Artistic Screening

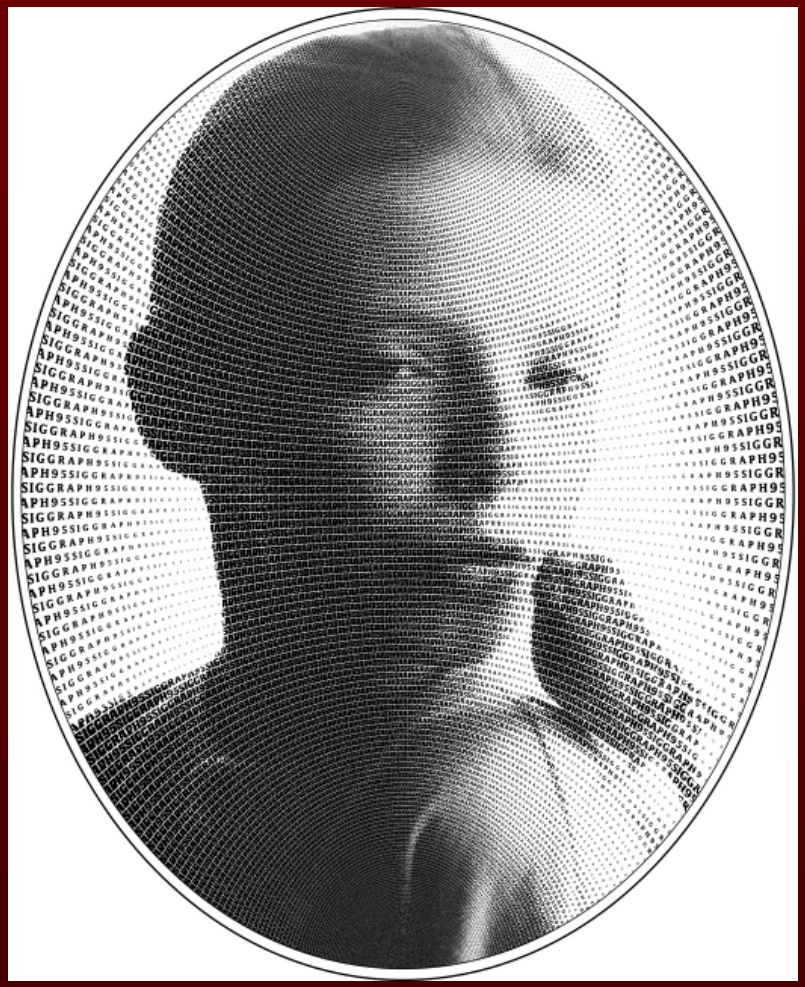
V. Ostromoukhov, R.D. Hersch

Eric Blais

Outline

- Introduction/Motivation
- Halftoning
- Artistic screening
- Summary/Conclusions

Introduction



Bella Vignette, by V. Ostromoukhov

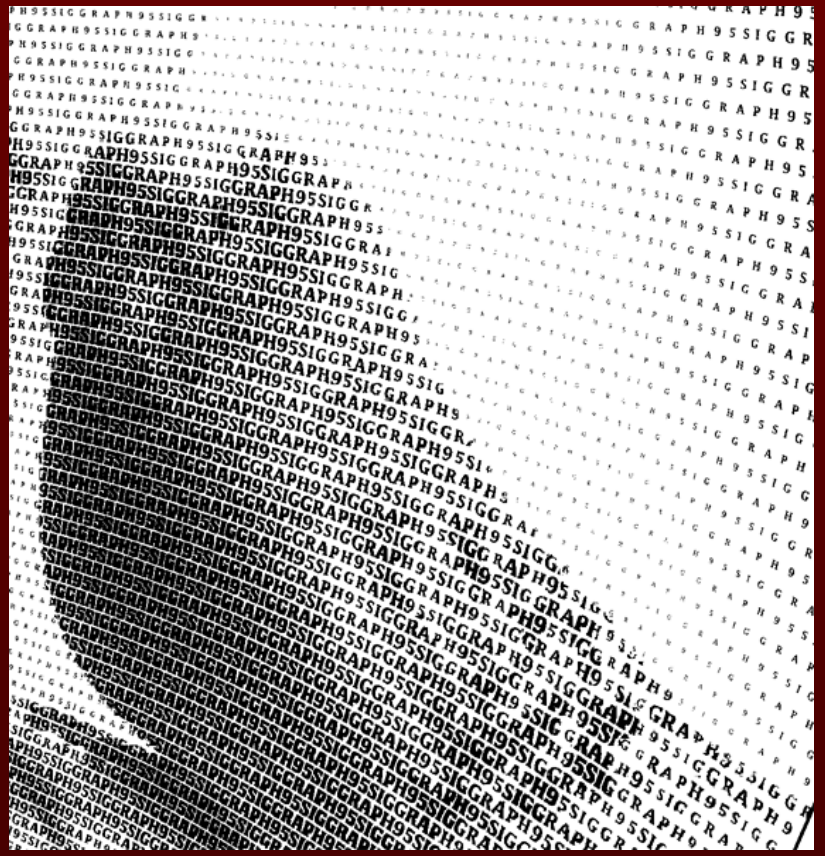
Introduction

- Printing images in black & white introduces artifacts
- Generally try to avoid artifacts to reproduce the original image as faithfully as possible

SmartCar, by C.Naylor

Introduction

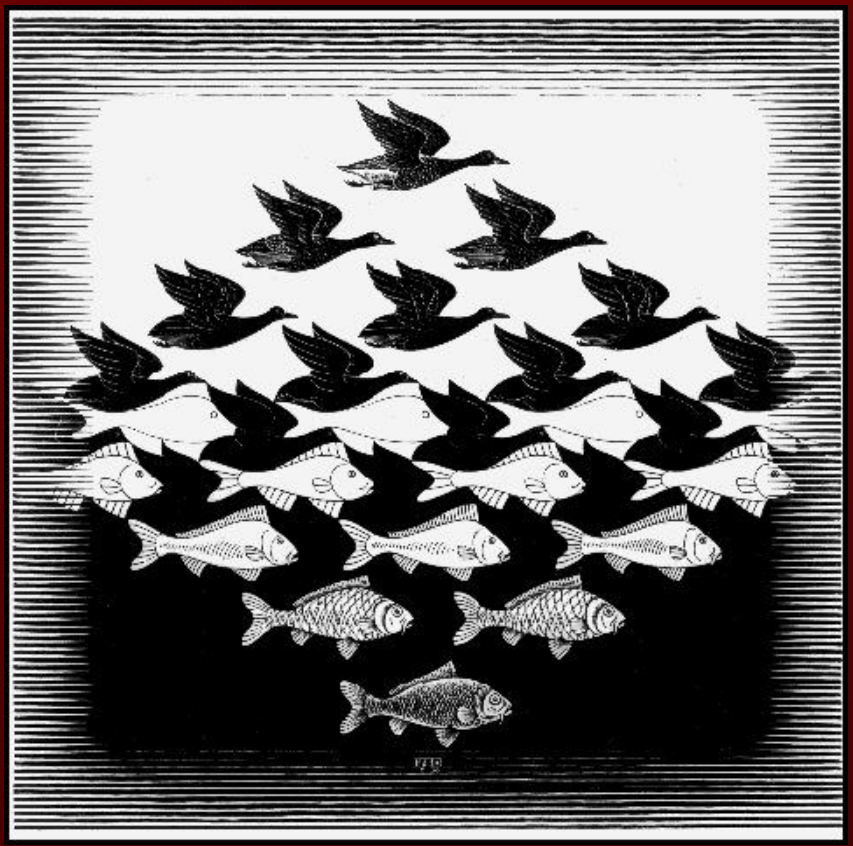
- Artistic halftoning does not try to remove all artifacts
- Instead, control the artifacts to add another layer of information!



