Digital Image Processing and Applications

Dr. Xiqun Lu

College of Computer Science

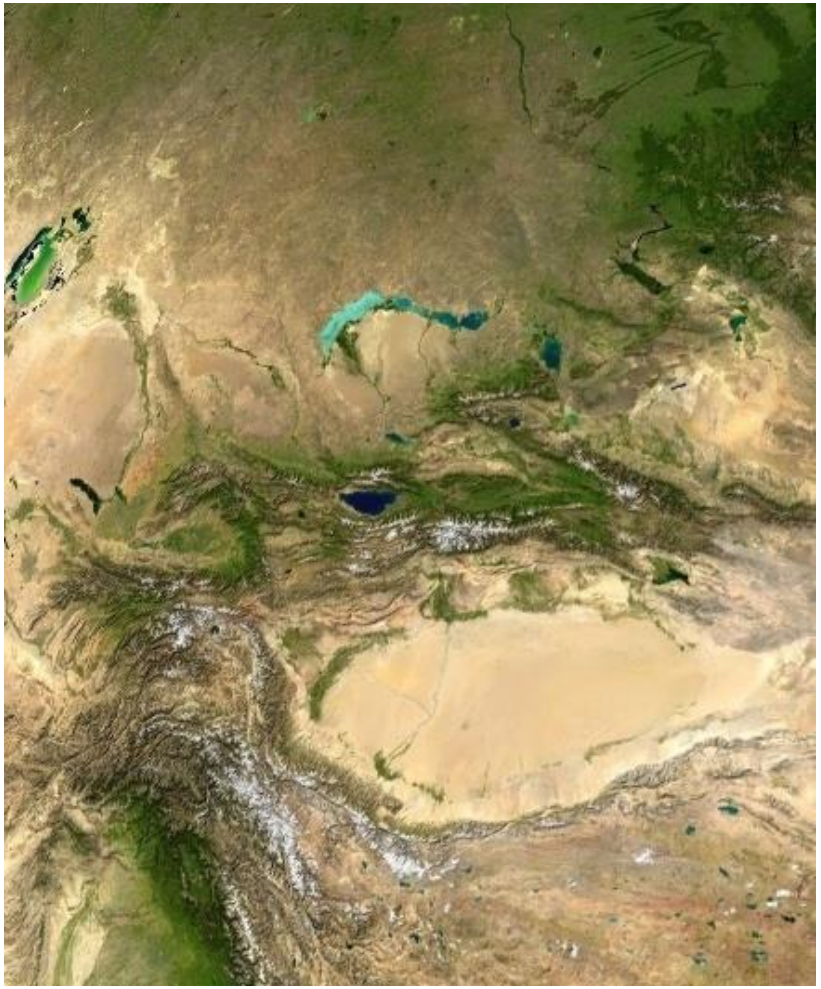
Zhejiang University

Course Outline

- Image Representation
- Motion Estimation (including Optical Flow Techniques)
- Image & Video Compression
- Human Visual System
- Image Halftone Techniques
- Image Filtering Techniques
- Image Interpolation & Super-resolution
- Edge Detection

A picture is worth a thousand words. A video is worth a thousand sentences.

- Rich information from visual data
- Examples of images around us
  - Natural photographic images
  - Artistic and engineering drawings
  - Scientific images (satellite, medical, etc.)
- Motion picture – video
  - Movies, TV programs, news
  - Family video
  - Surveillance and highway camera



Why do we process images & videos?

- Enhancement and restoration
  - To remove artifacts and scratches from an old photo/movie
  - To improve contrast and correct blurred images/videos
- Transmission and storage
  - To transmit images from oversea via Internet, or from a remote planet
- Information analysis and automated recognition
  - To provide “human vision” to machines ~ computer vision
- Security and rights protection
  - encryption and watermarking

Why Digital?

- “Exactness”
  - Perfect reproduction without degradation
  - Perfect duplication of processing result
- Convenient & powerful computer-aided processing
  - Can perform rather sophisticated processing through hardware or software
  - Even kindergartners can do it!
- Easy storage and transmission
  - Paperless transmission of high quality photos/videos through network within seconds

Compression

- **Color image of 600×800 pixels**
  - Without compression
    - 600 × 800 × 24 bits/pixel = 11.52K bits = 1.44M bytes
  - After JPEG compression (popularly used on web)
    - only 89K bytes
    - compression ratio ~ 16:1
- **Movie**
  - 720 x 480 per frame, 30 frames/sec, 24 bits/pixel
  - Raw video ~ 243M bits/sec
  - DVD ~ about 5M bits/sec
  - Compression ratio ~ 48:1

"Library of Congress" by Dr. M.Wu (@Maryland University)

