Digital Photogrammetry

Presented by:
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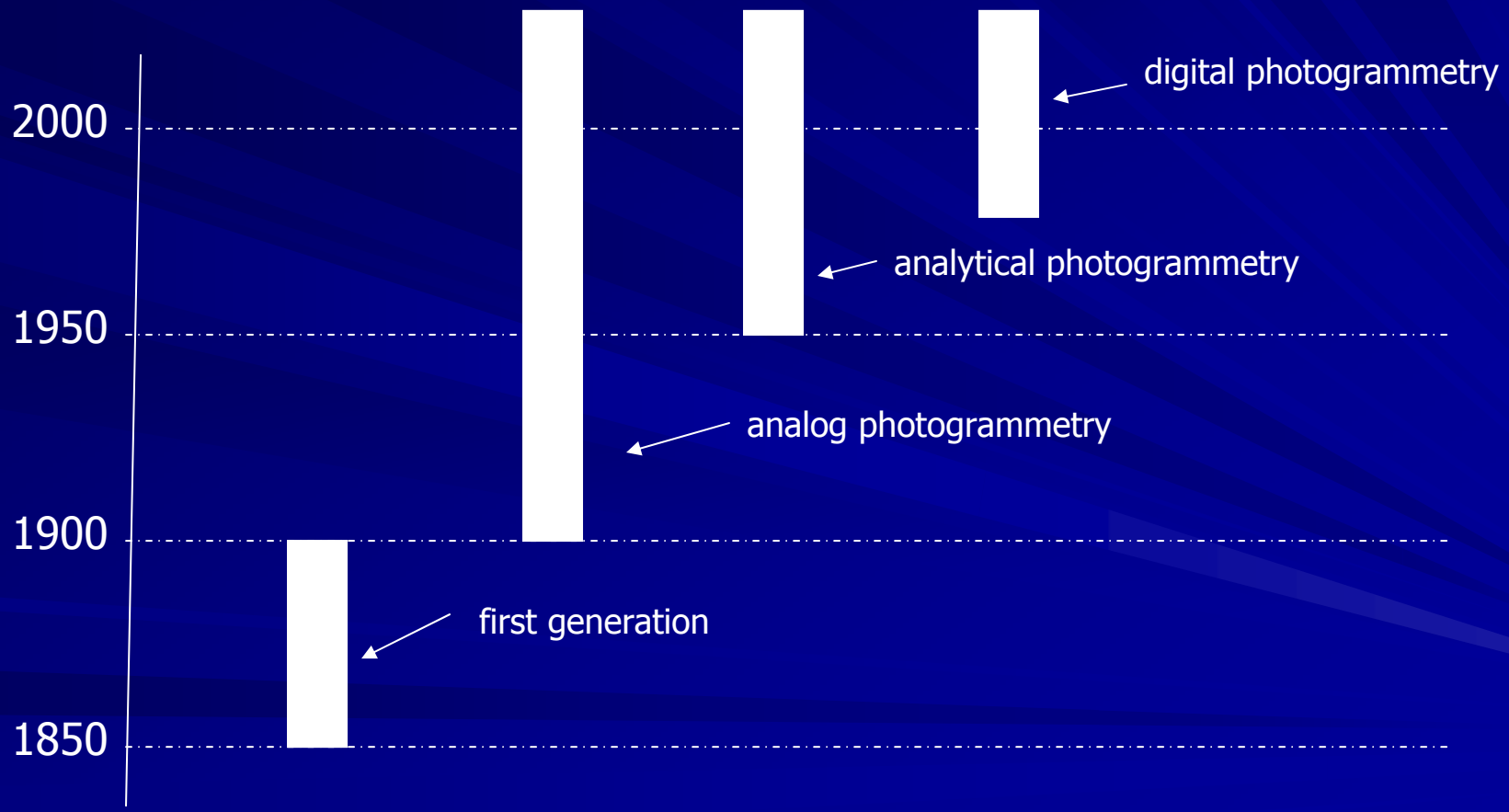
Background

- First Generation
- Analog Photogrammetry
- Analytical Photogrammetry
- Digital Photogrammetry