Detail of *Bella Vignette*, by V.Ostromoukhov

M.C. Escher

- Sky and Water woodcut
  - Shows tiling of shapes... but also:
  - Gradient of white to black
  - The birds & the fish give the gradient



Sky and Water, by M.C. Escher

Islamic Art

- Alhambra (Spain)
  - From a distance: rich textures on all the walls
  - Up close: textures are created by finely-detailed tiles

Alhambra Detail, by Blair Fraser

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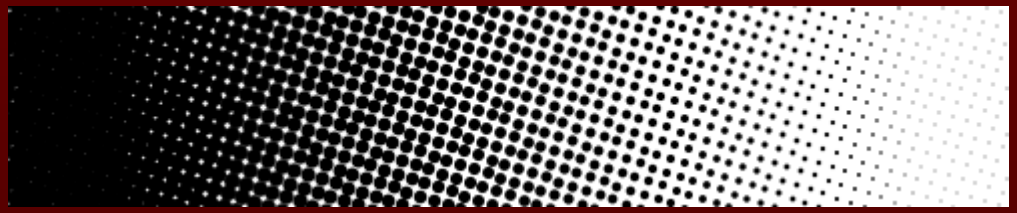
Halftoning

- Method of simulating gray levels using only black & white



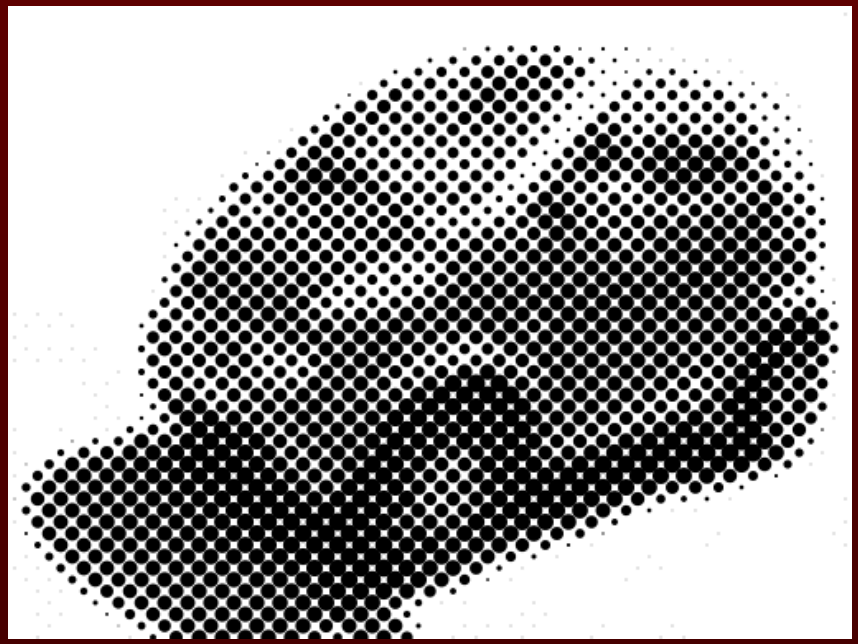
- Illusion of gray levels provided by individual shapes that "blend together" when seen from a distance

Halftoning

- Three methods:
  - Traditional
    - "Newspaper"-style halftoning
  - Threshold
    - Sometimes known as dithering
  - Pattern
    - Will be used for artistic halftoning

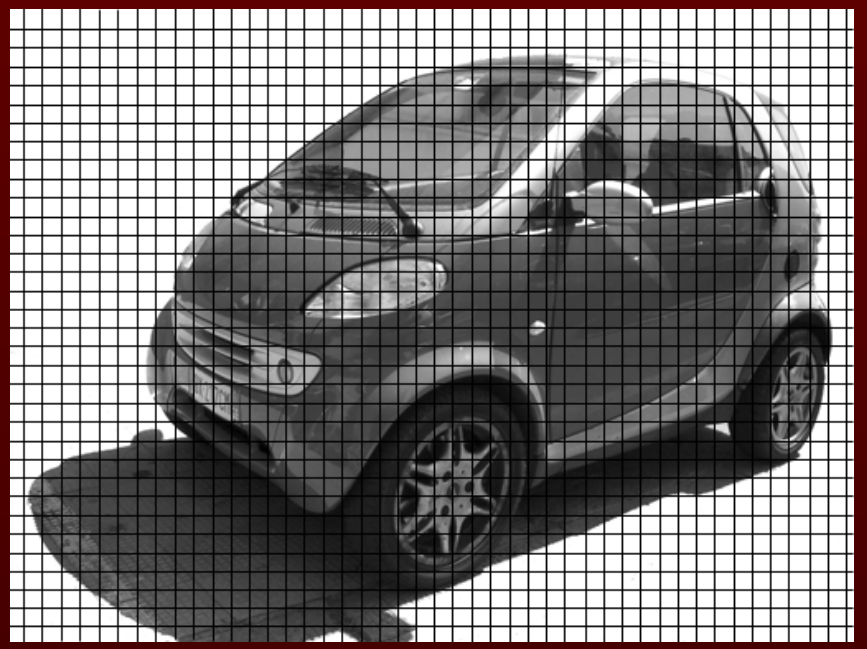
Traditional Halftoning

- Can be seen by looking closely at newspaper images
- Gray levels created by dots of different sizes
- Best for printers with low resolution but variable dot size



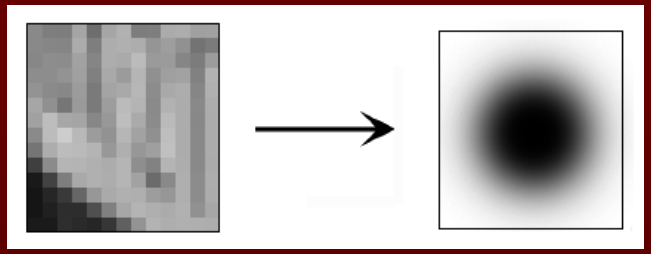
Traditional Halftoning

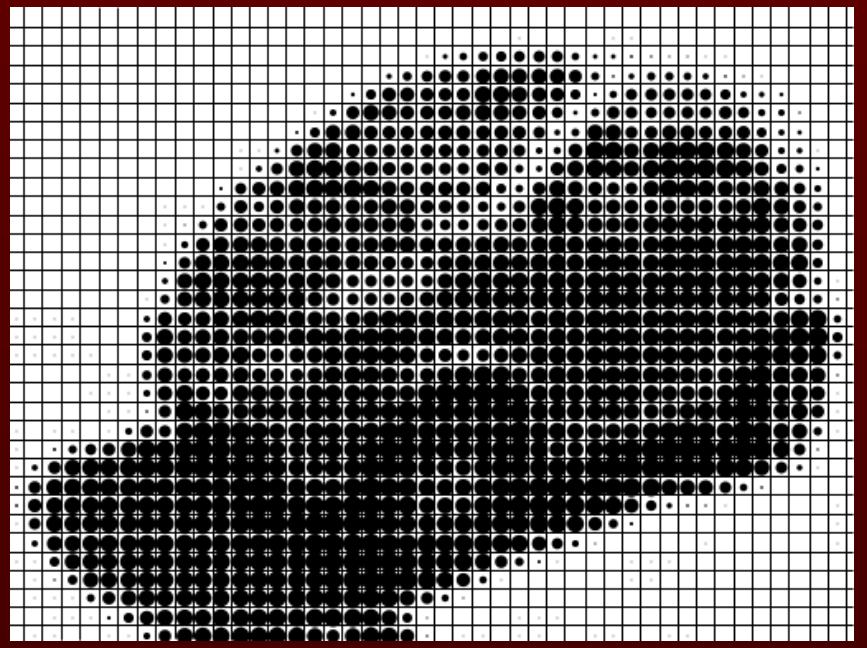
- First Step: divide the input image into tiles
- Individual tiles are called screen elements
  - In this example, each grid square (about 16x16 pixels) corresponds to one screen element



