Therefore we have to design random patterns with the following properties

- the images will look homogeneous in spite of the repetitive basic pattern that appears in them (i.e. we need processes that are self similar under scalings).
- their autocorrelation leads to strong peaks at the correct disparities (i.e. high $R''(0)$)

So far WHITE NOISE PATTERNS with $R(\tau) \sim \delta(\tau)$ seem to be great for both reasons above but they lead to

STRONGLY SEPARATED PEAKS & WILL MAKE IT DIFFICULT TO "LOCK" INTO THE NON PLANAR INTERPRETATION.

FIGURES 4.

Therefore we argue that

- WHITE NOISE leads to SHARP A.S. IMAGES
  difficult to "LOCK INTO" depth perception
- $1/f$ NOISE leads to SHARP A.S. IMAGES
  optimal "LOCK IN" properties
- $1/f^{2+}$ NOISE leads to more and more BLURRED A.S. effects with good LOCK IN to blurred depth perception ...

Hence, under the Λ-model considered,

$1/f$ NOISE is OPTIMAL for AUTOSTEREO EFFECTS: Λ peaks are narrowing with decreasing scale in direct proportion to scale!

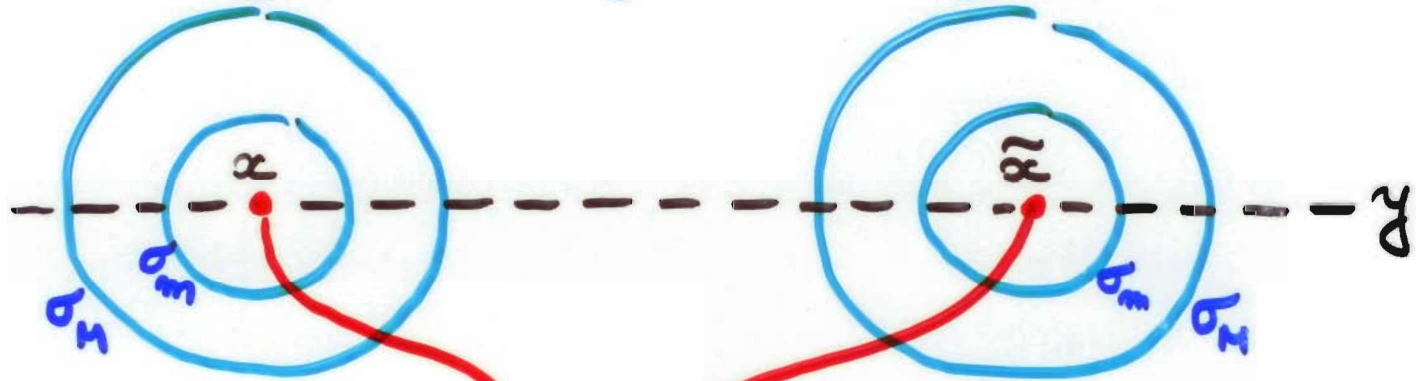
EXAMPLES:

Figures 5: generated with independent lines

Figures 6: generated with correlated lines

So far our discussion was in 1-D, doing (horizontal) line-by-line analysis. E_ω was an operator assumed to be implemented via averaging in the vertical direction.

The eyes certainly do something different.