Photogrammetric Generations

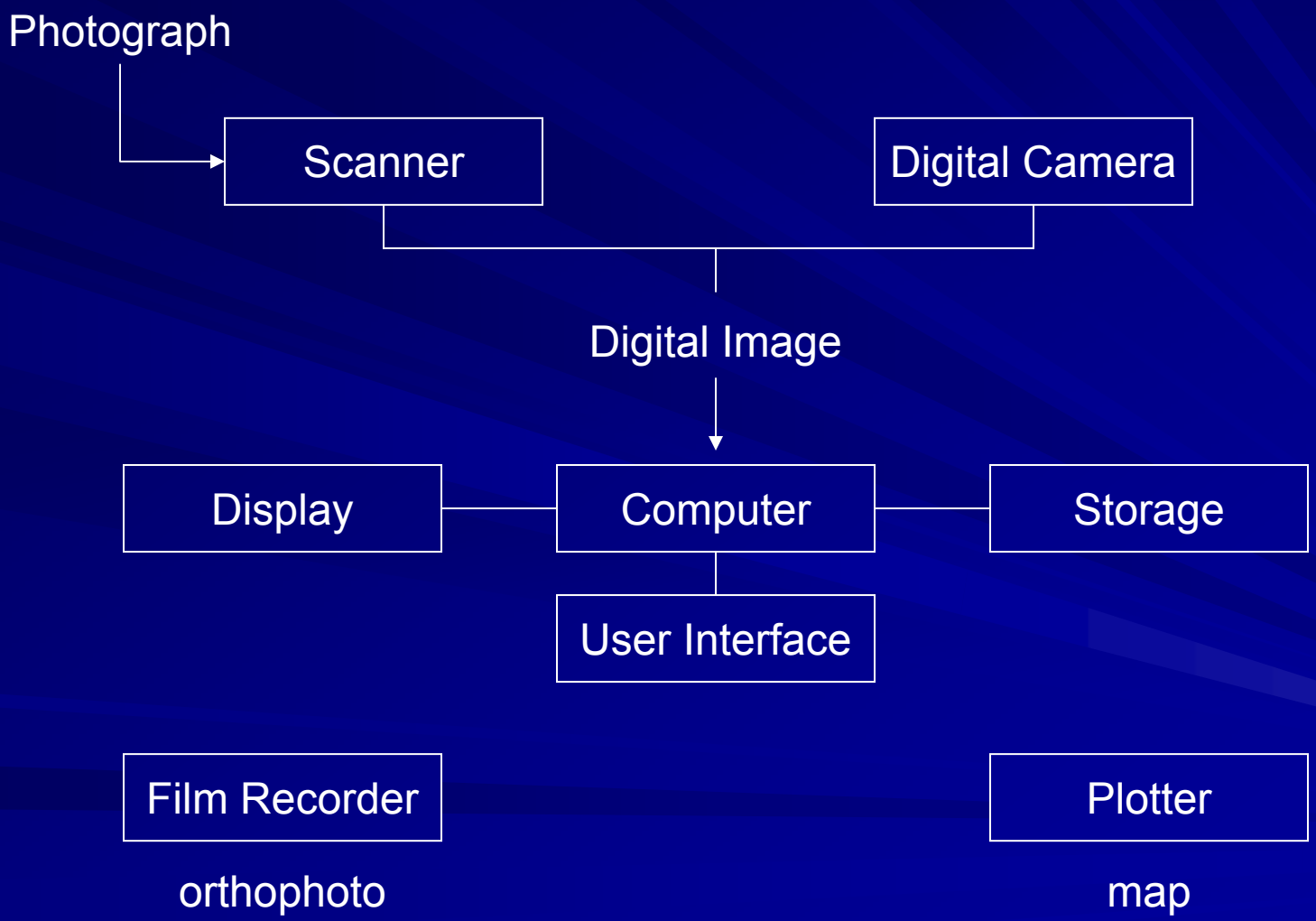


Computer Generations and Photogrammetric Discipline

Generation	Hardware	Software	Photogrammetric Discipline
1	-Vacuum tubes	-machine code	- analytical photogrammetry -aerial triangulation -correlation -analytical plotter
2	-transistors -magnetic core memory	-higher level languages (FORTRAN-COBOL)	
3	-IC memory -minicomputers -mag.disk storage	-time sharing -operating systems -Virtual memory	
4	-Microprocessors, PC -VLSI -networking	-new languages -(PASCAL-MODULA) -IGS, DBMS	Computer-assisted photogrammetry
5	-parallel processing -RISC architecture -VHSIC -optical disk storage	-knowledge based SW -expert systems - natural language processing	-digital photogrammetry -real-time photogrammetry

Terminology-Or the Lack Thereof

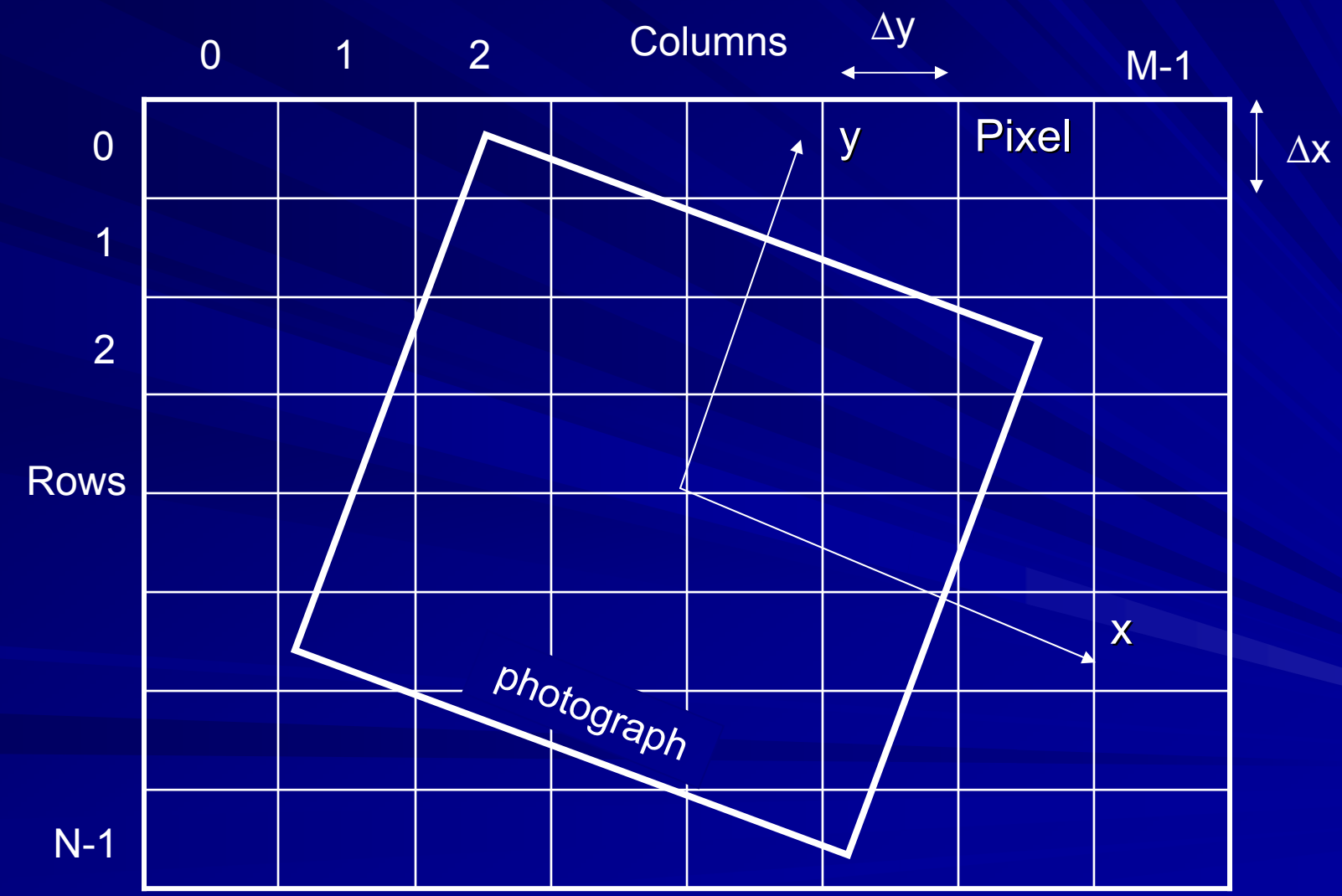
Generic Digital Photogrammetry Environment