Traditional Halftoning

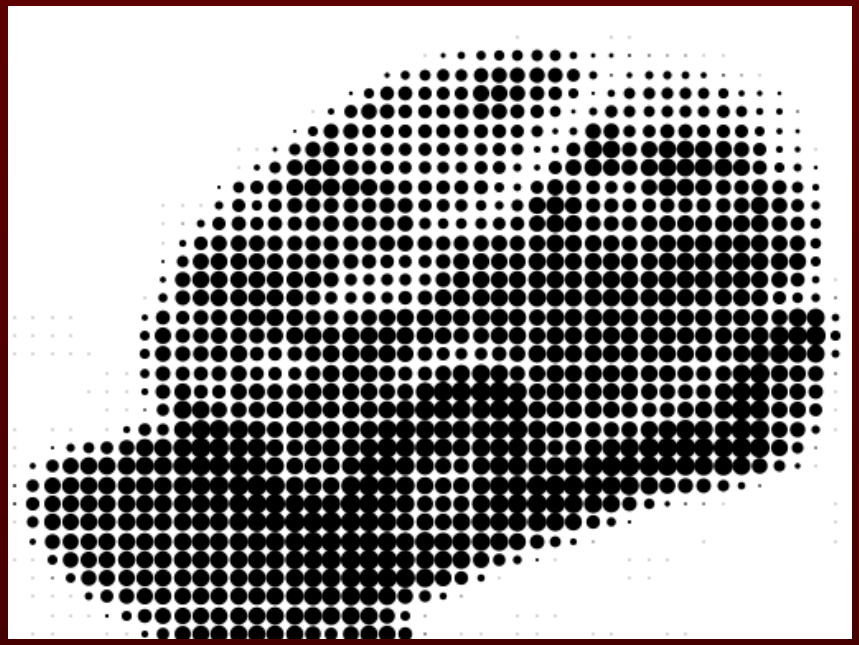
- Second step: add one dot per screen element
- Size of the dot determined by the average colour of the screen element





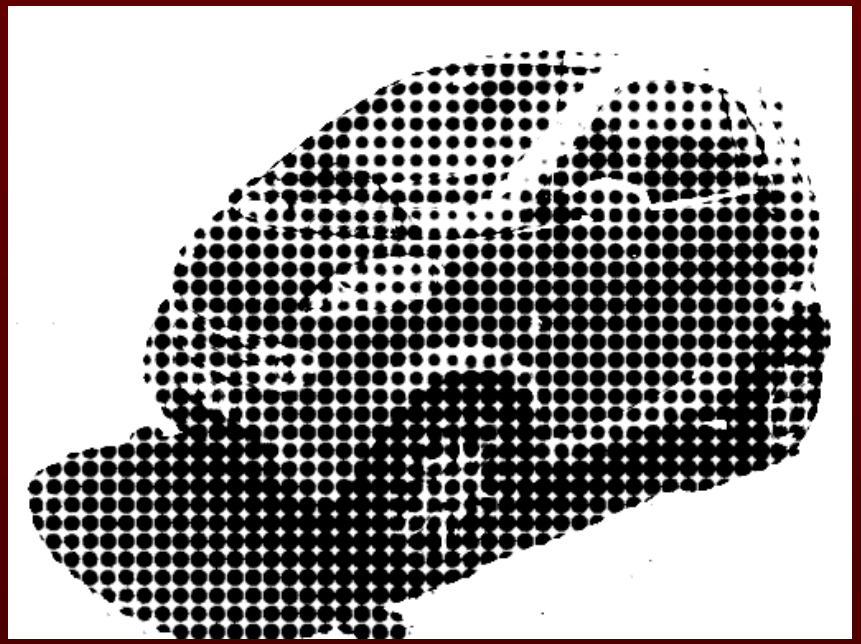
Traditional Halftoning

- Quality of results depends heavily on the output resolution
- Edges are not really sharp
- Can improve results with diagonal grids, non-circular dots



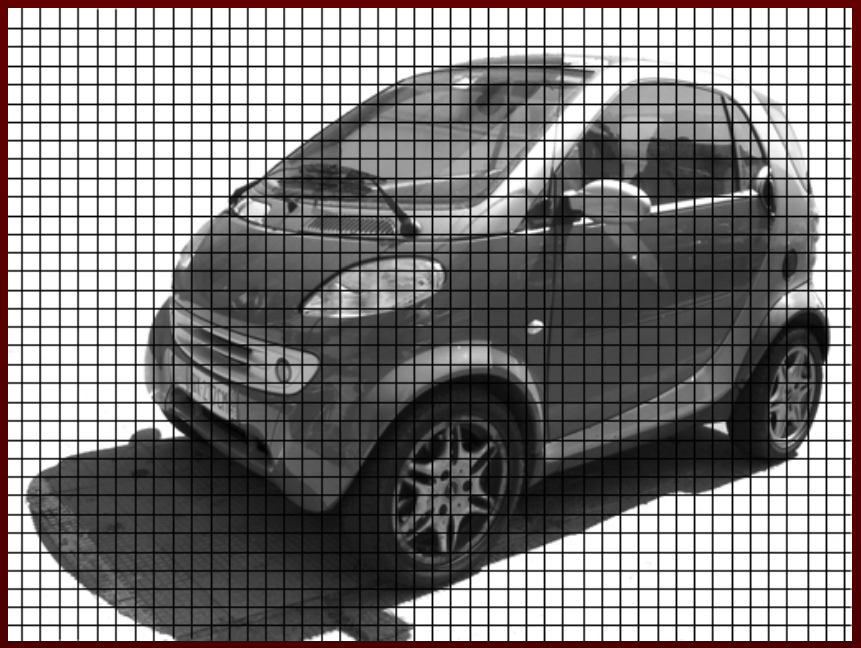
Threshold Halftoning

- Alternative to the traditional method
- No colour averaging within the screen elements
- Gives a more accurate picture