$$\left(I_\sigma(x,y) - I_\sigma(\tilde{x},y)\right)^2$$

$$\downarrow$$

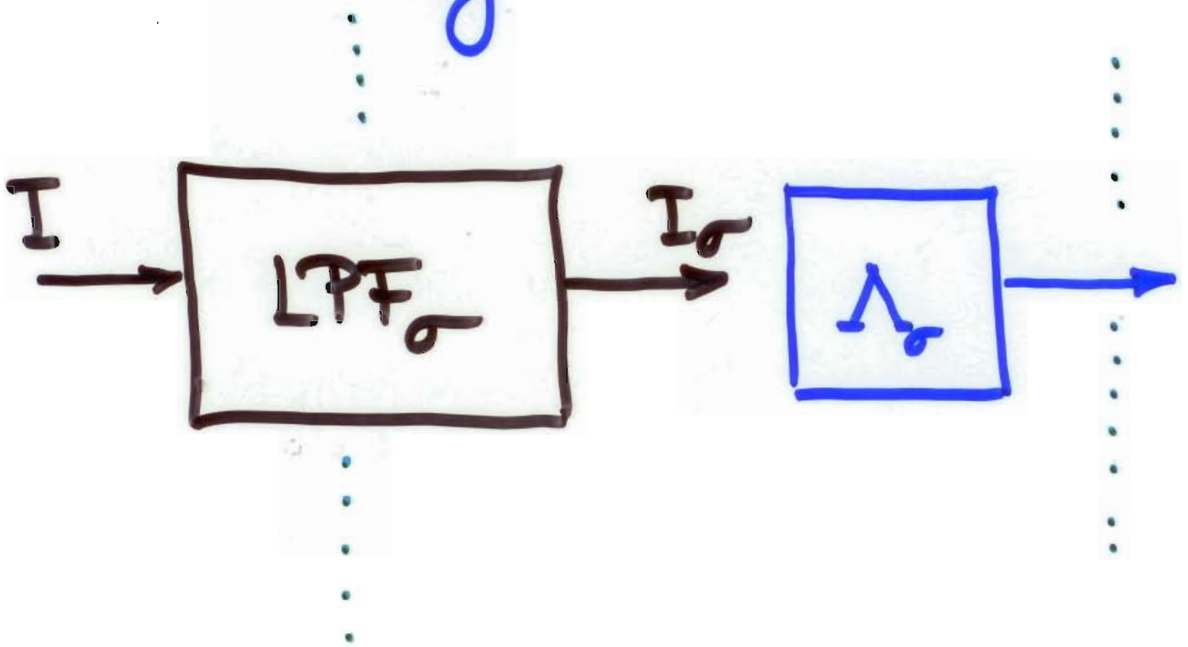
$$\boxed{\text{2D LPF}}$$

$$\downarrow$$

estimate of $E_\omega\left(I_\sigma(x,y) - I_\sigma(\tilde{x},y)\right)^2$

So we need to design $I_\omega(x,y)$ so as to get the desired (1D) behavior for $E_\omega(\cdot)$ here

We are led to consider a more refined model for $\Lambda(x,\bar{x})$ based on the assumption that the visual system performs a SCALE SPACE MATCHING PROCESS & ANALYSES A SEQUENCE of functions $\Lambda_\sigma(x,\bar{x})$ based on filtered versions of $I(x,y)$; $I_\sigma(x,y)$. On each scale we have a random process with correlation $R_\sigma(\tau)$ and we should have $R_\sigma(\tau)$ get narrower & narrower with decreasing σ.



This model leads to 2D basic pattern designs of the form

$$I(x,y) = \sum a_i \sin(i\omega_0 + \phi_{iy})$$

with $E a_i^2 \propto 1/i$ and ϕ_{iy}'s performing a random walk from line to line :

$$\phi_{iy+} = \phi_{iy} + \underbrace{\delta}_{\text{correlation factor}} \underbrace{\xi_i}_{\text{(iid)}} / \sqrt{i}$$

The basic patterns designed this way best "SIMULATE" the 1D results in the framework of the "more realistic" 2D processing model.

See Figure 6

for results with various δ's

(for $1/f$ noise & $1/f^2$ noises)

FIGURE 5(a)

FIGURE 5(b)