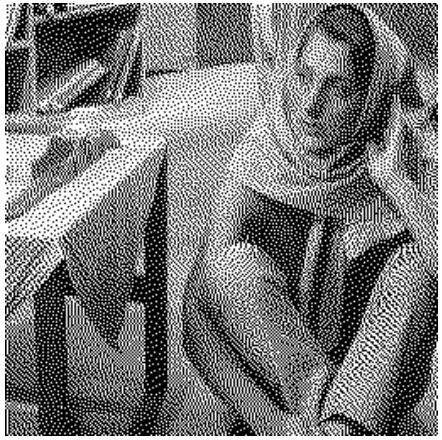
Image Halftone

Original Image

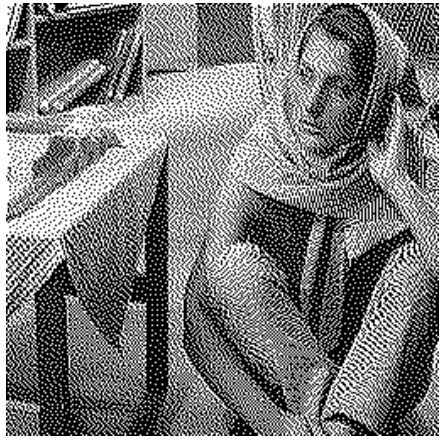
Threshold at Mid-Gray

Dispersed Dot Screening

Clustered Dot Screening



Floyd Steinberg Error Diffusion



Stucki Error Diffusion

Image Denoising

Median Filtering

Bilateral Filtering [1]

Image Interpolation & Superresolution

clear

nearest

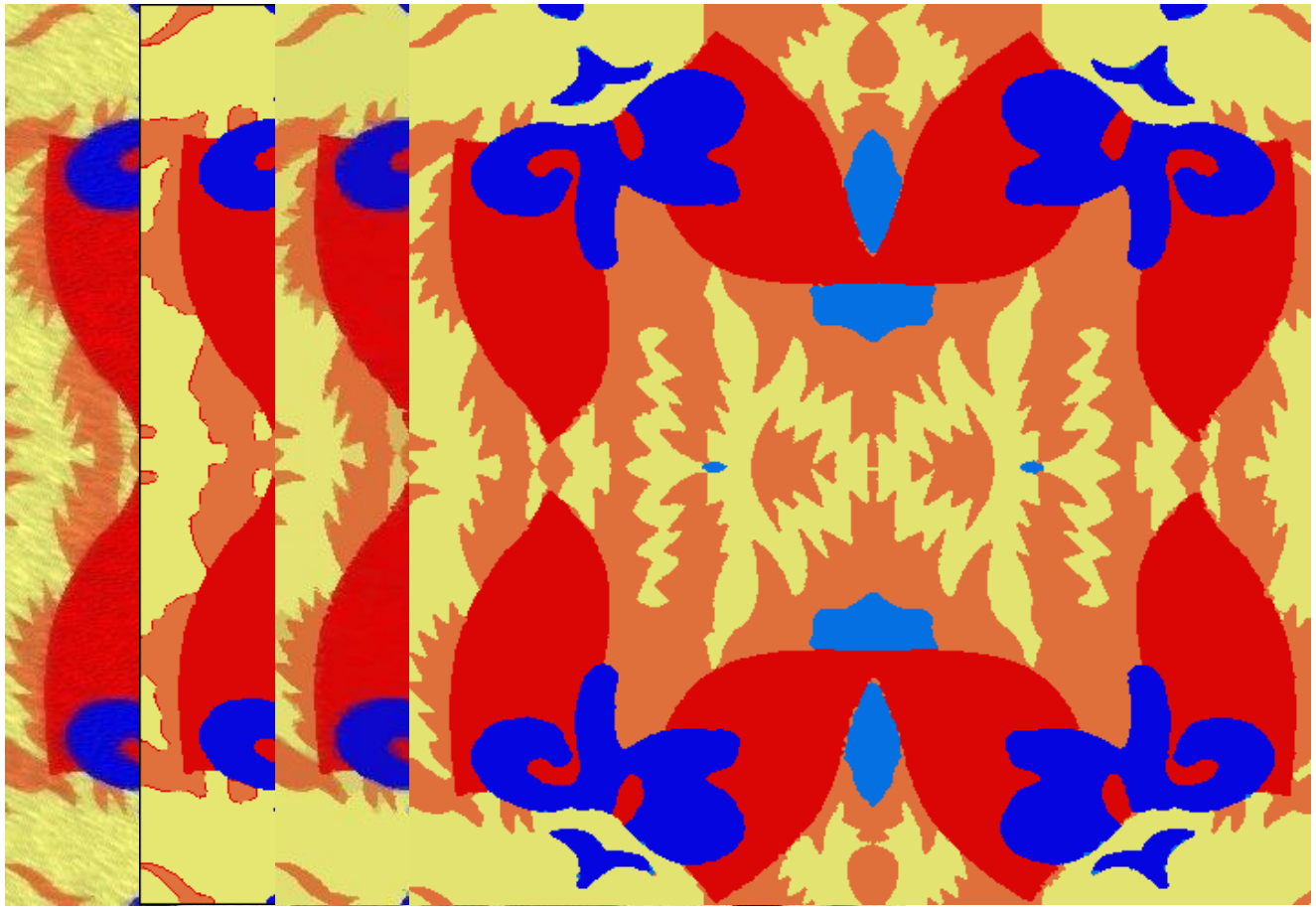
bilinear

bicubic

in scale BP

ICCV2009 [2]

Image Segmentation



Multiscale Context Model [5]

References

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- [2] D. Glasner, S. Bagon, and M. Irani, “Super-resolution from a single image,” in Proc. of IEEE International Conference on Computer Vision (ICCV), pp.349-356, 2009.
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Thank You!

Dr. Xiqun Lu

xqlu@zju.edu.cn