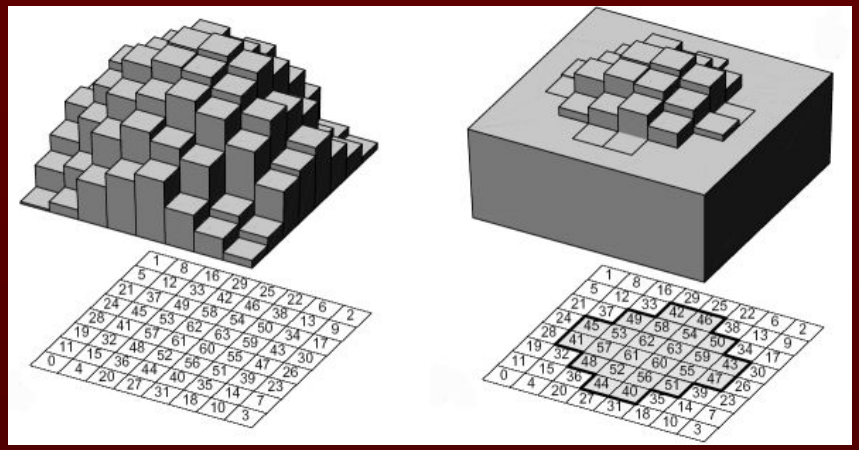
Threshold Halftoning

- First Step: divide the image into screen elements
  - Same as before



Threshold Halftoning

- Second step: define a threshold for each pixel in the screen element



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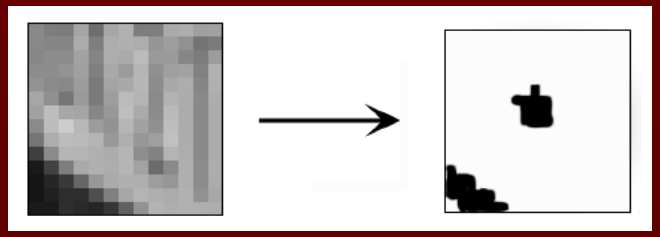
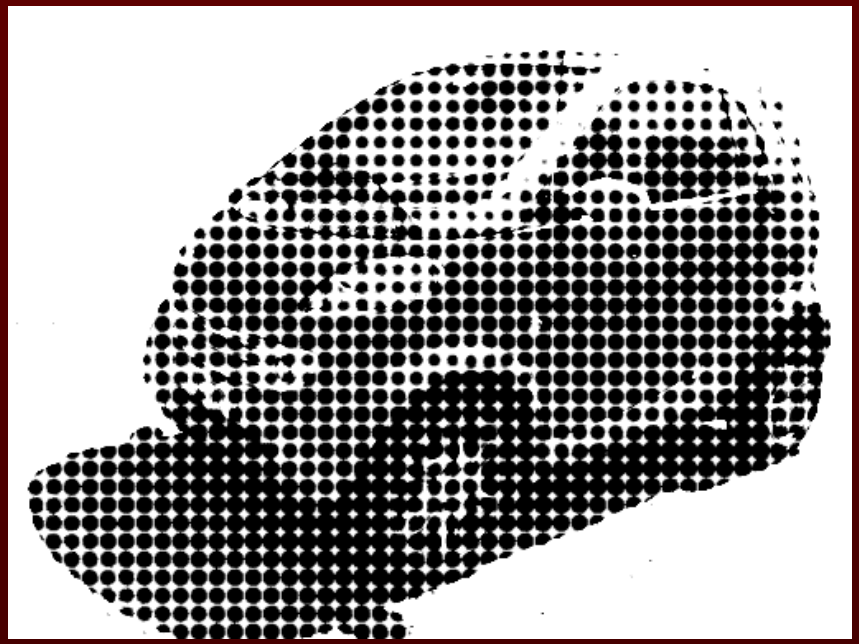
- Only pixels darker than their associated threshold are drawn in the output image

Threshold Halftoning

- Creates sharper edges than traditional method
- Dots are not always complete!





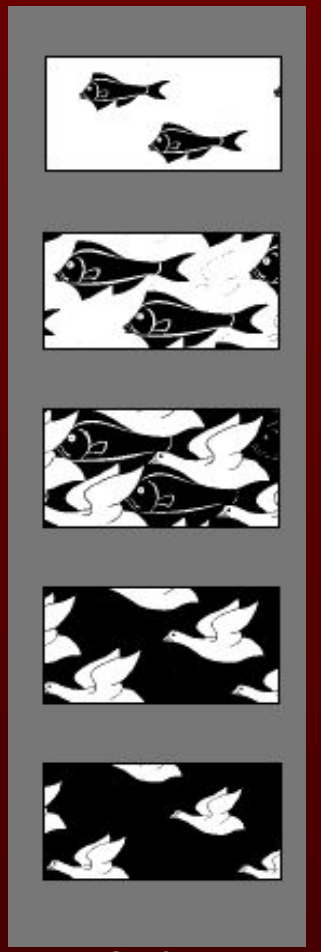
Pattern Halftoning

- Gets rid of the threshold function
- Instead, uses pattern images to create illusion of gray levels
- Much more flexible!

Warrior, by V. Ostromoukhov

Pattern Halftoning

- Additional pre-processing step is required:
- Create a screen element pattern for each gray level
  - Any pattern is possible, as long as similar gray levels have similar pattern images



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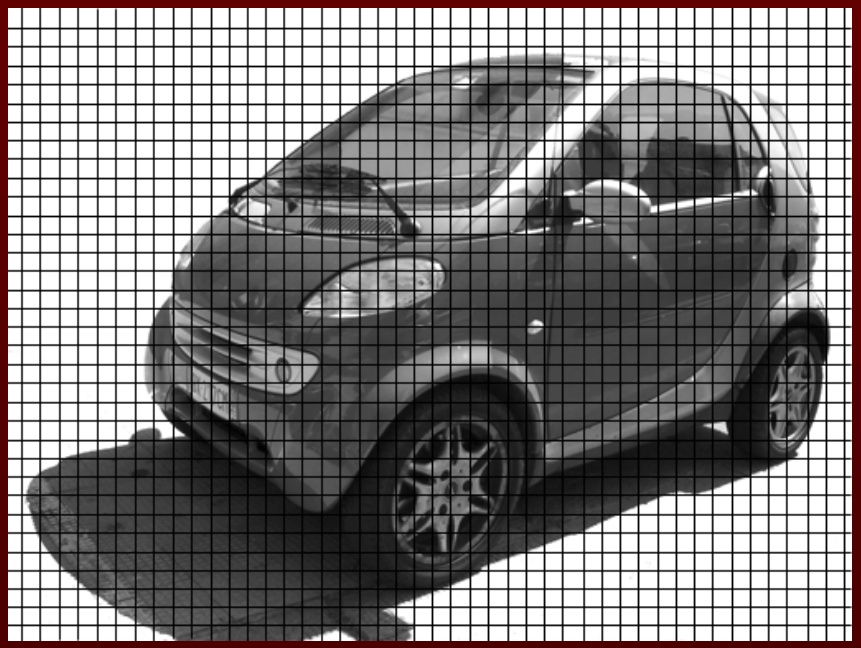
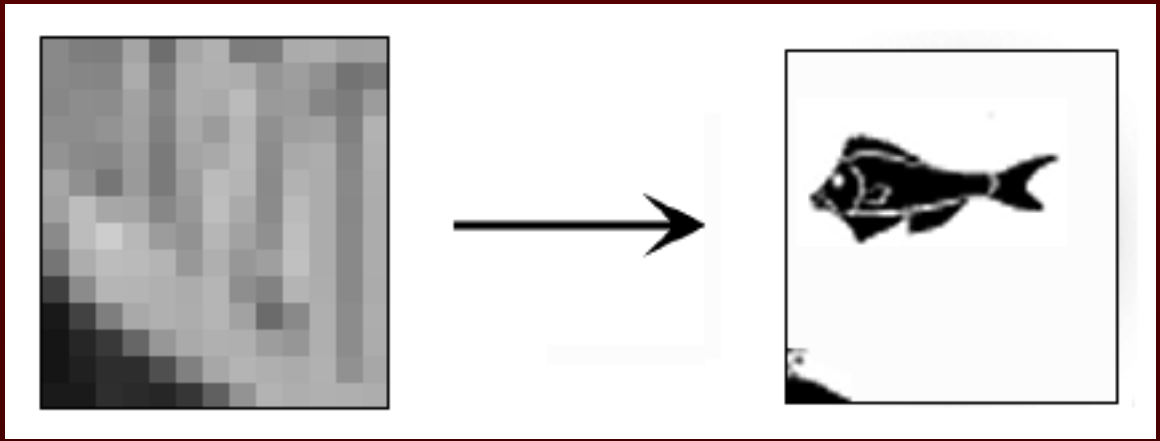
Pattern Halftoning

- Next step:
  - Once again, divide the image into screen elements



Pattern Halftoning

- Last step: use the patterns to form the final image
- A pixel's colour determines which pattern image is sampled at that position



Pattern Halftoning

- Results can be much more interesting than traditional or threshold halftoning methods!
- If pattern images are stored in a library, this method is about as fast as the other two methods