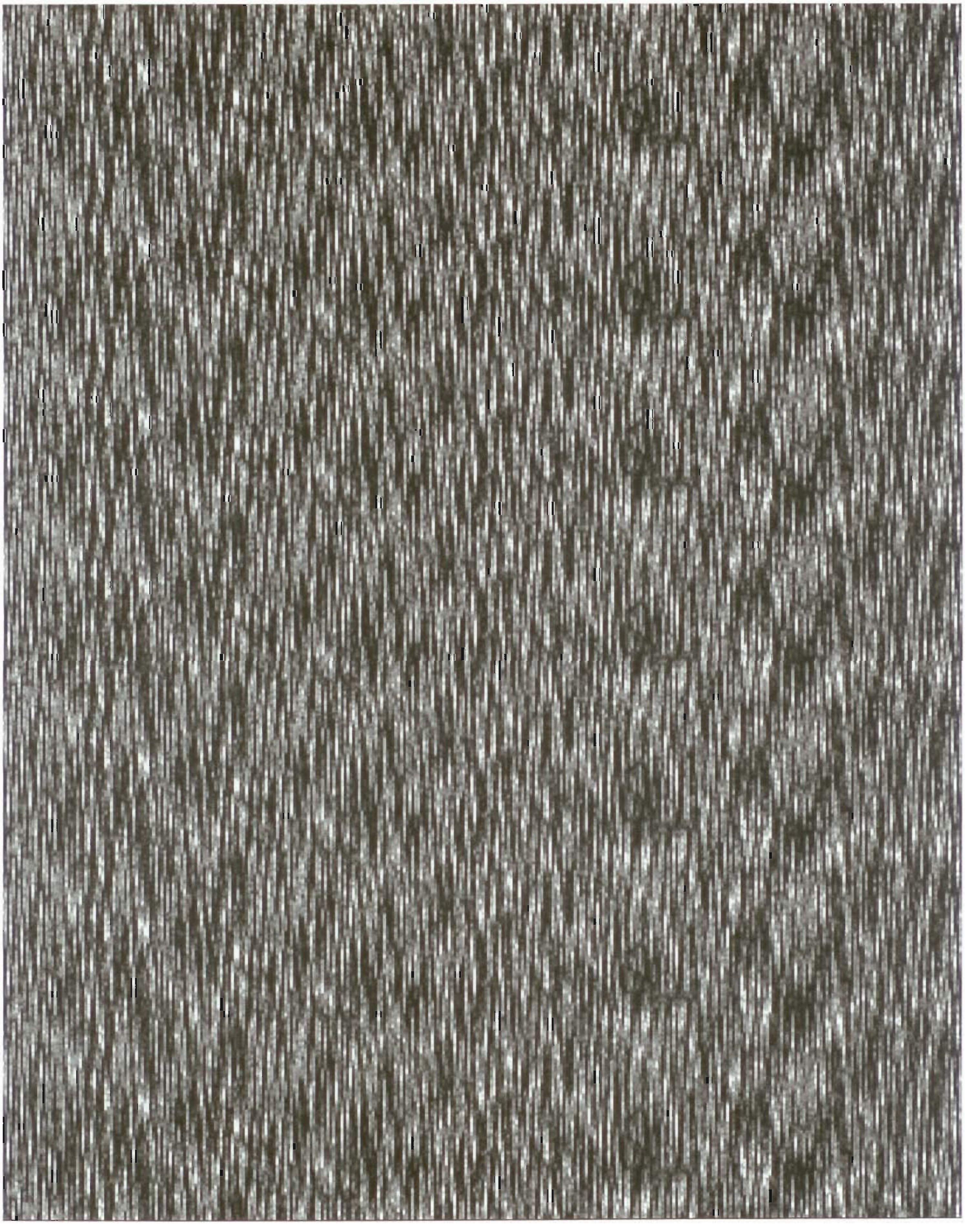


FIGURE 5(c)