Properties of Digital Imagery

- Definition of Digital Image
- Spatial Resolution and Geometric Accuracy
- Radiometric Resolution

Definition of Digital Image



Spatial Resolution and Geometric Accuracy

Pixel Size(micron)	Number of Pixels	Storage Requirement (MB)
960	240 * 240	0.058
480	480 * 480	0.230
240	960 * 960	0.922
120	1920 * 1920	0.686
60	3840 * 3840	14.746
30	7680 * 7680	58.982
15	15360 * 15360	235.931
7.5	30720 * 30720	943.721

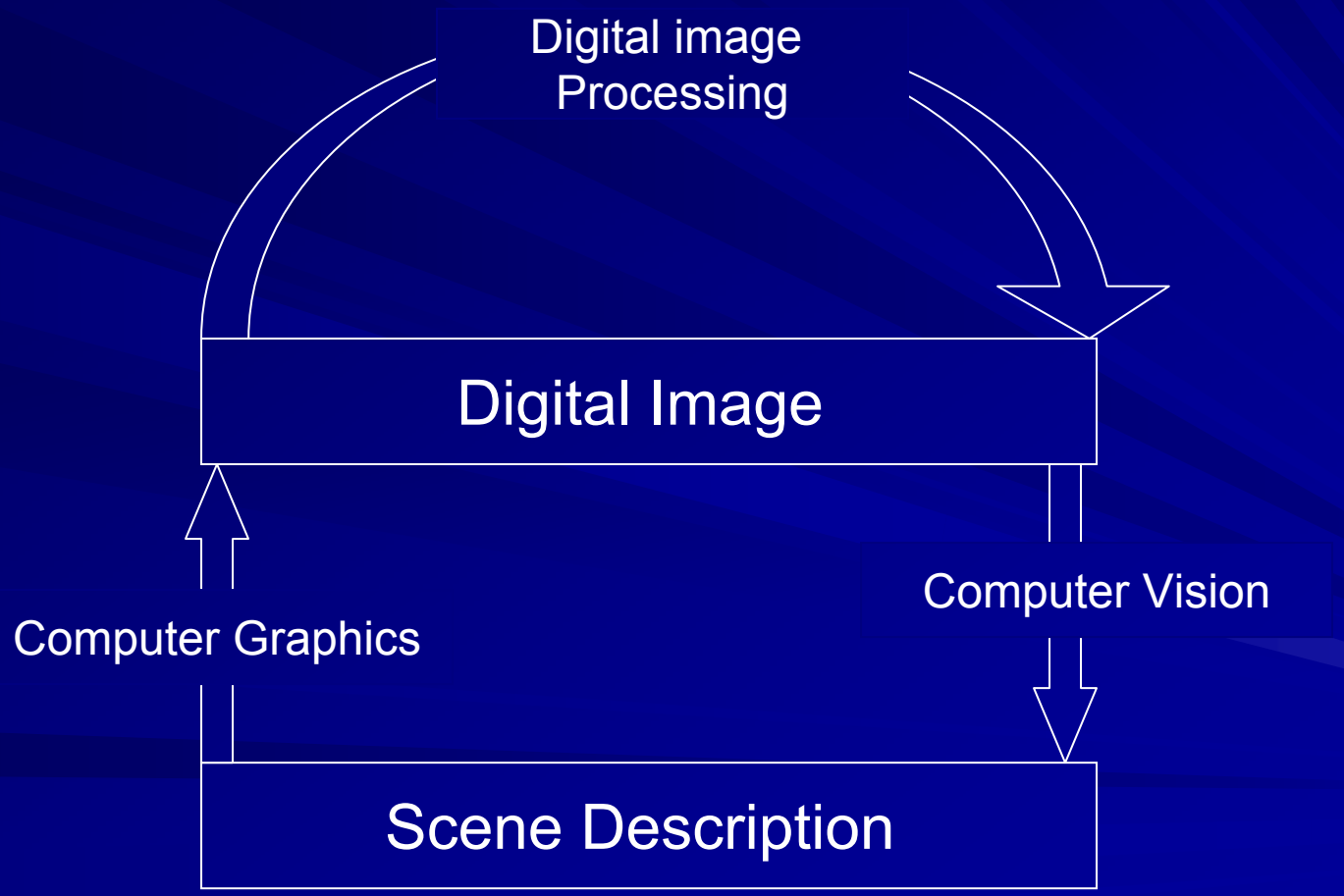
Classification of Processes and Tasks in Digital Photogrammetry

