

# Using Guiding Lines for Increasing the Effectiveness of Images



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# Outline

- Introduction
- Related work
- Basic idea
- Guiding lines
  - ✱ From the description of guiding lines to the 3D scenes
  - ✱ Results
- Gaze shifting
- Conclusion



# Introduction

- Image synthesis
  - ✱ Rendering: much research, very realistic images
  - ✱ Modelling: taking into account constraints
    - ◆ about the use of computed objects
    - ◆ rarely about the computed images
- Images are as important as scenes
  - ✱ Medium of communication
  - ✱ The decoding of an image has an impact on its perception

Taking images' characteristics into account in  
the design process of 3D scenes

- Guiding lines which control the gaze shifting

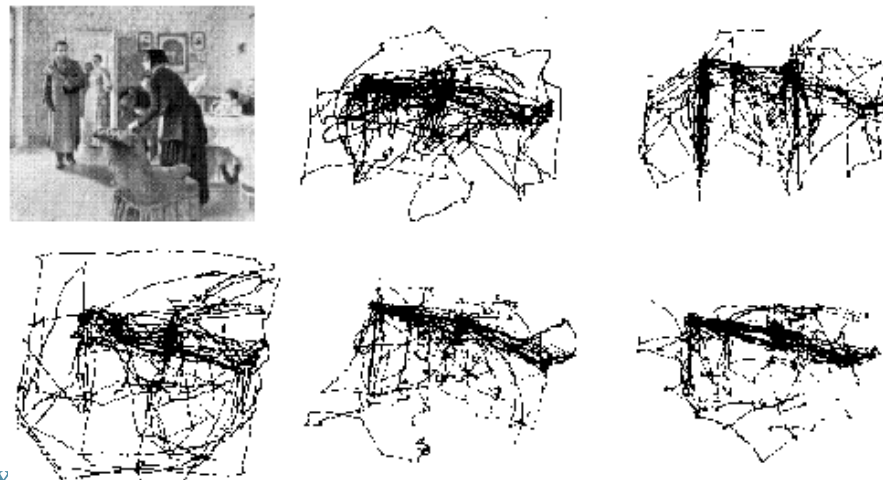
# Related work: Scientific approach

## ■ Cognitive psychology

- ★ Reading process = a series of jerks between fixed areas
- ★ The next eye movement depends on information contained in images

## ■ Yarbus experience

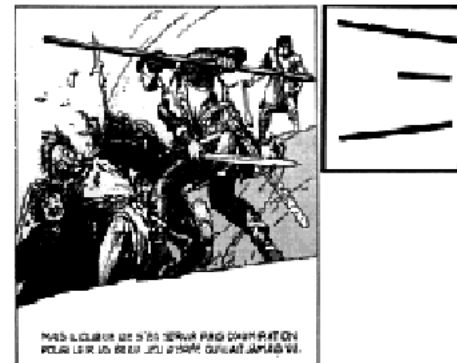
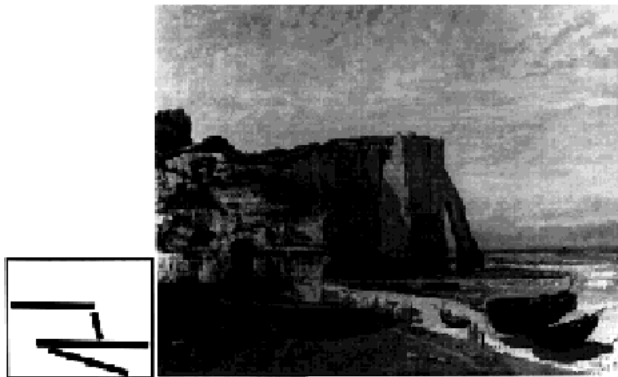
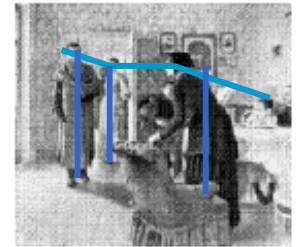
- ★ Recording the movements of the eyes during 3 minutes
- ★ Many ways to explore an image ; but some similarities
- ★ Curves followed by the eyes are nearly the same



The eye exploration is at the beginning of the perception process

# Related work: Pragmatic approach

- Painters = first people interested in the gaze shifting
  - ★ How to control the reading through paintings?
  - ★ Tricks to increase the natural tendencies of the eye or to oppose them
- Guiding lines
  - ★ Define the secret skeleton of images
  - ★ Force the observer's gaze to follow a predefined path
    - ◆ Can be cut or not
    - ◆ Can be composed of disparate objects placed along a virtual curve
  - ★ Applicable to all image-based fields
    - ◆ Connected to the eyes that explore and decipher the image surface