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Artistic Screening

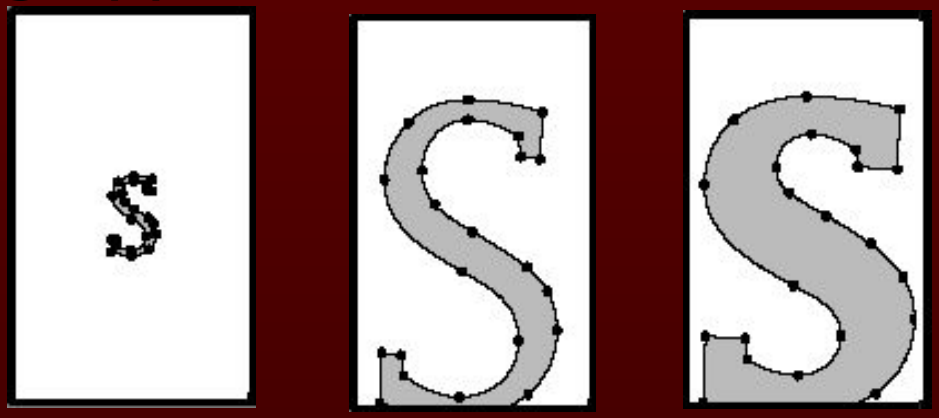
- Creation of artistic pattern images
- Edges smoothing
- Multiple patterns
- Screen distortions

Creating pattern images

- Creating the pattern image for each gray level by hand is possible...
  - Tedious
  - Very time consuming
  - Difficult to change the number of gray levels afterwards
  - Cannot adjust the screen element shape or size afterwards

Creating pattern shapes

- There is a better way:
  - The artist defines the contour of the pattern for specific gray levels
  - Can be done in any commercial shape drawing application



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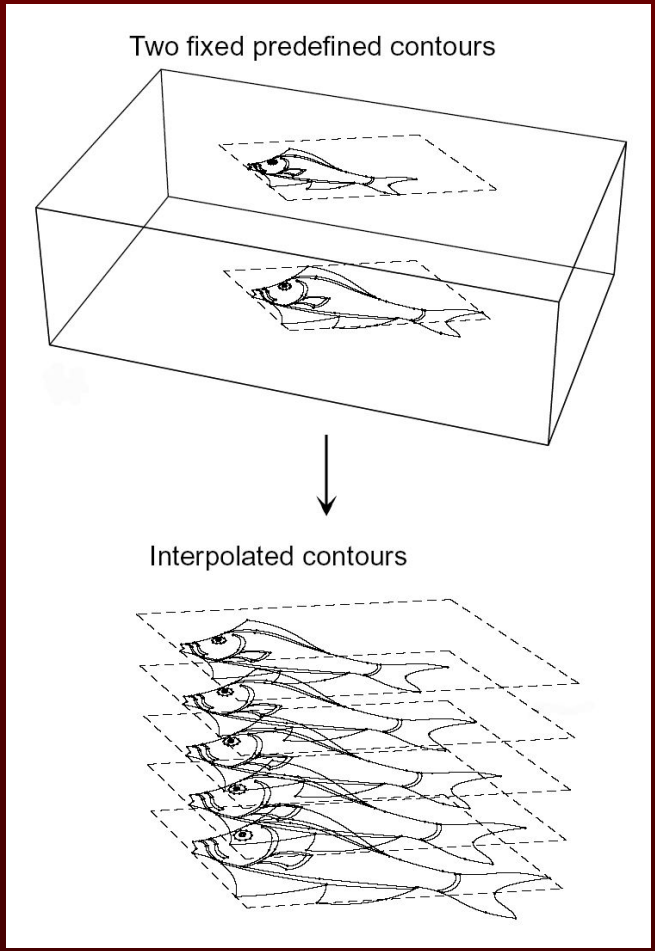
Interpolating pattern shapes

- Shape blending algorithm used to interpolate between the defined contours
- Can blend between any number of gray levels



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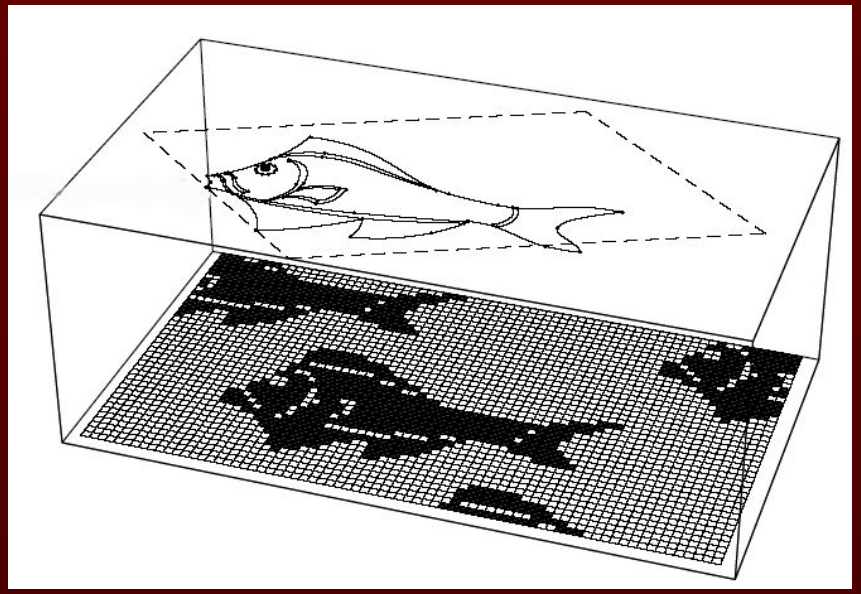
Creating pattern images

- Discretization
  - Pattern images are created from the contours for each gray level



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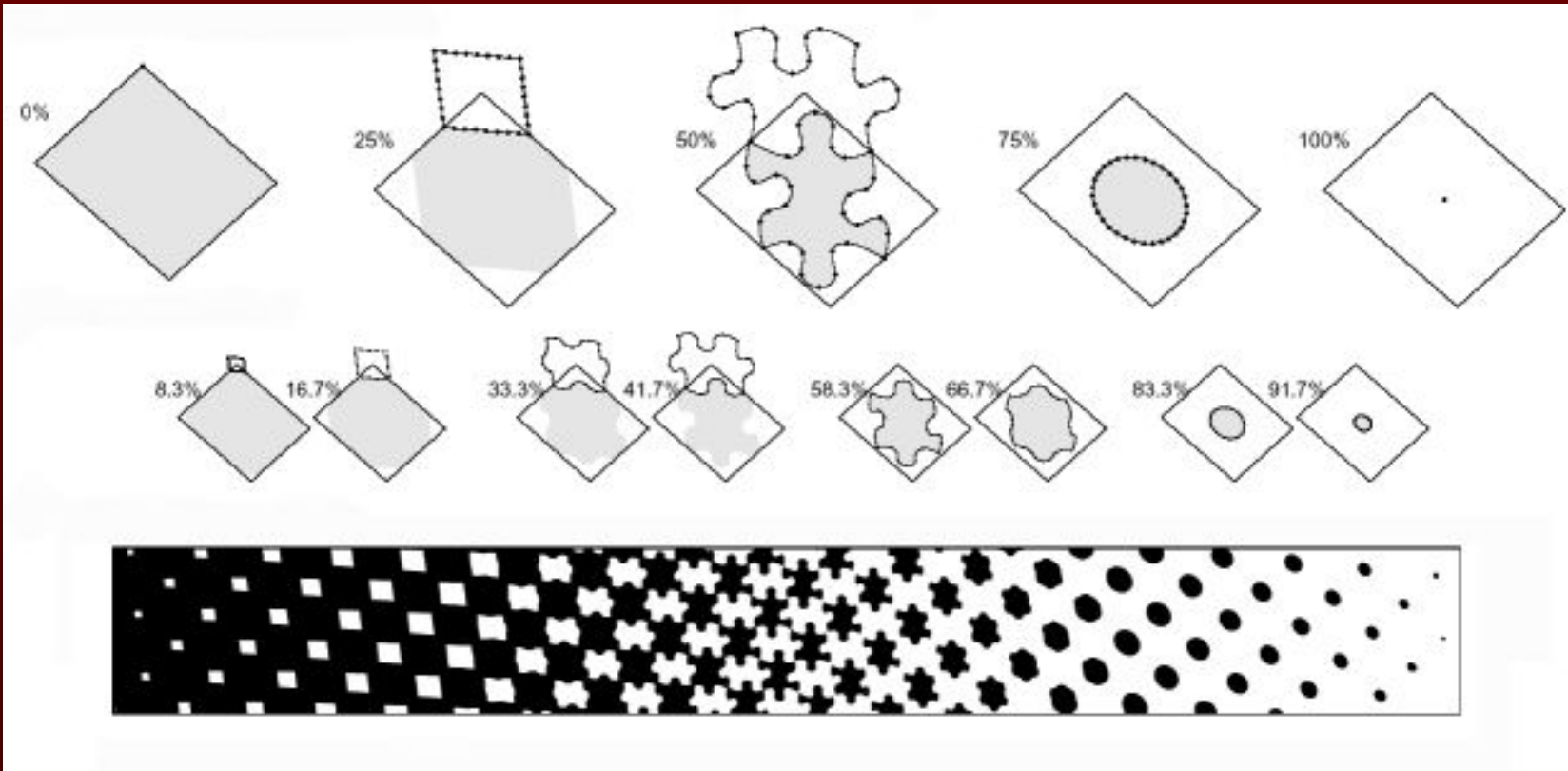
Creating patterns - review



