Multimedia Technology (IT-204-F)

Section A
Introduction to multimedia

Lecture *6*

Images-An Introduction

Image functions

- Recognizing or reconstructing objects in a 3D scene from one image is an ill-posed problem.
- Recovering information lost by perspective projection is only one, mainly geometric, problem of computer vision.
- The second problem is how to understand image brightness. The only information available in an intensity image is brightness of the appropriate pixel, which is dependent on a number of independent factors such as object surface reflectance properties (given by the surface material, microstructure and marking), illumination properties, and object surface orientation with respect to a viewer and light source.
- Some scientific and technical disciplines work with 2D images directly; for example, an image of the flat specimen viewed by a microscope with transparent illumination, a character drawn on a sheet of paper, the image of a fingerprint, etc.
- Many basic and useful methods used in digital image analysis do not depend on whether the object was originally 2D or 3D.

Image Characteristics

- A **monochromatic image** f(x,y,t) provides the brightness distribution.
  - Image processing often deals with static images, in which time t is constant.
  - A monochromatic static image is represented by a continuous image function f(x,y) whose arguments are two co-ordinates in the plane.
  - Computerized image processing uses digital image functions which are usually represented by matrices, so co-ordinates are integer numbers.
  - The customary orientation of co-ordinates in an image is in the normal Cartesian fashion (horizontal x axis, vertical y axis), although the (row, column) orientation used in matrices is also quite often used in digital image processing.
  - The range of image function values is also limited; by convention, in monochromatic images the lowest value corresponds to black and the highest to white.

Image Properties

- Metric properties of digital images:
- **Distance** is an important example.
- The distance between points with co-ordinates (i,j) and (h,k) may be defined in several different ways; the **Euclidean** distance is defined **city block** distance
  - **chessboard**
- **Pixel adjacency** is another important concept in digital images.
- **4-neighborhood**
- **8-neighborhood**

- The quality of a digital image grows in proportion to the spatial, spectral, radiometric, and time resolution.
- The **spatial resolution** is given by the proximity of image samples in the image plane.
- The **spectral resolution** is given by the bandwidth of the light frequencies captured by the sensor.
- The **radiometric resolution** corresponds to the number of distinguishable gray levels.
- The **time resolution** is given by the interval between time samples at which images are captured.

Animation

- Animation: animation is the illusion of movement. When you watch television, you see lots of things moving around. Although 12 fps-frames per second, is enough technically to make animation work, the animations sometimes look jerky. Most professional animations therefore use a higher frame rate. Television uses 30 fps, and motion pictures use about 24 fps.
- Animation Principles
- Persistence of vision
  - object seen by human eye remains mapped on retina for a brief time after viewing
  - display series of images rapidly and they blend together to create illusion of movement
  - requires at least 16 frames per second to look seamless
- Television: 30 frames per second
- Movies: displayed at 48 frames per second

- **Basic Concepts**
  A signal is a function depending on some variable with physical meaning.
  Signals can be:

  1. *one-dimensional* (e.g., dependent on time),

  2. two-dimensional (e.g., images dependent on two co-ordinates in a plane),

  3. three-dimensional (e.g., describing an object in space), or higher-dimensional.

A scalar function may be sufficient to describe a monochromatic image, while vector functions are to represent, for example, color images consisting of three component colors.

Types of Animation

- **Frame-Based Animation:** *Frame-based animation* is the simpler of the animation techniques. It involves simulating movement by displaying a sequence of static frames. A movie is a perfect example of frame-based animation; each frame of the film is a frame of animation. When the frames are shown in rapid succession, they create the illusion of movement.

- **Cast-Based Animation:** *Cast-based animation*, which also is called *sprite animation*, is a very popular form of animation and has seen a lot of usage in games. Cast-based animation involves objects that move independently of the background. In this case, an object is something that logically can be thought of as a separate entity from the background of an image. For example, in the animation of a forest, the trees might be part of the background, but a deer would be a separate object moving independently of the background.

Animation Techniques

- 2-D Animation Techniques
- Cell animation (also called frame animation)
  - start with first and last image in motion (called *keyframes*)
  - draw images between keyframes (process called *tweening*) -- *small changes between images*
  - images are then *layered* onto background scene
  - images displayed rapidly
    - 15/second, 24/second, 30/second
- Computer animation
  - logic and procedural concepts are same as in cell animation *(keyframe, tweening, layering techniques)*

- 2D Animation Techniques
- Results of cell animation are also called *flip books*
- Easier to create and process than movies

Cell-based Techniques: Morphing

- Morphing：Morphing is an image processing technique typically used as an animation tool for the metamorphosis from one image to another. The idea is to specify a warp that distorts the first image into the second. Its inverse will distort the second image into the first.
- We use the term "**morphing**" to describe the combination of generalized image warping with a cross-dissolve between image elements.
- The morph process consists of warping two images so that they have the same "shape", and then cross dissolving the resulting images. Cross-dissolving is simple; the major problem is how to warp an image.

  - uses frames to create illusion of one object changing into another
  - more key points = smoother morph
- Need at least 15 frames per second
- Professional quality uses 24-30 frames per second
- Cell-based animation is done more easily on computer than by hand

Vector Animation

- Path-based Animation (vector animation)
  - Creates animated objects by following object's transition over a line or vector
  - Artist creates one drawing and a path
  - Computer program manipulates object by drawing frames as object travels over the path
- **Vector Devices**
- Vector displays
- Vector drawing plotters
- Vector cutting machines: apparel industry, ship construction, shoe industry

Ways of Graphics Representation:

1. Vector Graphics

- *Image is represented by continuous geometric objects: lines, curves, etc.*
- Graphics objects: geometry + colour
- Complexity ~ O(number of objects)
- Geometric transformation possible without loss of information (zoom, rotate, …)
- Diagrams, schemes, ...
- Examples: PowerPoint, CorelDraw, ...