# Objective and the basic idea

- Strong link between the image decoding and the perception
  - ✱ Inducing the observer to read images the way the designer intended it
  - ✱ Describing the guiding lines wanted by the designer
  - ✱ Generating 3D scenes respecting the described guiding lines
- Photographer's method:
  - ✱ The 3D scene is already modelled
  - ✱ We look for an angle which reveals guiding lines
  - ✱ We can modify the scene but only slightly
  - ✱ Creation of displaying tools
- Painter's method:
  - ✱ Extensive liberty to build new scenes
  - ✱ Designer's constraints can be taken into account to design the scene
  - ✱ Great control in obtaining very well-composed images
  - ✱ Creation of modelling tools

# Characteristics of our modeller

## ■ Generation of landscape scenes

- ☀ Trees, houses, barriers, ways and hills
- ☀ The ground is an infinite plane
- ☀ All objects lay on the ground
- ☀ Guiding lines are created by the alignment of objects



## ■ Scenes are built step by step

- ☀ Description of the desired guiding lines and objects of the scenes
- ☀ Generation of layouts of 2D guiding lines
- ☀ Selection of one layout (draft 1)
- ☀ Generation of 3D scenes from the draft
- ☀ Selection of a 3D scene (draft 2)
- ☀ Improving the realism by adding objects in the draft 2

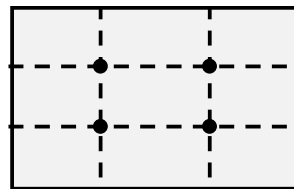
# Description of desired guiding lines

## ■ "Horizontality" measure

- ✱ To determine if guiding lines must be more or less horizontal, vertical or oblique
- ✱ To encourage horizontal reading, to force vertical or anarchic reading

## ■ Convergence measure

- ✱ To determine if they globally converge towards a chosen point
- ✱ Useful when the eyes are not naturally attracted by the main element



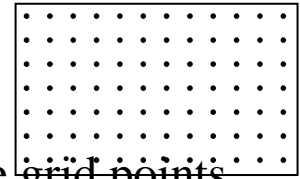
*The four main points of attraction in images*



# Generation of 2D guiding lines

- To compute the layouts in accordance with the description:

- ☀ Exploring the universe of all possible 2D-lines: not realistic
- ☀ Guiding lines do not need to be very precise
- ☀ Use of a grid, more or less fine
- ☀ Exploring the set of lines whose extremities are on the grid points



- An enumeration tree

- ☀ A node = a possible layout (a set of segments)
- ☀ A child is obtained by adding a new line
- ☀ A branch is cut when the last line do not verify a defined constraint

At the end of this phase: layouts of 2D guiding lines

The designer chooses one of them

# Placing 3D-objects

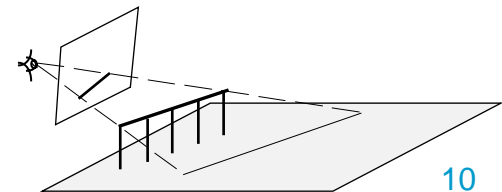
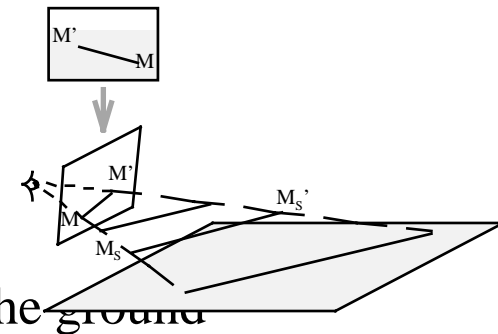
3D objects are placed so that the observer can see the desired guiding lines

- Each 2D segment generates a piece of plane in the 3D scene

- ★ Objects could be placed along any curve between the edges
- ★ Curves do not need to be continuous
- ★ There is an infinite number of possible curves.

