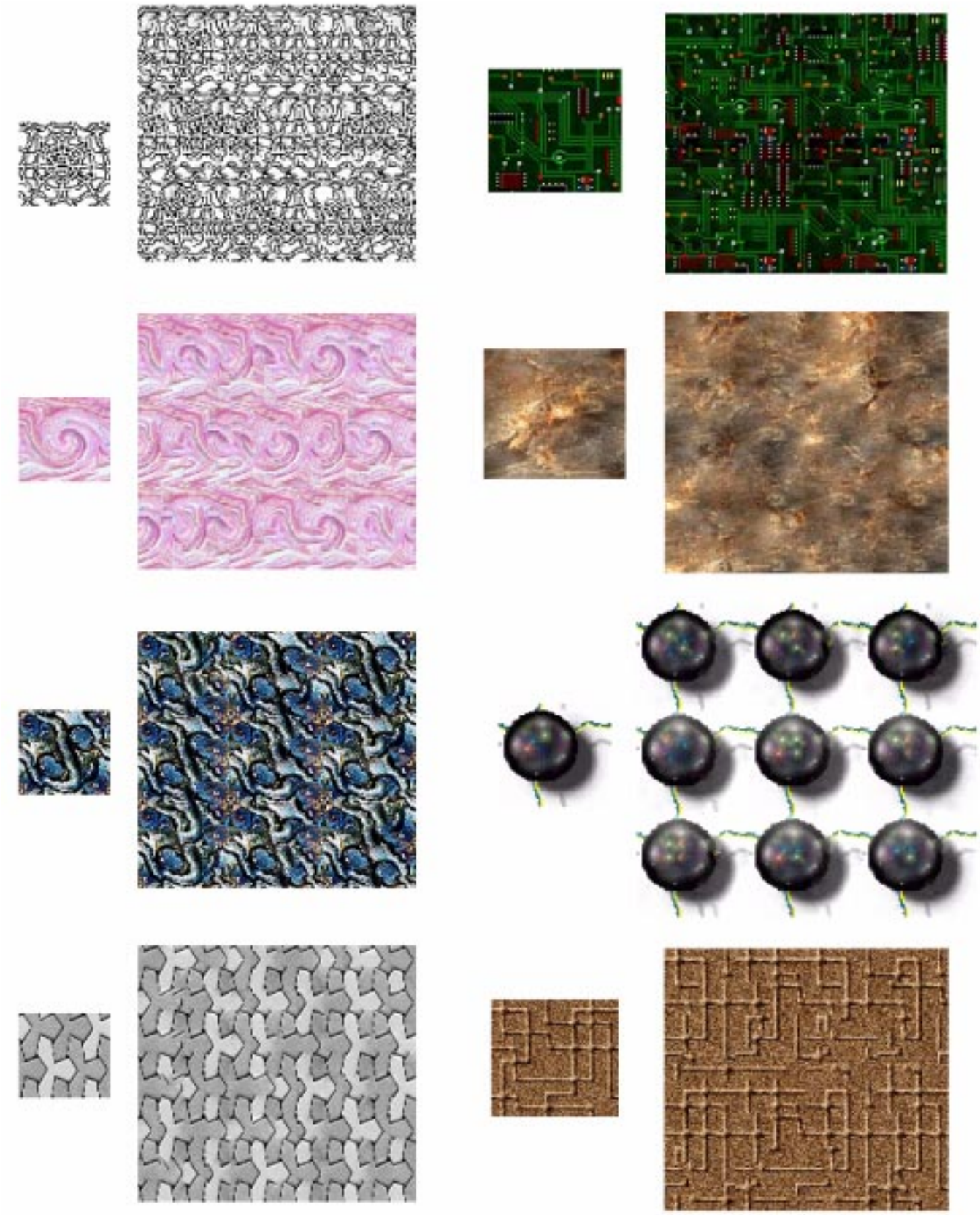

Figure 1: Texture synthesis results. The smaller patches are the input textures, and to their right are synthesized images which are 4 or 9 times larger.