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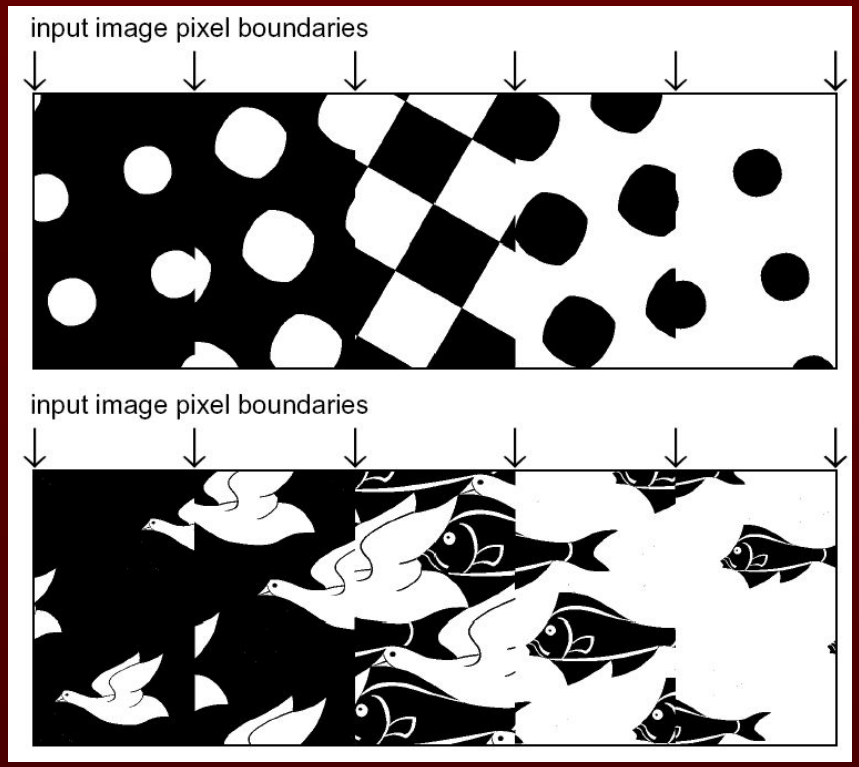
Edge Smoothing

- Problem:
  - Sharp edges cause discontinuities in our patterns



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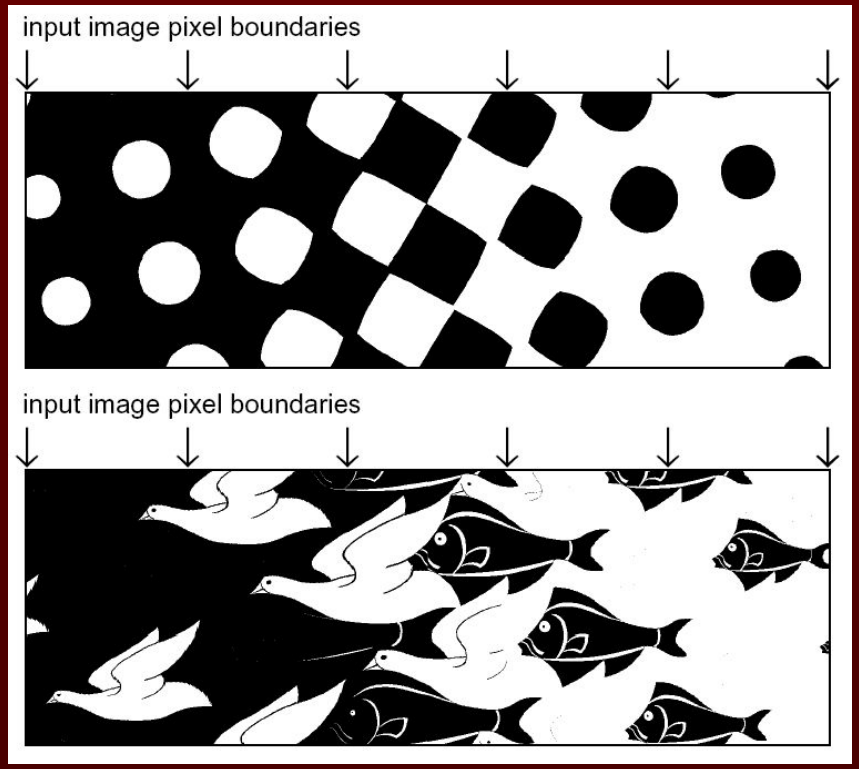
Edge Smoothing

- Solution is simple
  - Simply blur the original image
  - Lose the sharpness of edges, but now the patterns are continuous



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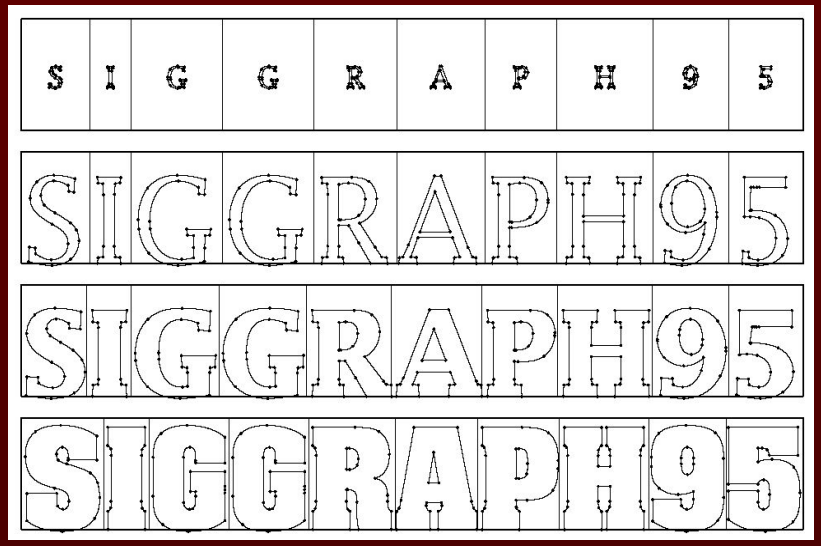
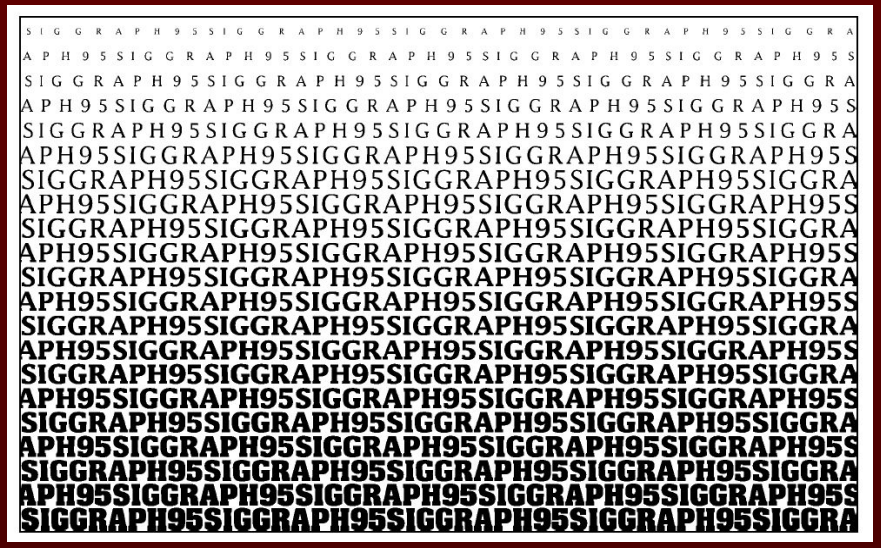
Multiple Patterns