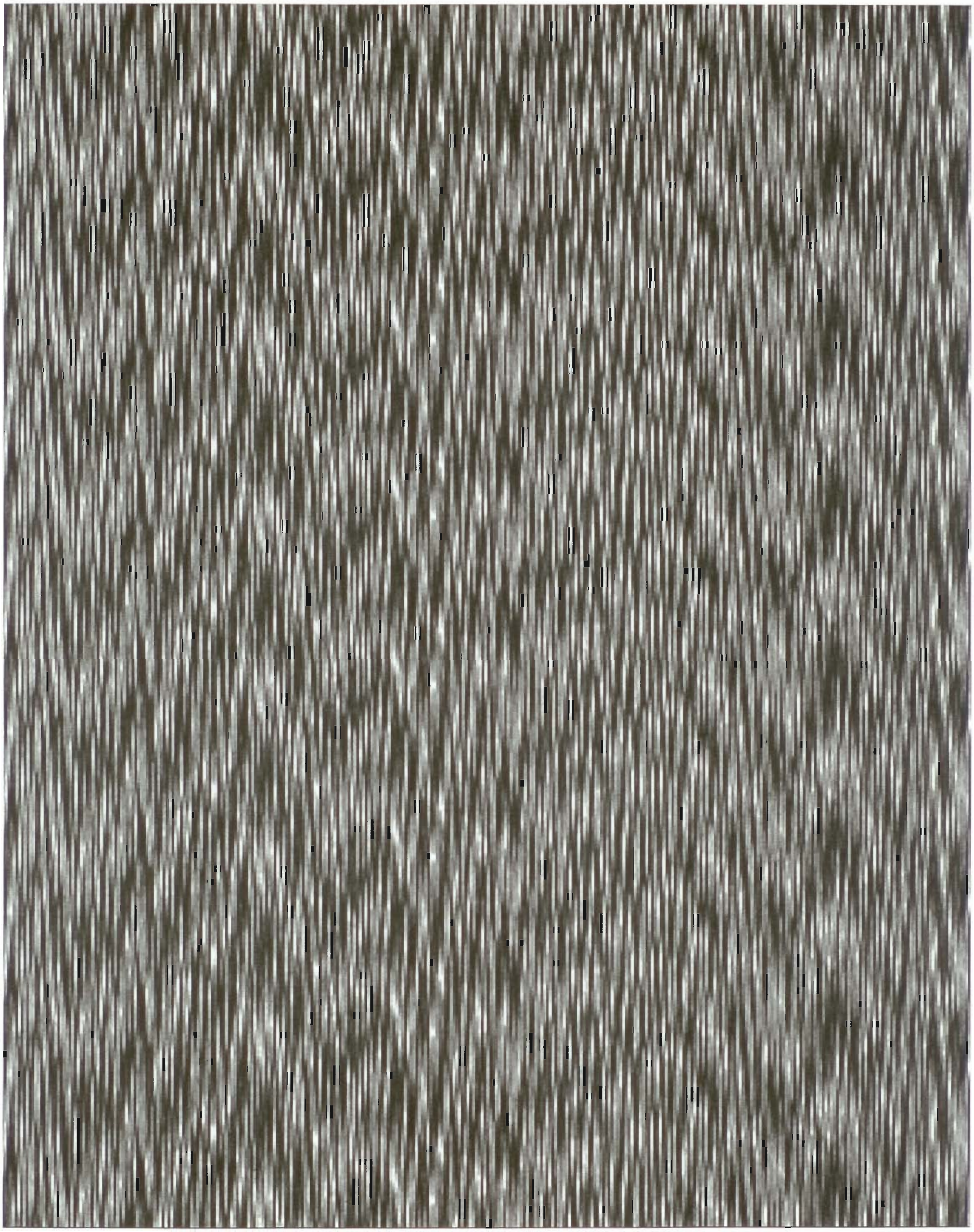


FIGURE 5(d)