2. Raster Graphics

- *Image is represented as an rectangular grid of coloured squares*
- Generic
- Image processing techniques
- Geometric Transformation: loss of information
- Complexity ~ O(number of pixels)
- Jagged edges, anti-aliasing
- Realistic images, textures, ...
- Examples: Paint, PhotoShop, ...

Vector Based Tool

Macromedia Flash

Macromedia Flash is a vector-based tool that is used to produce 2D vector animations for the Internet. Flash uses vector-drawing techniques to keep the file size small and has become the standard on the Internet for advanced streaming animation. Since the drawings are rendered at the local computer, the graphics quality is high and they can be resized without the pixelization of the graphics when enlarged.

Animation in Flash

- Animation in Flash
  - In-Between - tweening by adding incremental sprites between ending and starting sprites
  - Step recording - record sprite position in one frame, move ahead to next frame and record new sprite position
  - Real-time recording - use mouse to establish sprite path and record this movement. Record at slow rate and speed up when playing
  - Cast to time - create cast member, slightly modify it creating new cast member until sequence of still images created
  - Space to time - position cast member in different positions in different channels and then move from multiple channels to single channel
  - Paste special relative - automatically position sequence of frames on stage where last sequence ended

- **Animation Effects in Flash**
- Onion skinning -- allows creation of new images by tracing over existing image. Allows editing of animated sequences using other cast members for reference
- Trail effect -- previous image not completely erased when next image appears on screen
- Film loop -- cast member that consists of a series of animated frames set up to play over and over
- Warp, skew, perspective -- edit cast member to change a variety of aspects of the cast member (see cathiewarp.exe in LabMaterials)
- Filtering -- plug-in image editors that apply effects to bitmapped images (ex. Can install Photoshop effects)
- Color cycling -- change the palette used over the course of several frames in the animation. Excellent for representing flowing, spinning, or pulsing objects.

Steps to Create an Animation

1. Determine type of animation
2. Choose software
3. Create or select graphic to animate
4. Create color palette
5. Render (draw) graphic
6. Set display buffers for transformations
7. Generate basic design
8. Select and initialize palette
9. Create animation special effects

Shading

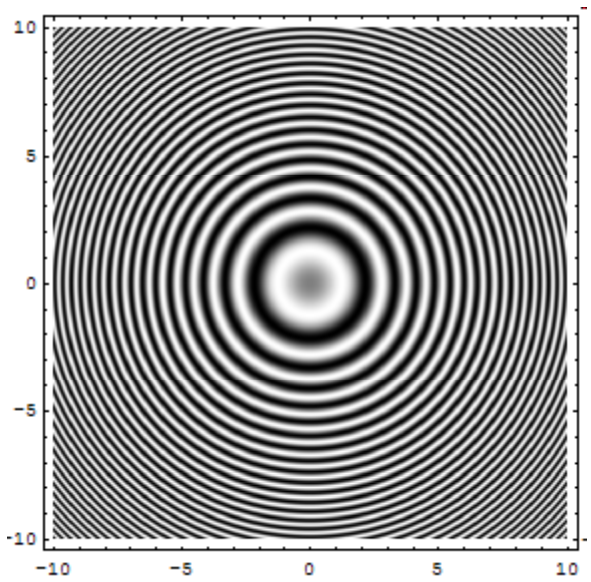
- Shade objects so their images appear three-dimensional
- Light-material interactions
- Phong model
- Why we need shading
- Suppose we build a model of a sphere using many polygons

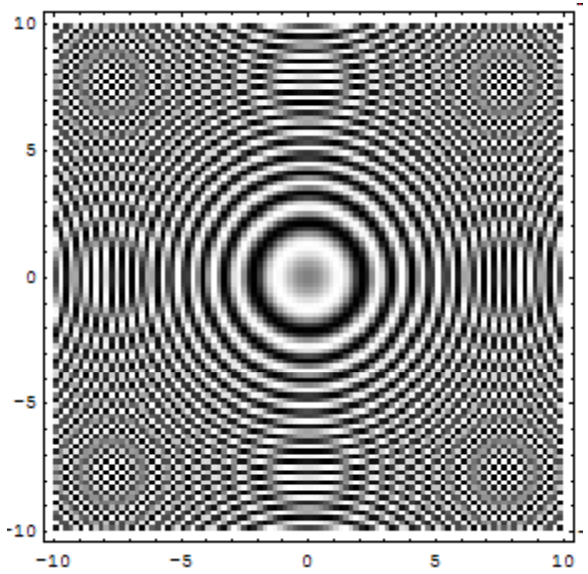
- Why does the image of a real sphere look like Light-material interactions cause each point to have a different color or shade
- Need to consider

– Light sources
– Material properties
– Location of viewer
– Surface orientation

Anti aliasing Techniques

- Aliasing occurs when signals are sampled too infrequently, giving the illusion of a lower frequency signal **alias** *noun* (c. 1605) an assumed or additional name





APPLICATIONS

- Image Processing
- Image Enhancement
- Medical Imaging

Scope of Research

- Image Processing
- Animation