- System Level Tasks
- Low Level Tasks
- Middle Level Tasks
- High Level Tasks

Classification of Processes and Tasks in Digital Photogrammetry

Category	Processes, Algorithms	Tasks
System level	Store, access, display, images	Manipulate digital imagery
Low level	Process, match images, extract features	Image processing: orientations, digital orthophoto, DEM, AT
Middle level	Group, segment images	Surface reconstruction Feature reconstruction
High level	Understand images	Object recognition Image interpretation

Relationship of Digital Photogrammetry to Other Discipline



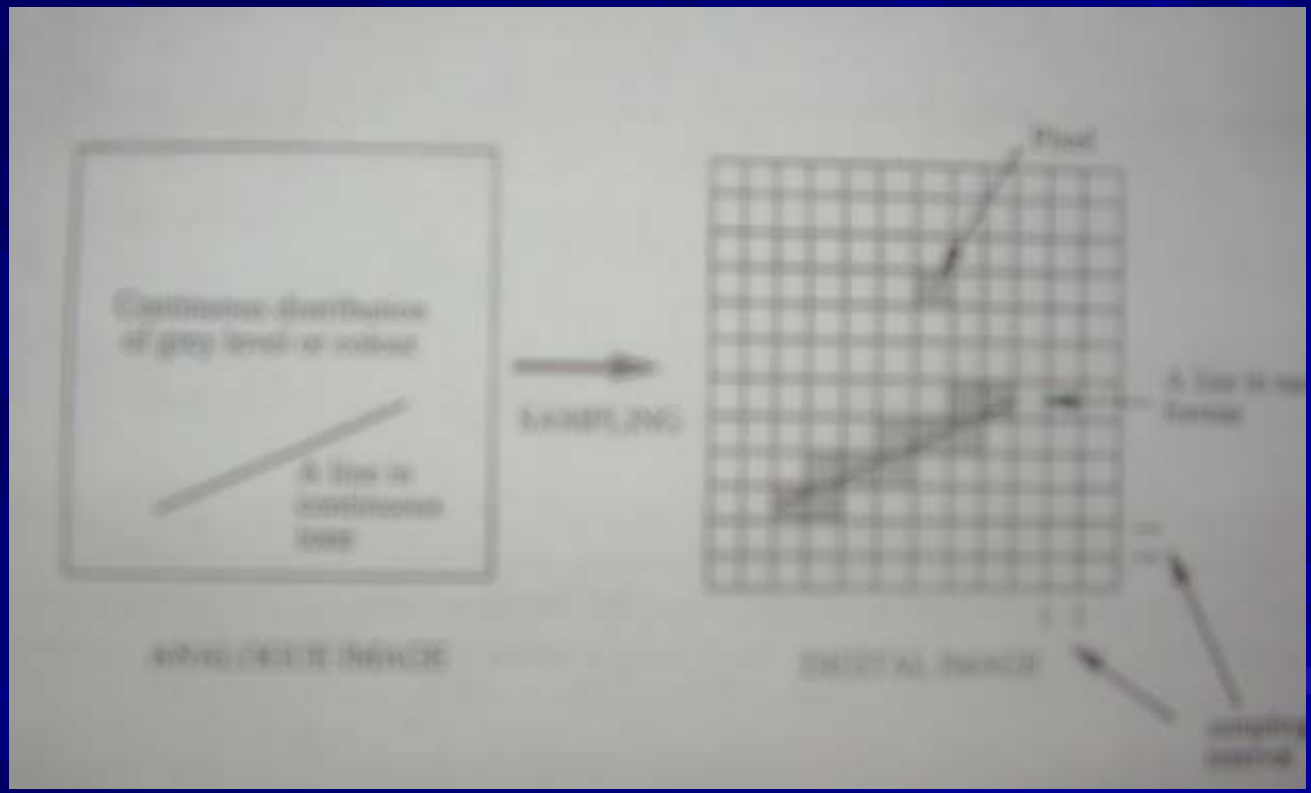
Fundamentals of Digital Photogrammetry

- Why use Digital Images?
- Advantages of using Digital Images:
  - Appropriate way for displaying and Measurement
  - Stability
  - Applying image Enhancement is possible
  - Automation can be applied
  - Real time phptogrammetry is not out of access