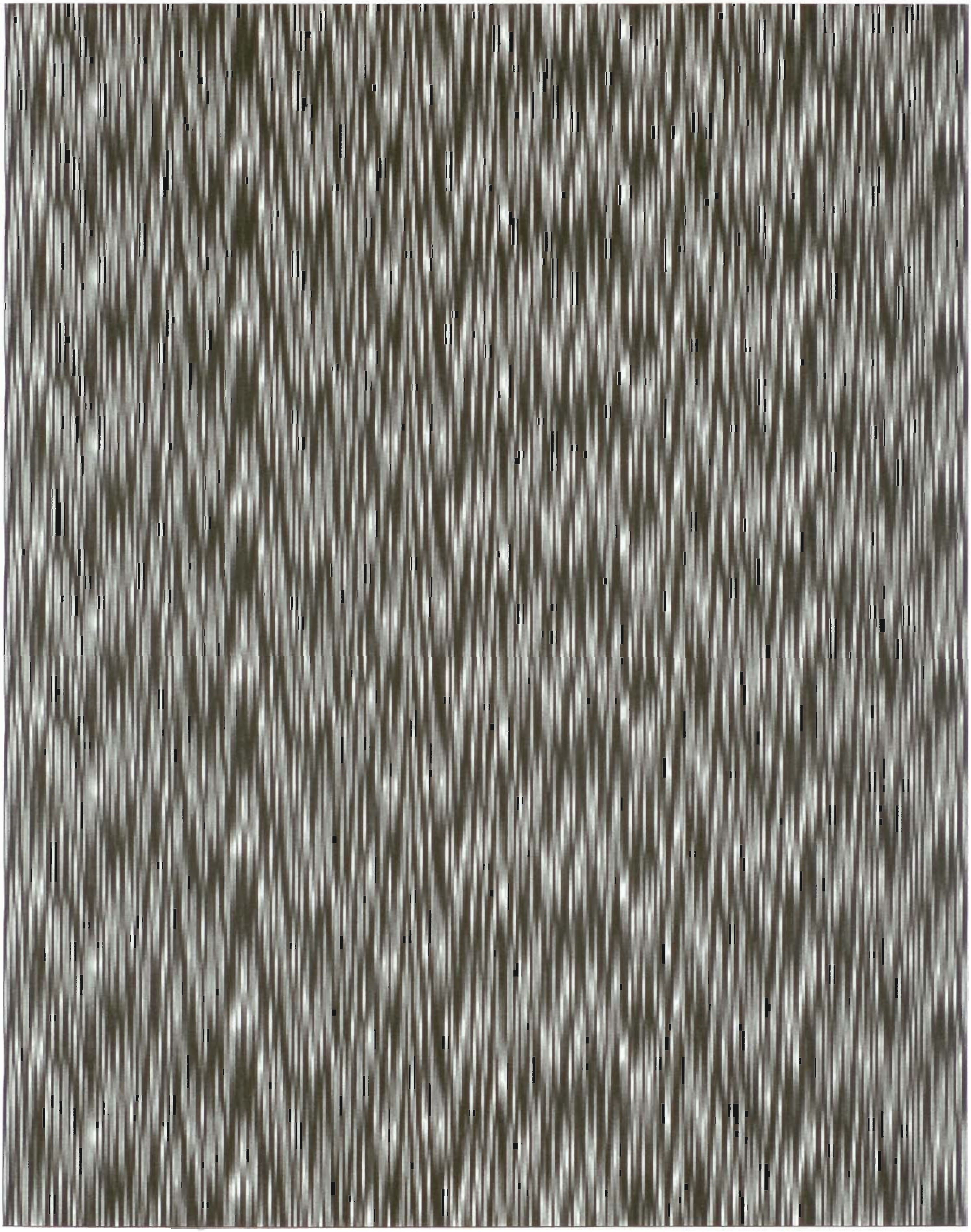


FIGURE 5(e)

FIGURE 6(a1)

FIGURE 6 (a2)

FIGURE 6(a3)

FIGURE 6(a4)