- Can also use multiple patterns on the same image





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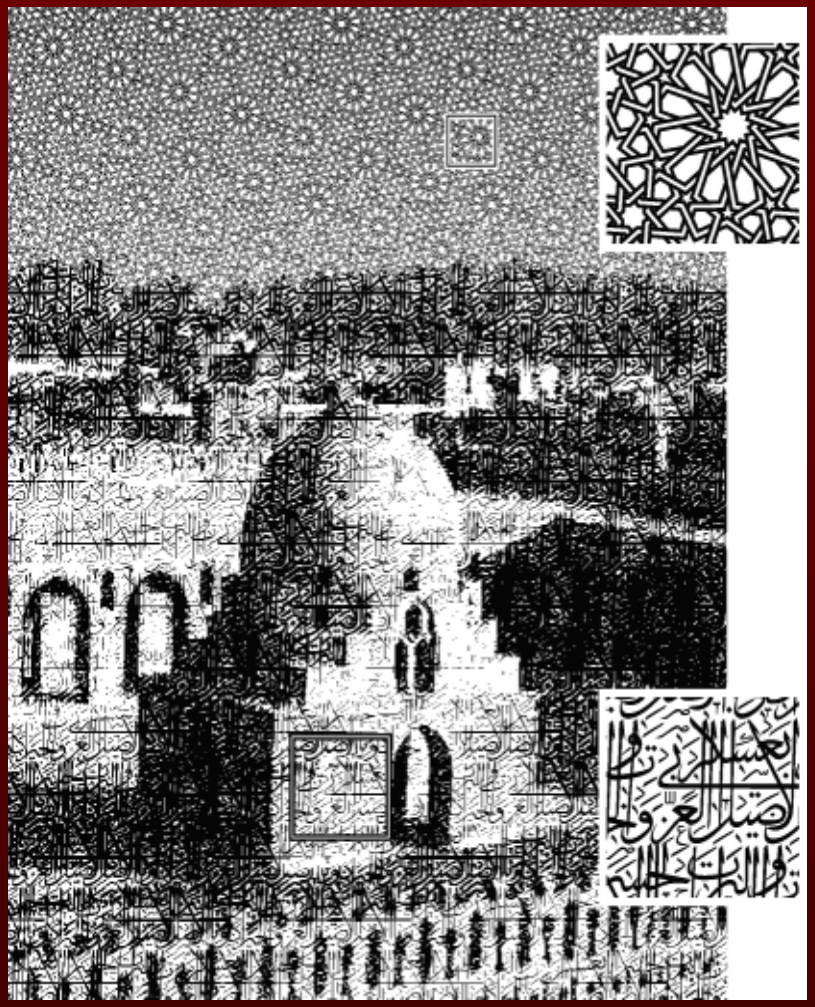
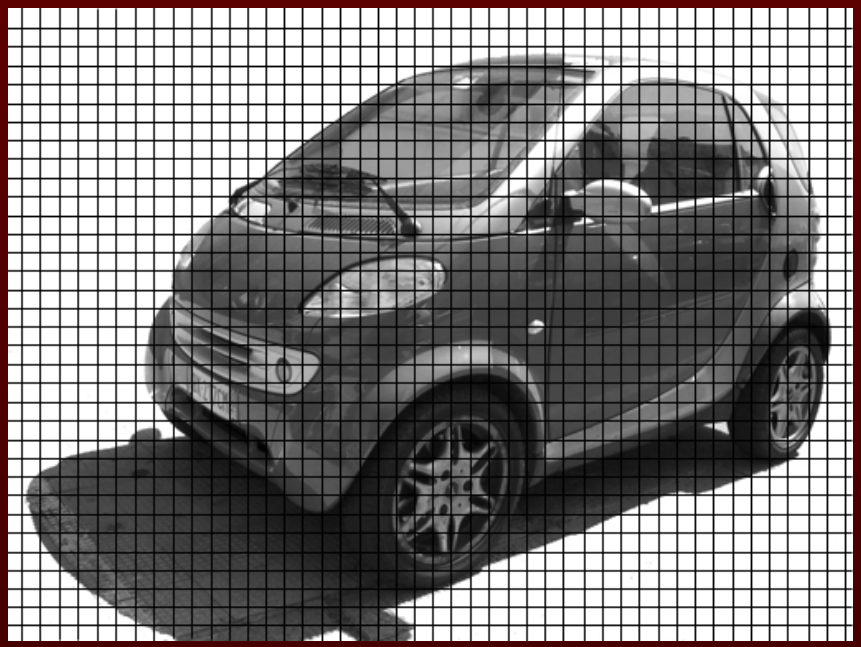
Multiple Patterns