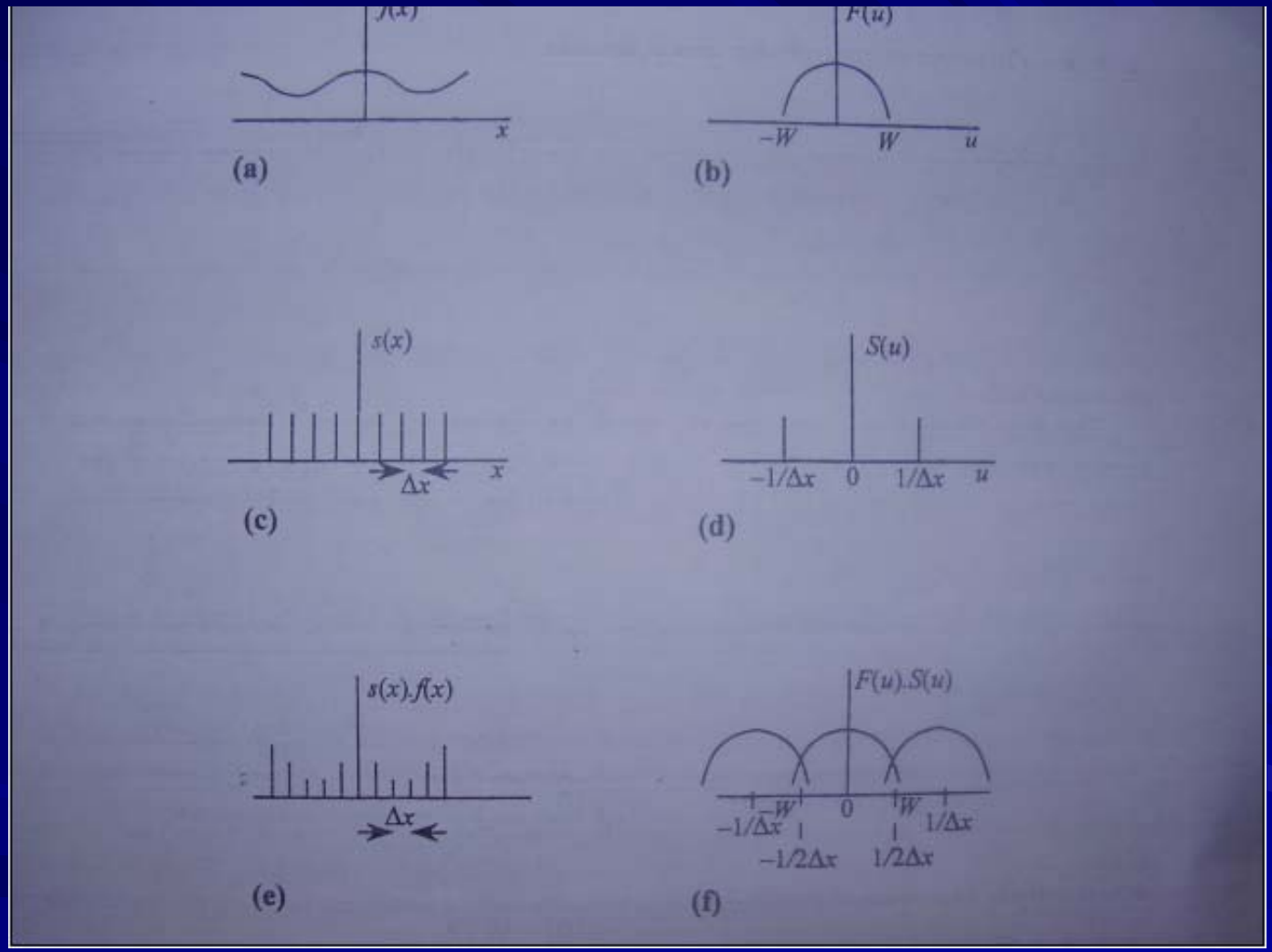
Characteristics of Digital Data

- Digitization
  - Intensity
  - Gray Value
  - Density
- Sampling
- Quantization of gray levels
- Noise