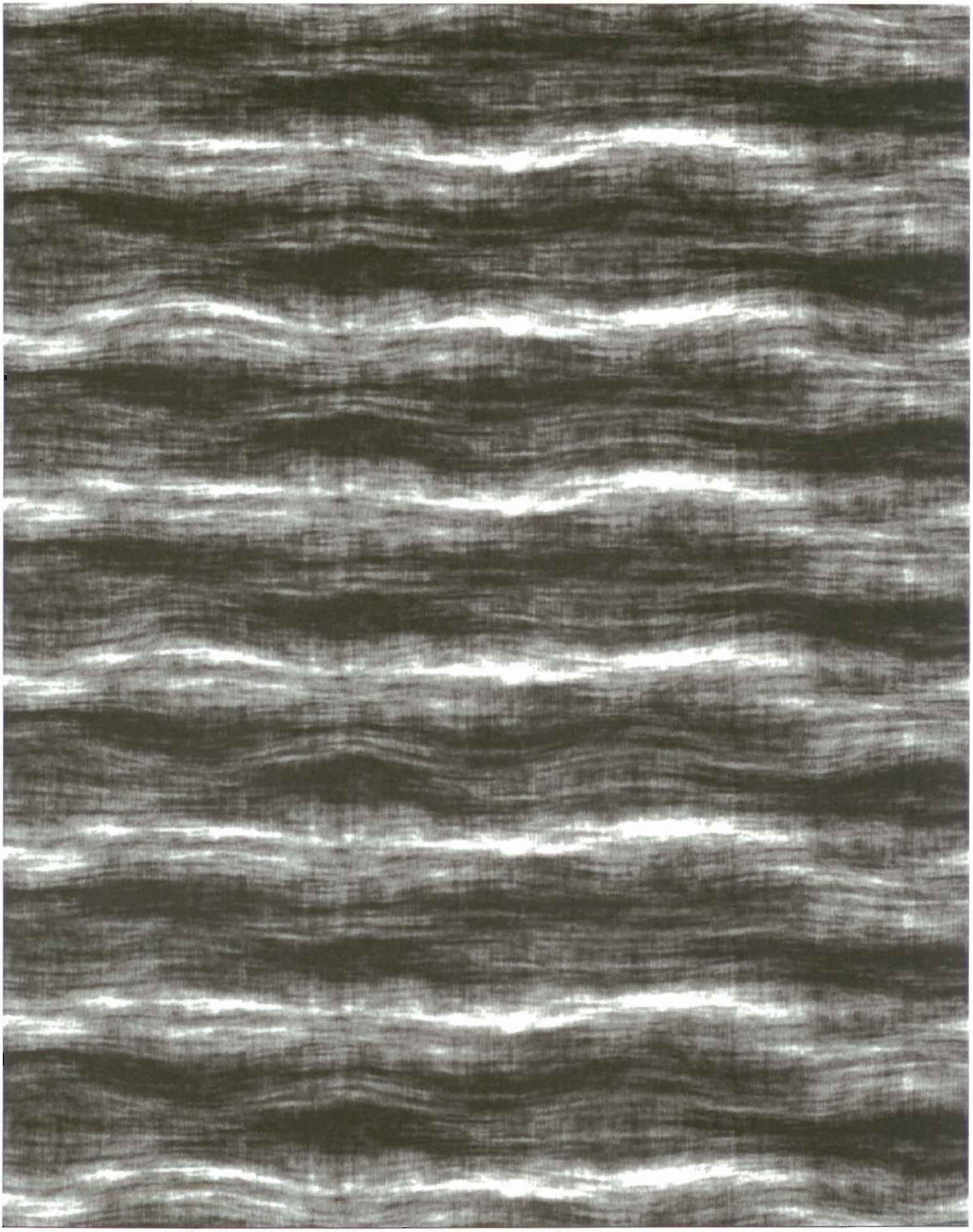


FIGURE 6(b1)