- In the first release of our modeller:

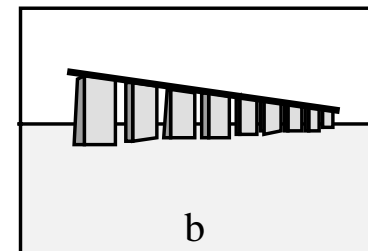
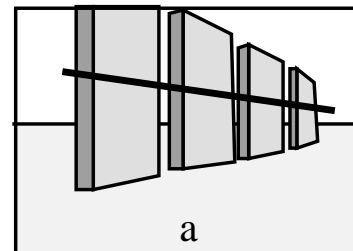
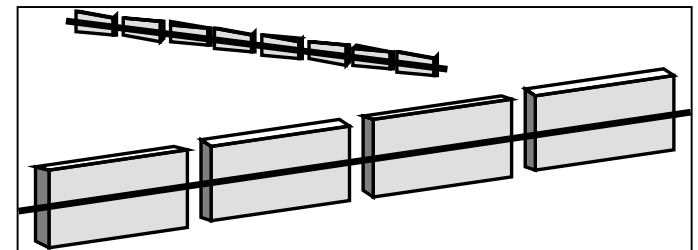
- ★ Chosen curves: rectilinear segments, parallel to the ground
- ★ Guiding line:
  - ◆ Alignment of similar objects
  - ◆ Succession of reference points associated with each object
- ★ There is a unique 3D line for each kind of objects
  - ◆ Objects lay on the ground
  - ◆ They have nearly the same height



# Placing 3D-objects (cont.)

- To create 3D scenes from the selected layout
  - ✦ For each 2D guiding line of the selected layout
    - /\* Placing 3D objects so that the guiding line can be seen \*/*
      - ◆ For each kind of object of the library
        - ⌚ The height of objects is predefined
        - ⌚ The 3D line is computed
        - ⌚ 3D objects are placed along the 3D line
- How to place objects along a 3D line ?

- ✦ For distant lines
  - ◆ Reference point: centre of objects
- ✦ For lines above horizon
  - ◆ Reference point: top of objects



## Placing 3D-objects (cont.)

- Each kind of objects has its own parameters
  - ✱ Height value
  - ✱ Spacing value (the space between 2 objects)
  - ✱ Angle value (the orientation of objects towards the line)
  - ✱ ...
  
- To avoid excessive regular alignments:
  - ✱ Noise is added in each parameter
  - ✱ Each parameter is defined by:
    - ◆ A value
    - ◆ A tolerance