Concept of Sampling



Theory of Sampling



Concept of Quantization

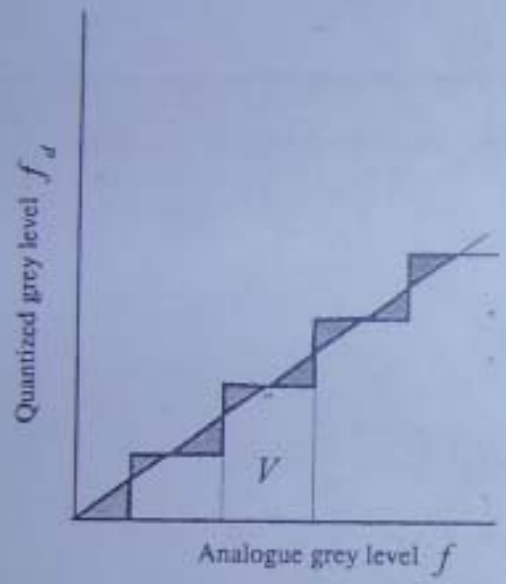


Figure 3.3 *The concept of quantization (after Murai, 1993).*

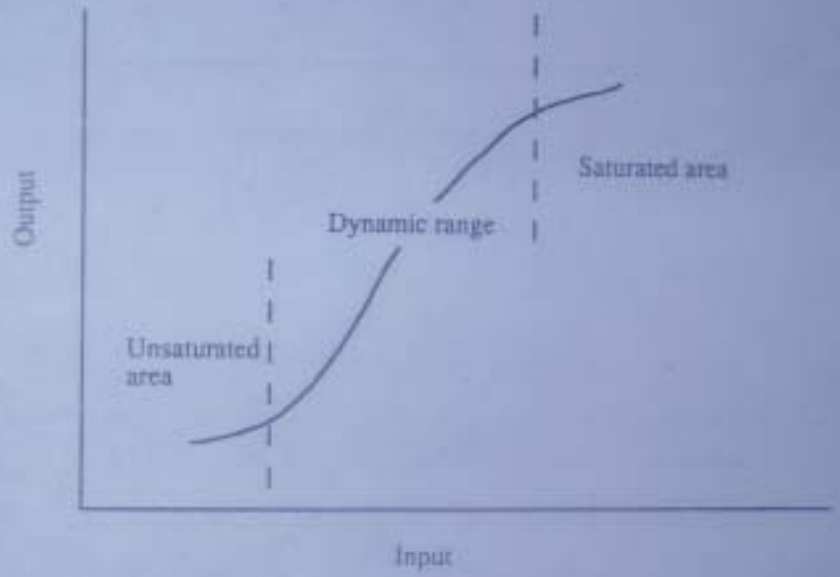
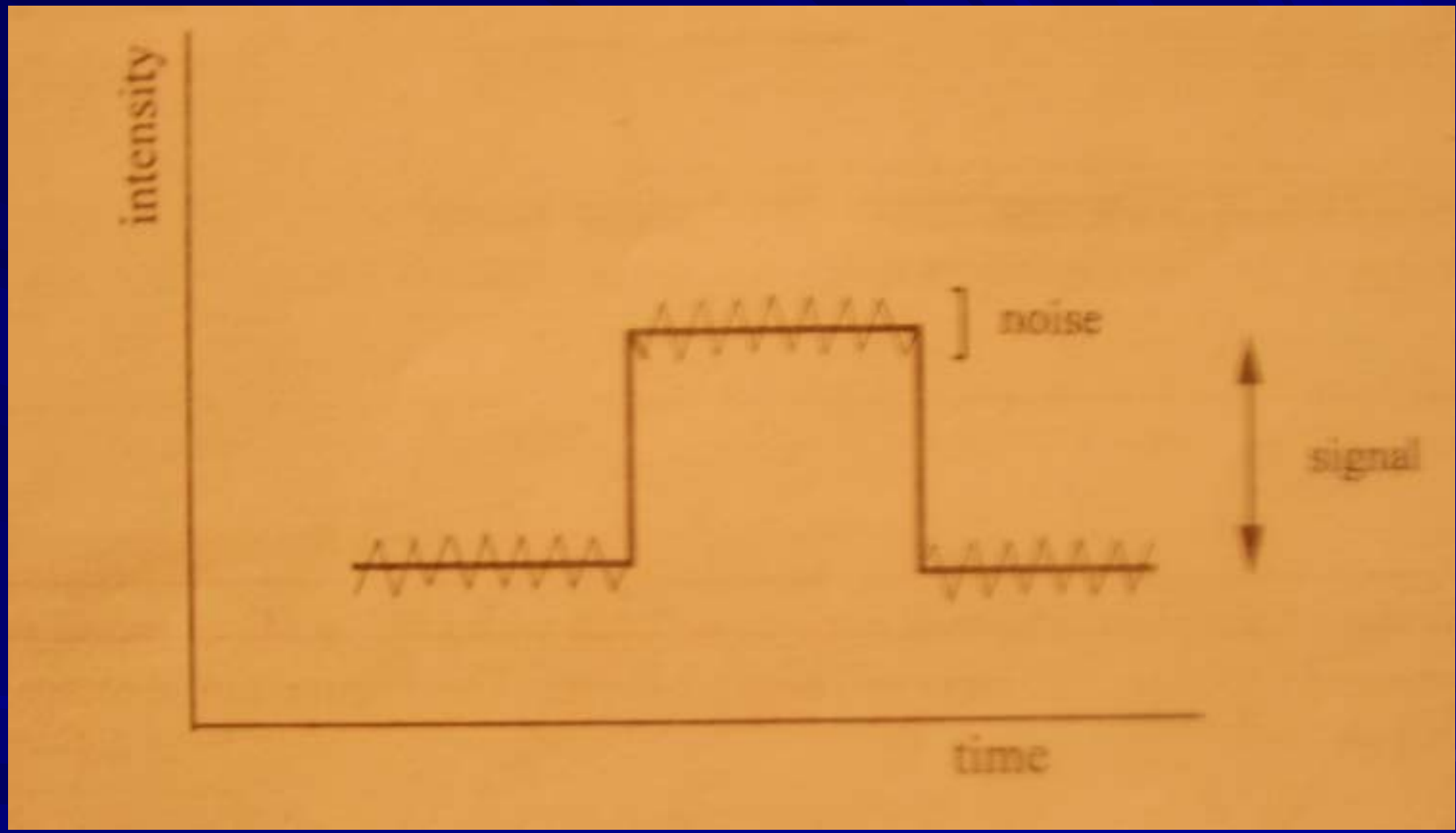


Figure 3.4 *The characteristic curve of a sensor (after Murai, 1993).*

Signal versus Noise



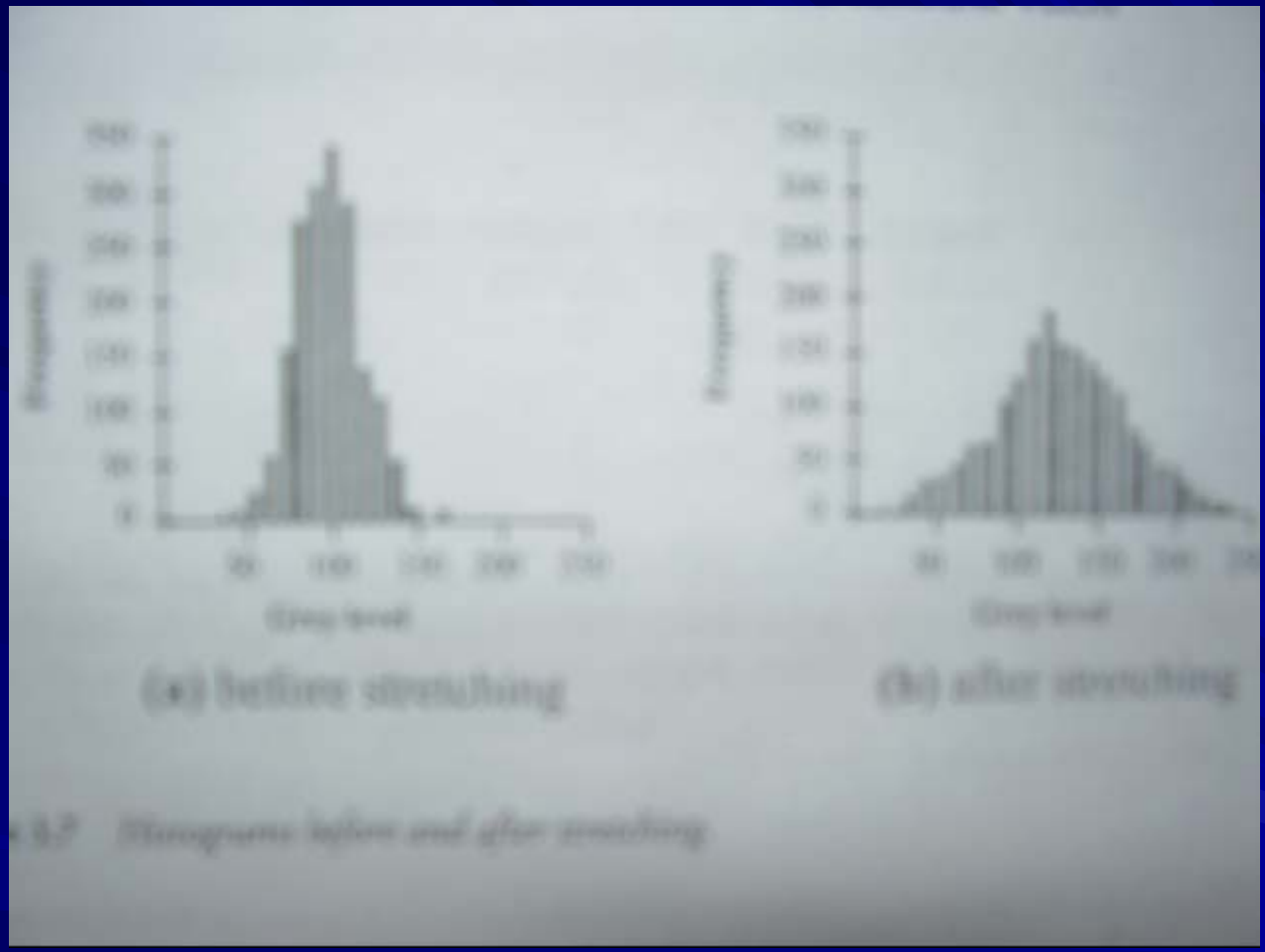
Charge Coupled Devices (CCDs)