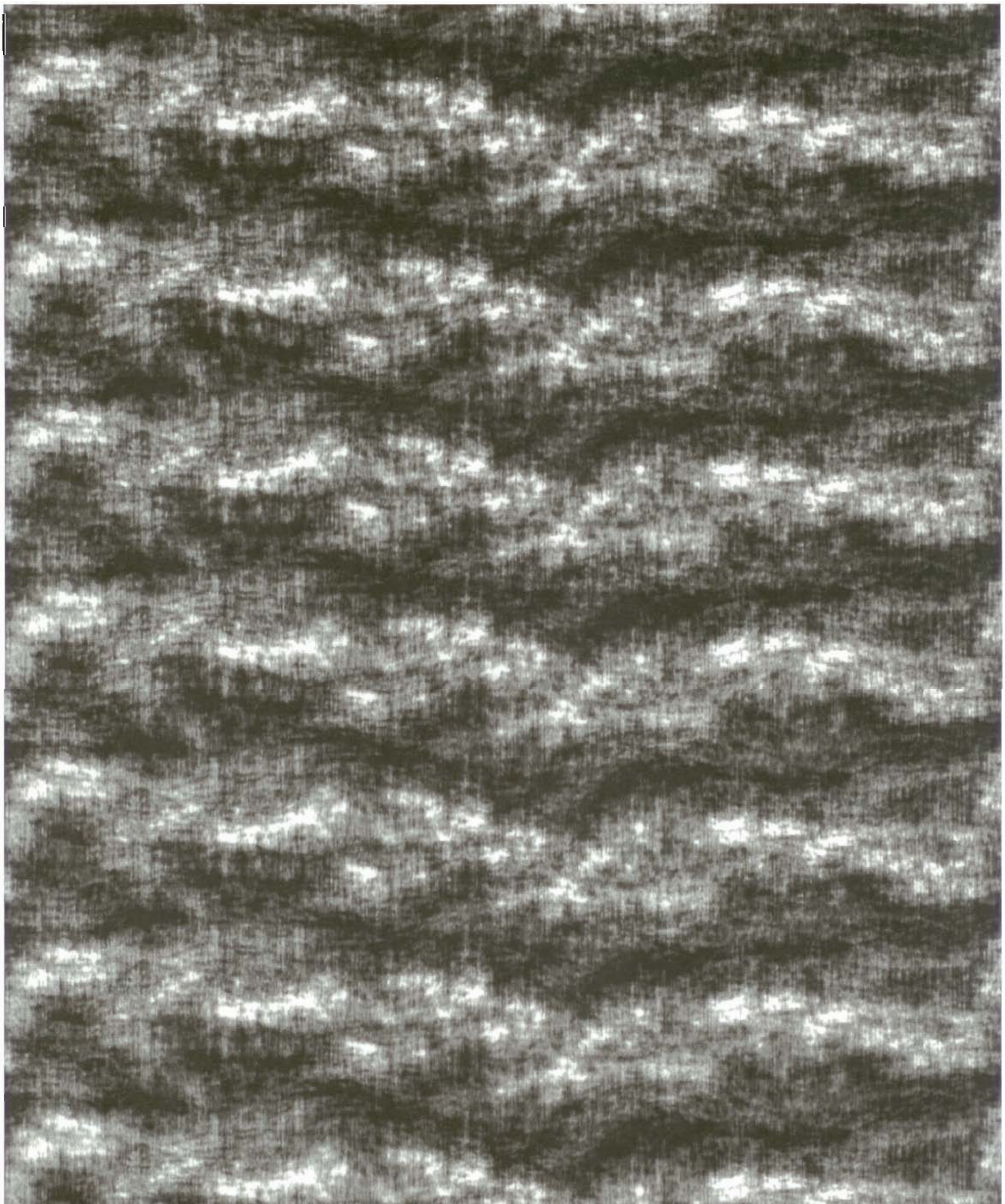
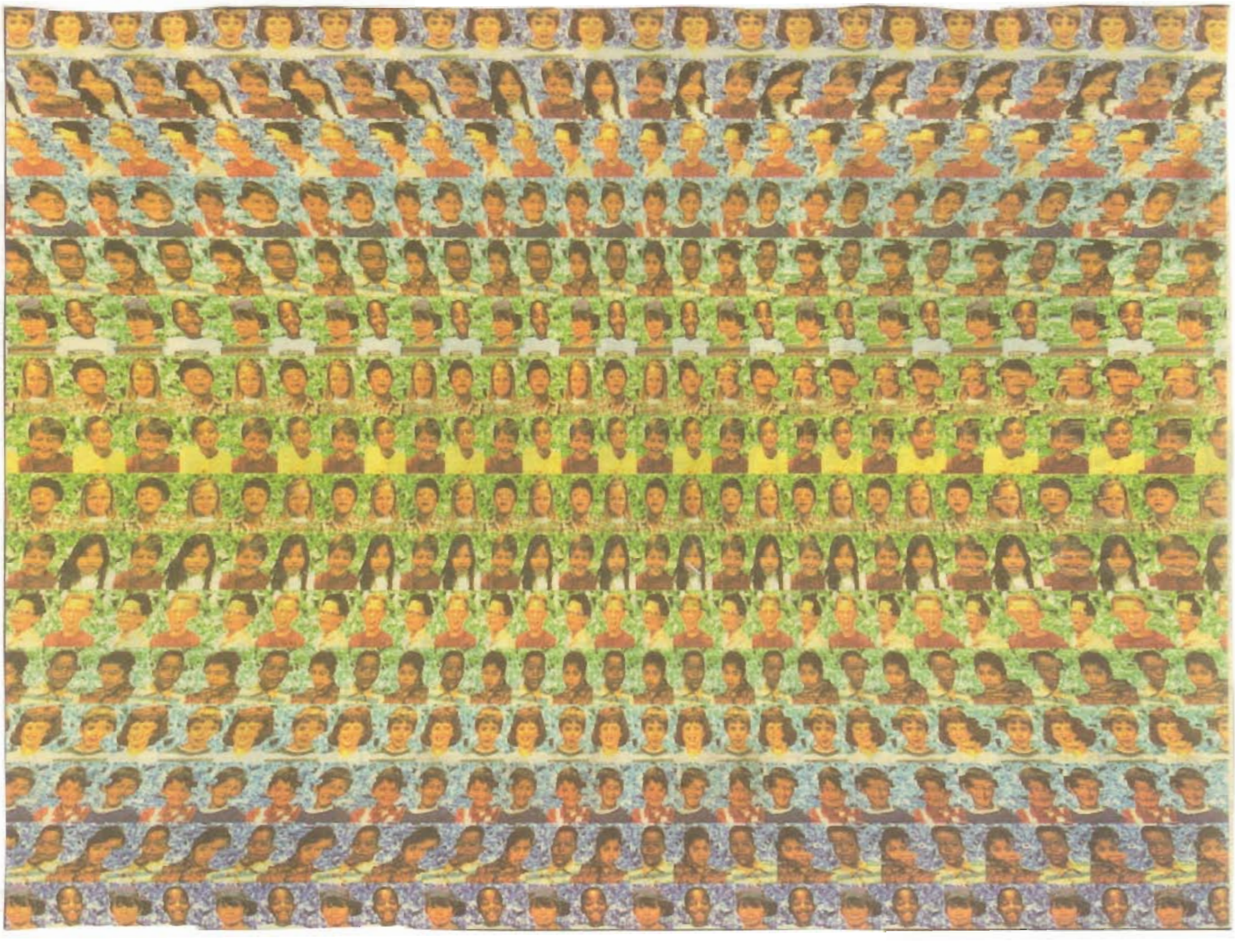