Detail of the Ibn Tulun Mosque, by R.&S. Michaud

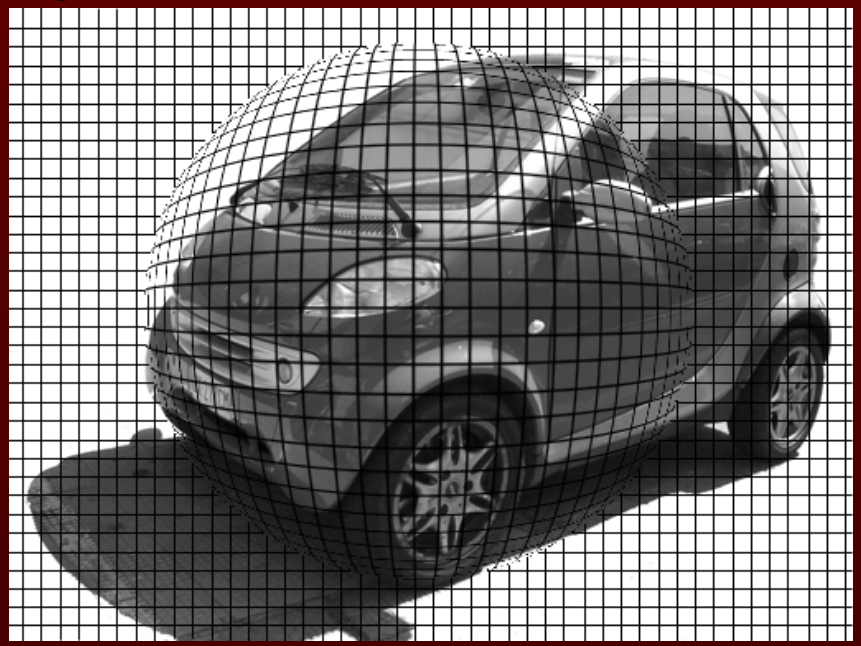
Screen Distortion

- So far, we have applied the patterns to the image in a simple grid pattern



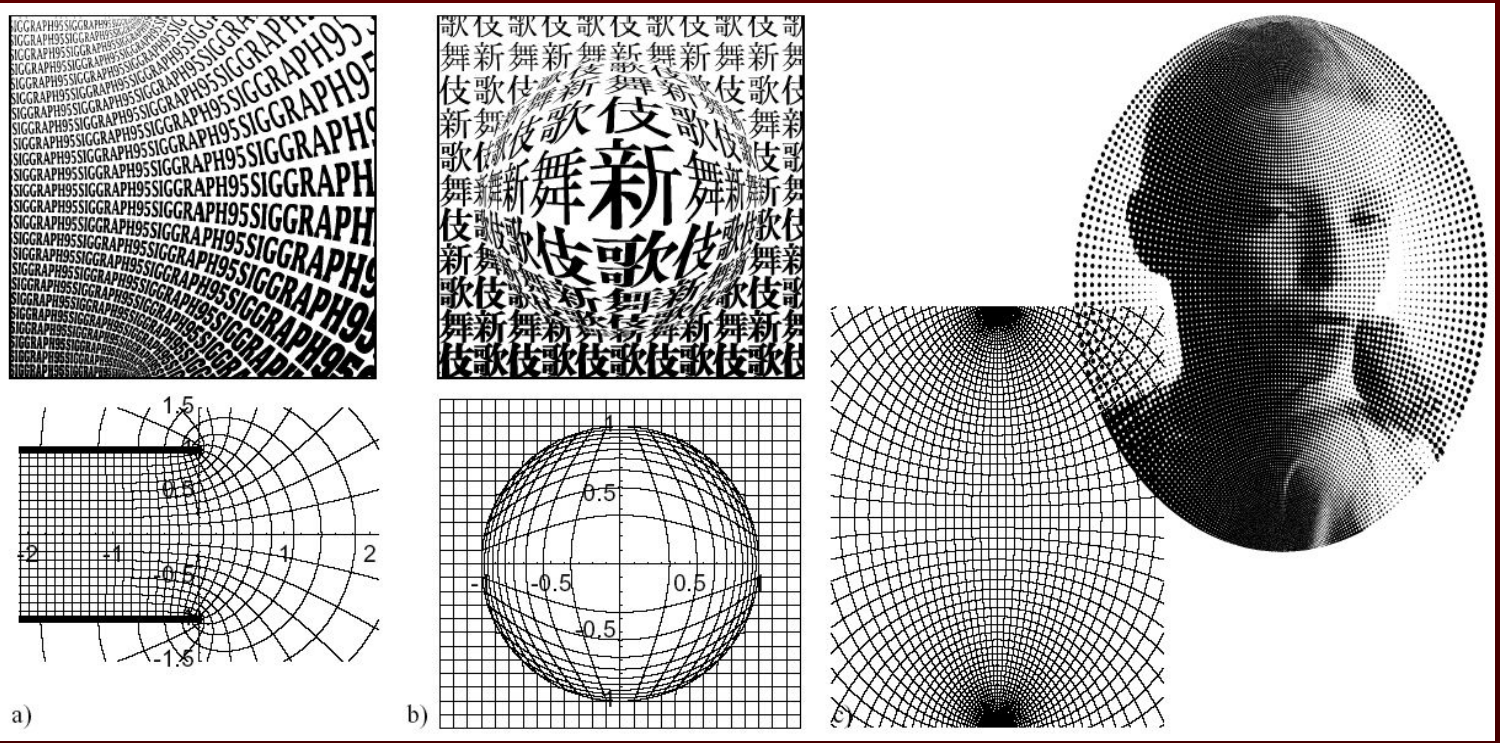
Screen Distortion

- Can also use a non-linear mapping between the screen elements and the pattern shapes



Screen Distortion

- Original image is unchanged – only the pattern shapes are distored



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Summary

- Artistic Screening is a new halftoning technique that lets designers freely create custom halftone pattern shapes
- New types of images possible with 2 layers of information

Conclusions

- Interesting technique
- Some of the places where it can be useful:
  - Event posters
  - Billboards
  - Improved security features for banknotes

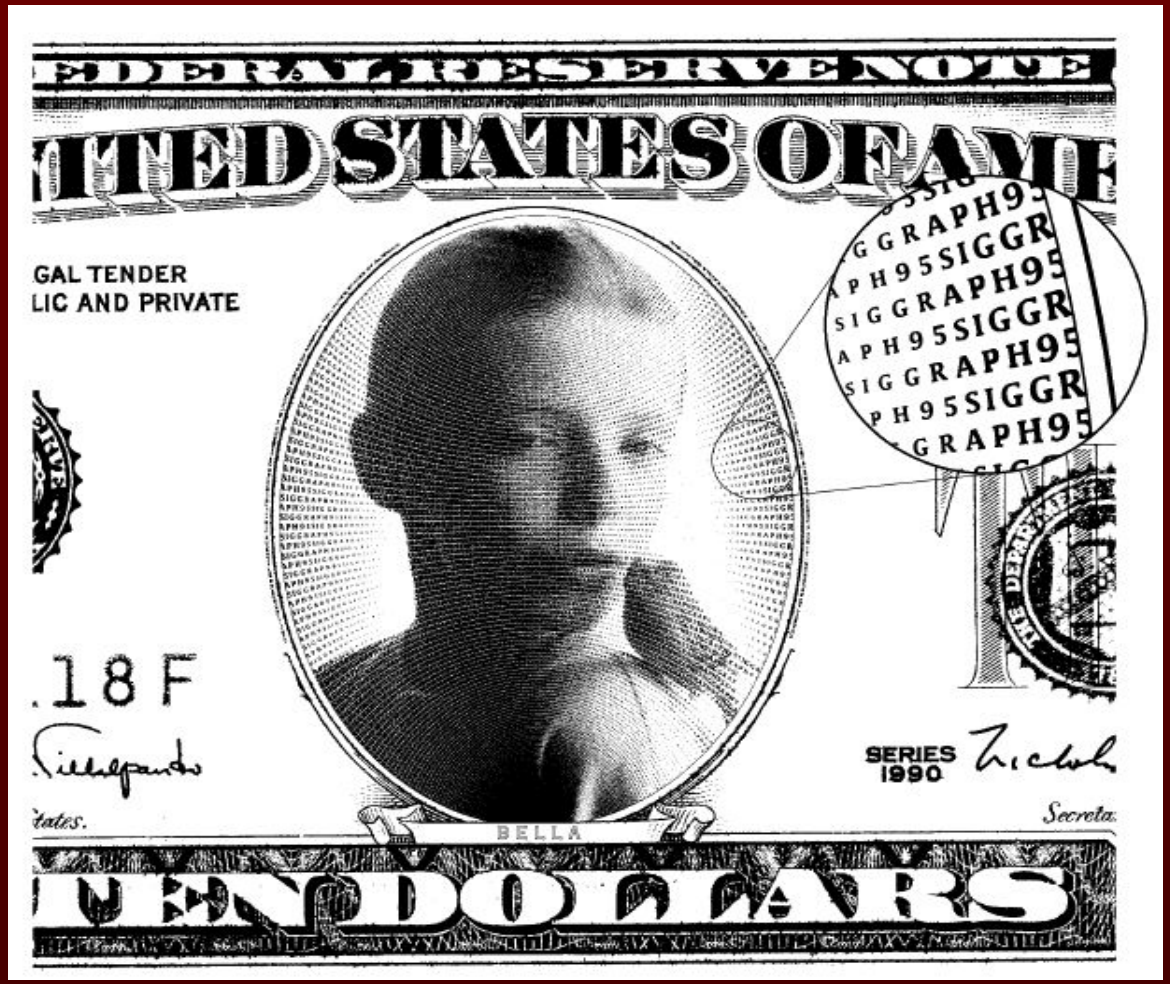
Kabuki event poster

Kabuki actor, by Toshusai Sharaku

Jeremias Gotthelf billboard

Gotthelf portrait, V. Ostromoukhov

Safety features for banknotes



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