- Characteristics
  - Size of the array
  - Pixel size
  - Dynamic range
  - Geometric aspect (Lens Distortions)
  - Transfer of Data from sensor to storage
  - Time taken to record an image
- Pixel size and Resolution
  - Spatial
  - Radoimetric
  - Spectral

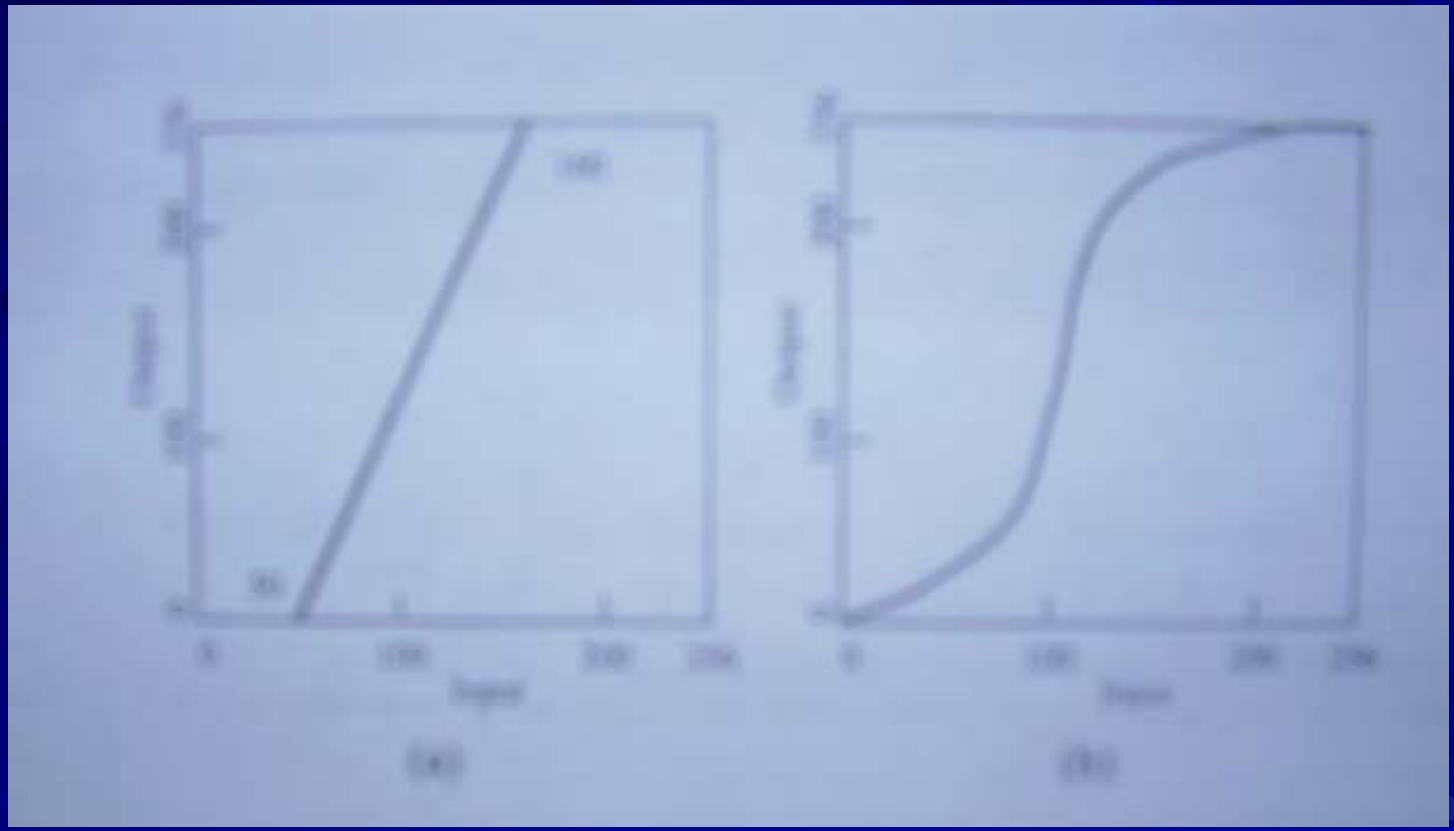
Image Processing

- Operations
  - Enhancement
  - Restoration
  - Compression
  - Classification
- Enhancement
  - Contrast Stretching
  - Filtering
- Resampling

