3D Models from 2D Images

A Lecture in the Freshman Seminar Series: Puzzling Problems in Science and Technology
About This Presentation

This presentation belongs to the lecture series entitled “Puzzling Problems in Science and Technology,” devised for a ten-week, one-unit, freshman seminar course by Behrooz Parhami, Professor of Computer Engineering at University of California, Santa Barbara. The material can be used freely in teaching and other educational settings. Unauthorized uses, including any use for financial gain, are prohibited. © Behrooz Parhami

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3D Models from 2D Images
A 3D Object’s Six 2D Projections

If we were to manufacture this object, we also need to know about its insides (e.g., is it hollow or solid?)
3D Structures Built of Cubic Blocks

A 3D assembly of blocks can be specified by three views:

- Top view (aka base view)
- Front view
- Right view (aka side view)
3D Structures Built of Cubic Blocks

Draw the top, front, and right projections in two cases

1. Shapes formed from blocks; 2. Shapes carved out in one piece

How many blocks?

Top

Front

Right

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3D Reconstruction from 2D Projections

5-minute video: https://www.youtube.com/watch?v=PXp3D-R7--E
Challenge Puzzle 1: Draw the Three Views

Draw once without and once with the removed piece
Challenge Puzzle 2: Draw the Three Views

Draw once without and once with the two removed pieces

Top

Front

Right
Comparing 3D Objects with 2D Projections

Are these two objects the same? If not, list the differences.

Change the projections so that they correspond to the 3D object.
Engineering Drawings of A 3D Object

Draw the 3D object here

Dashed lines represent elements that are invisible in that view (i.e., they are on the back side or inside the object)
Engineering Drawings of A 3D Object

Top View

Isometric View

Front View

Right View
3D Modeling in Practice

**3D models are needed everywhere:**
Computer games | Architecture | Medical diagnostics
Industrial manufacturing (mechanical parts, cars, planes, …)
3D Optical Illusions: Sidewalk Art
3D Optical Illusions

How to create a 3D illusion: Hole on palm of hand
2-minute video: http://www.youtube.com/watch?v=s2LrmAThAhk
Computer Game Character Animation

Similar to animation for film, but here speed is more important
1-minute video: http://www.youtube.com/watch?v=yQuStfDbd9s
UCSB's Long-Term Development Plan
Virtual Architectural Preview

Residential complex viewed from different angles before it is built:
3-minute video: http://www.youtube.com/watch?v=_zeEiQfgicY
Virtual Reconstruction of the Temple Mount

UCLA’s Urban Simulation Team built a 3D computer model:
8-minute video: http://www.youtube.com/watch?v=HHLD6RXVLaM
3D Medical Imaging

Multiple 2D images (views or slices) turned into a 3D model.
1-minute video: http://www.youtube.com/watch?v=QeqzJbRgQx0
3D Modeling of a Car

Turning 2D views into a 3D model
2-minute video: http://www.youtube.com/watch?v=uvwthq5ZD0o
3D Model Built from Slices: Terrains, etc.
3D Model Built from Slices: Human Body

Darth Vader’s head assembled from slices
2-minute video: http://www.youtube.com/watch?v=S2G2ySEaJso
3D Printing: Important Emerging Technology

Printing an actual usable wrench with moving parts
4-minute video: http://www.youtube.com/watch?v=qx5fDHqHVOE
Example 3D Printing Application

**Airbus’s Thor concept aircraft:**
Built from sixty 3D-printed structural segments
3D Pen: For Playful Experimentation

Pen with rapidly cooling molten plastic “ink” for creating wireframes
2-minute video: http://www.youtube.com/watch?v=6r5q9T_7u8A