At the end of this phase: a set of simple 3D scenes

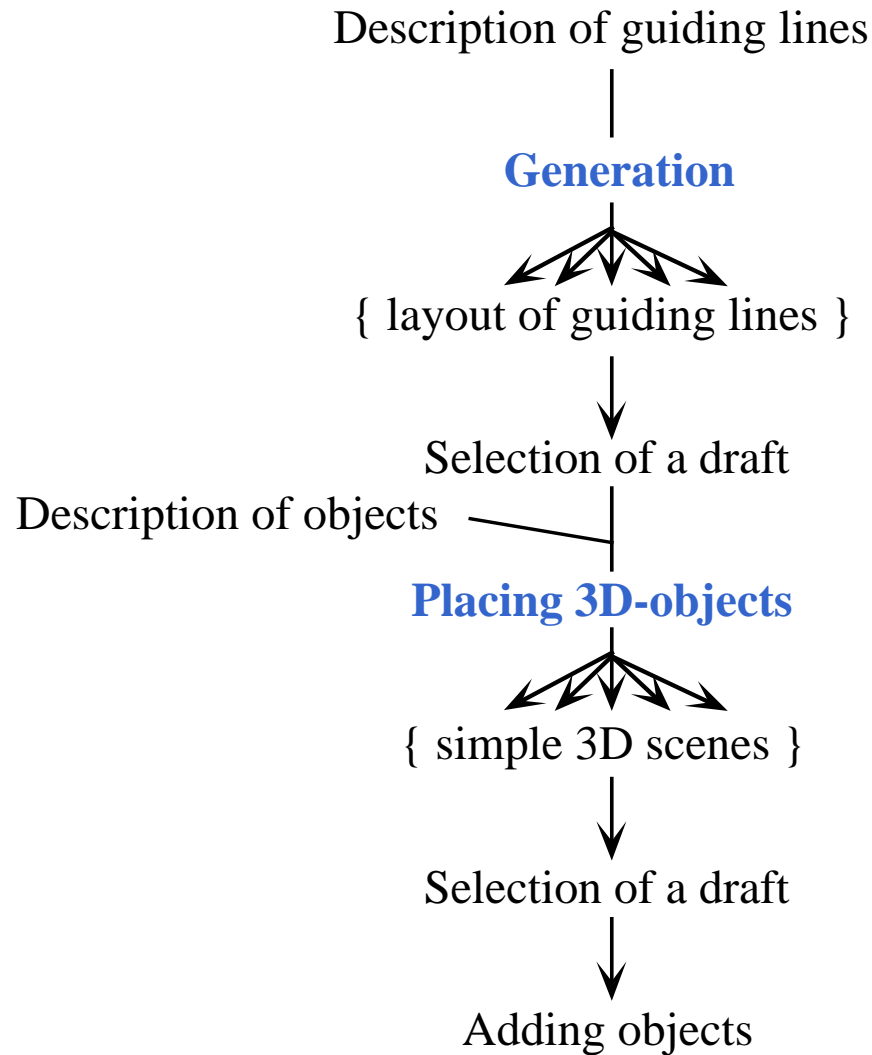
The designer chooses one of them



# Improving the realism

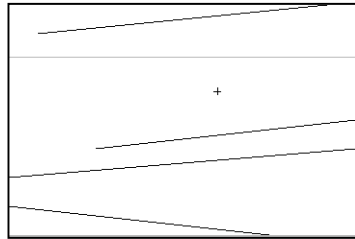
- Images are only composed of objects placed along guiding lines
  - ✿ It is not very natural
  - ✿ The designer can add objects
  - ✿ Currently, they are randomly placed
- Problems
  - ✿ Adding objects can cut guiding lines
  - ✿ Adding objects can create other guiding lines
  - ✿ Adding objects can change the main element
- The adding of objects must be controlled (in the future) meanwhile, the designer can ask another adding

# Summary of the design process

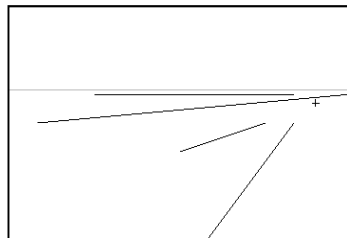


# Results

- A rather horizontal layout and a corresponding 3D scene



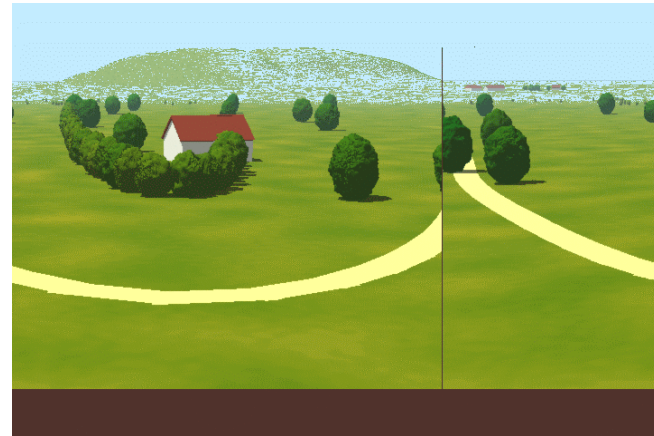
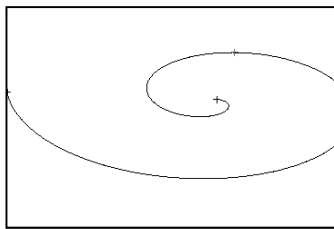
- A convergent layout and a corresponding 3D scene



# Gaze shifting

- Controlling the global behaviour of the gaze:
  - ★ A limited technique
  - ★ A horizontal reading, a convergent reading, ...
  - ☞ Taking into account the path the gaze must follow during the reading
- A similar process
  - ★ Describing the path of the desired gaze shifting
  - ★ Generation of path in accordance with the description
  - ★ Placing 3D objects (extension to polylines)

*The gaze starts from the left, then turns around the main element*





# Conclusion

- Images contain a message
  - ✱ defined by the designer and intended for the observers.
- Taking the designer's concept of the image into account
  - ✱ To control the way the designer conveys his message to observers
  - ✱ Less discrepancy between the emitted and the received message
- First release of our modeller
  - ✱ Building 3D scenes from the description of image's characteristics and respecting an artistic knowledge on images
  - ✱ Test of our approach ↻ images stress its interest
- Perspectives
  - ✱ Studying the unresolved problems
  - ✱ Increasing the number of the image's characteristics
  - ✱ Experimental study with a large number of people to validate the results

Thanks for your attention



## Related work: Computer science

- Taking images' characteristics into account in the design process of 3D scenes
  - ✿ Classical modellers: allow only a manual design process
  - ✿ Recent modellers: allow the definition of constraints
- Declarative modeller
  - ✿ Creating 3D scenes giving properties that the scenes must respect
  - ✿ 3 phases: Description, Generation, Understanding
- Declarative modellers are in charge of a great part of the work
- ↻ The designer can concentrate on the creation process