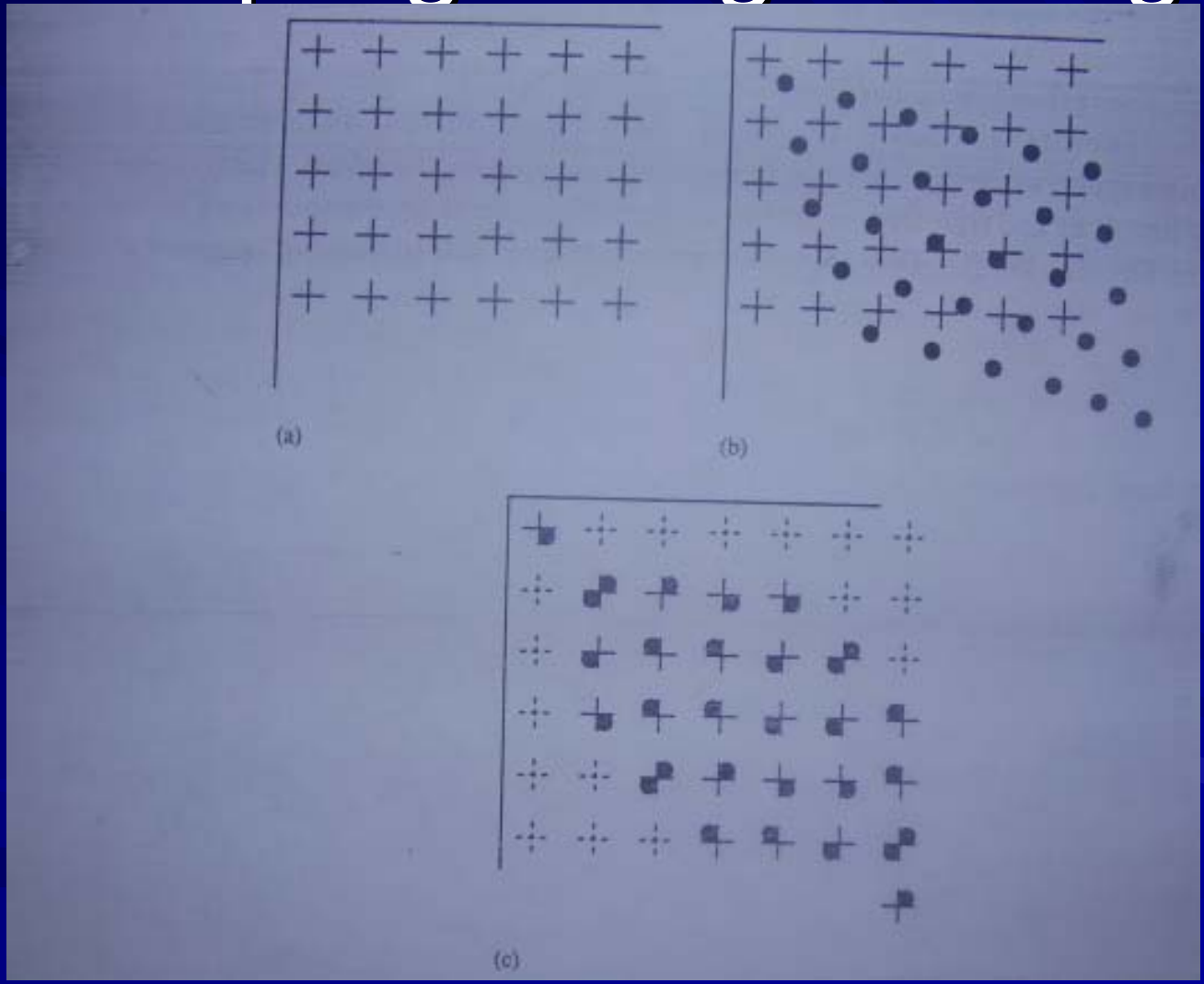
Contrast Stretching



Contrast Stretching



Resampling of Digital Images



Data Acquisition

- CCD Cameras
- Scanners
  - Drum Scanners
  - Linear Arrays
  - CCD Arrays
- Data Compression
  - JPEG

Hardware for Digital Photogrammetry

- Basic Hardware Requirements
  - High Resolution Display
  - Flexible image memory with fast access for real time roaming
  - Interface capability for scanners and cameras
  - Interface with output devices
  - Image enhancement processor
  - 3D measurement with special control devices
  - Subpixel accuracy
  - Data capture in a GIS or CAD
- Stereoscopic Viewing
- Special Hardware requirements

Software Requirements for DP

- Standard Requirements:
  - Handling Image Display
  - Measurement
    - Recording Pixel Coordinates
  - Determination of Orientations
    - Inner Orientation including Calibration parameters
    - Relative and absolute orientations, **B**undle Adjustment
  - Transformations
  - Image Processing Functions
    - Image Matching
    - Edge Detection
  - Digital Rectification
  - Visualization
- Automation

References

- T. Schenk, “ Digital Photogrammetry”, Terra Science, 1999
- M. Kasser and W. Egels, “ Digital Photogrammetry”, Taylor and Francis, 2002
- H. Ebadi, “ Advanced Analytical Aerial Triangulation”, Lecture Note, K.N.Toosi University of Technology, 1999
- T.C.Tang, “Digital Image Correlation”, UCSEm Report, 1988