NUS Computing Camp for Junior Colleges & High School Students

Stereogram Generation Workshop

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What are stereograms?

How do stereograms work?

- Because there is a small separation between our eyes, they perceive slightly different images.
- These differences allow us to perceive depth.
- Autostereograms work by repeating patterns in such a way as to give us an illusion of depth.

Generation of stereograms

- Key idea: compute the sets of points that are constrained to be of the same colour.
- Note that we can compute the required image one line at a time.
- How do we compute these sets?
- Use simple geometry.

1. Create a 3-d model of the object
   - Use a function $f(x,y)$ to define the depth of an object.
2. Decide on some parameters
   - Distance between eyes and image.
   - Position of object relative to image plane.
   - Distance between the two eyes.
3. Compute one line at a time.
How would YOU create a stereogram?

- We have already written the program that will automatically generate a stereogram based on the method described.
- What you need to do is to create a depth map and feed it to the stereogram generator:

\[
\frac{s}{-z} = \frac{E}{D - z}
\]

You will learn how to manipulate some simple objects to build your own depth maps and create your own stereograms.

Simple programming 😊
Plan for Today

- You will get a worksheet that will guide you through what we have discussed
- My lab assistants will help you
- Create cool stereograms and share with your friends and family

Primitive building blocks

(show rcross-bb)

(show corner-bb)

(show sail-bb)

(show nova-bb)

(show heart-bb)
Primitive building blocks
(show circle-bb)

Primitive building blocks
(show spiral-bb)

Primitive Operation: Rotating to the Right

(show (quarter-turn-right sail-bb))

Derived Operation: Rotating Upside Down

(show (turn-upside-down sail-bb))

How about Rotating to the Left?

(show (turn-quarter-left sail-bb))

Flipping Objects

(show (flip-horiz nova-bb))
(show (flip-vert nova-bb))
Means of Combination: Stacking

(clear)
(show (stack rcross-bb sail-bb))

Multiple Stacking

(clear)
(show (stack rcross-bb
(stack rcross-bb sail-bb)))

Placing objects one beside the other

(clear)
(show (beside sail-bb rcross-bb))

A complex object

(clear)
(show (stack
(beside
{quarter-turn-right rcross-bb
(turn-upside-down rcross-bb)
(beside
(rcross-bb
{quarter-turn-left rcross-bb)}))
This operation is also known as make-cross

Naming your objects with define

(clear)
(define myPic
(make-cross sail-bb))
(show myPic)
(define myPic2
(make-cross nova-bb))
(show myPic2)

Repeating the pattern

(clear)
(show (make-cross (make-cross nova-bb)))
Repeating multiple times

What about 3 rows?

Repeating n times

A rectangular repeated pattern

Another regular pattern

Creating 3D objects

- We use greyscale to represent depth
- Black is nearest to you
- White is furthest away

means
Creating 3D objects

Overlay Operation

(clear)
(show (overlay sail-bb rcross-bb))

Advanced Overlay Operation

(clear)
(show (overlay-frac 1/4 corner-bb heart-bb))

Scaling

(clear)
(show (scale 1/2 heart-bb))

Wait, did we say we’re creating stereograms?
- Yeah, that’s the easy part!
- Do:
  (stereogram <depth map>)
- Example:
  (show (overlay sail-bb rcross-bb))
  (stereogram
   (overlay sail-bb rcross-bb))

Your First Stereogram
Loading from/Saving to File

- You can also create a depth map using some paint program and load using:
  \( \text{(load-map <filename>)} \)

- You can save your work with:
  \( \text{(save <filename>)} \)

What if you cannot see stereograms?

Think Different

Image plane

Think Different

Image plane

Think Different

Image plane

3D Anaglyphs

Use filters to show one image to each eye!
What else can we do to create an illusion of 3D?

Simulating 3D Effect with Animation

Image plane

Simulating 3D Effect with Animation

Image plane

Simulating 3D Effect with Animation

Image plane

Simulating 3D Effect with Animation

Image plane
Simulating 3D Effect with Animation

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Simulating 3D Effect with Animation

QUESTIONS

What you have seen are the basics of programming! 😊
The World of Computer Science

- Programming Languages
- Logic
- Vision
- Architecture
- Operating Systems
- Software Engineering
- Data Structures & Algorithms

Human-Computer Interaction
- Artificial Intelligence
- Graphics
- Programming
- Database
- Theory
- Compilers
- Security

Words of Advice

- Consider Computer Science if:
  - Like Maths (esp. 'elegant' Maths)
  - Like to ‘create’ or build things
  - Want to make a difference to society in the work you do
  - You are impatient and you want to see your work out there in the real world in a hurry

Words of Advice

- Follow your heart, NOT the market
- Figure out what you like and what you’re good at – and keep doing it
- Try and explore different things
- Ask yourself: What do you want to do with your life? WHY?