FIGURE 6(b2)

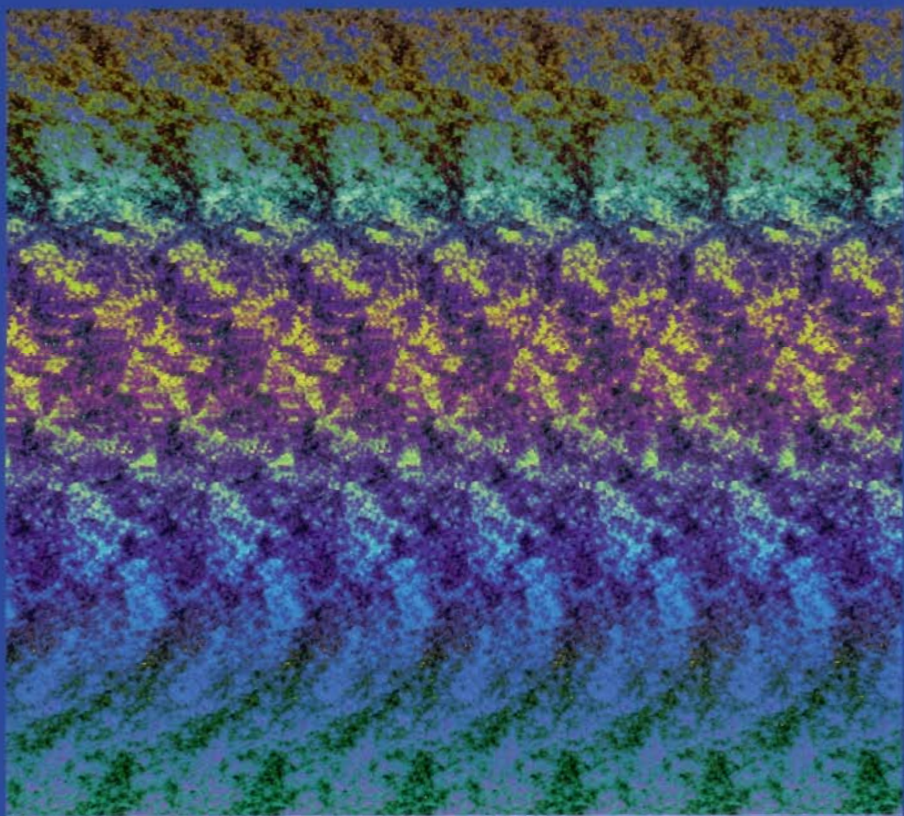
FIGURE 6(b3)

FIGURE 6(b4)



3D from 2D

ADVANCES IN IMAGE UNDERSTANDING



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