

INTERVID

In conjunction with **Barry T. DUDLEY**
(MSc Image Analysis)

“Electronic Imaging Fundamentals”



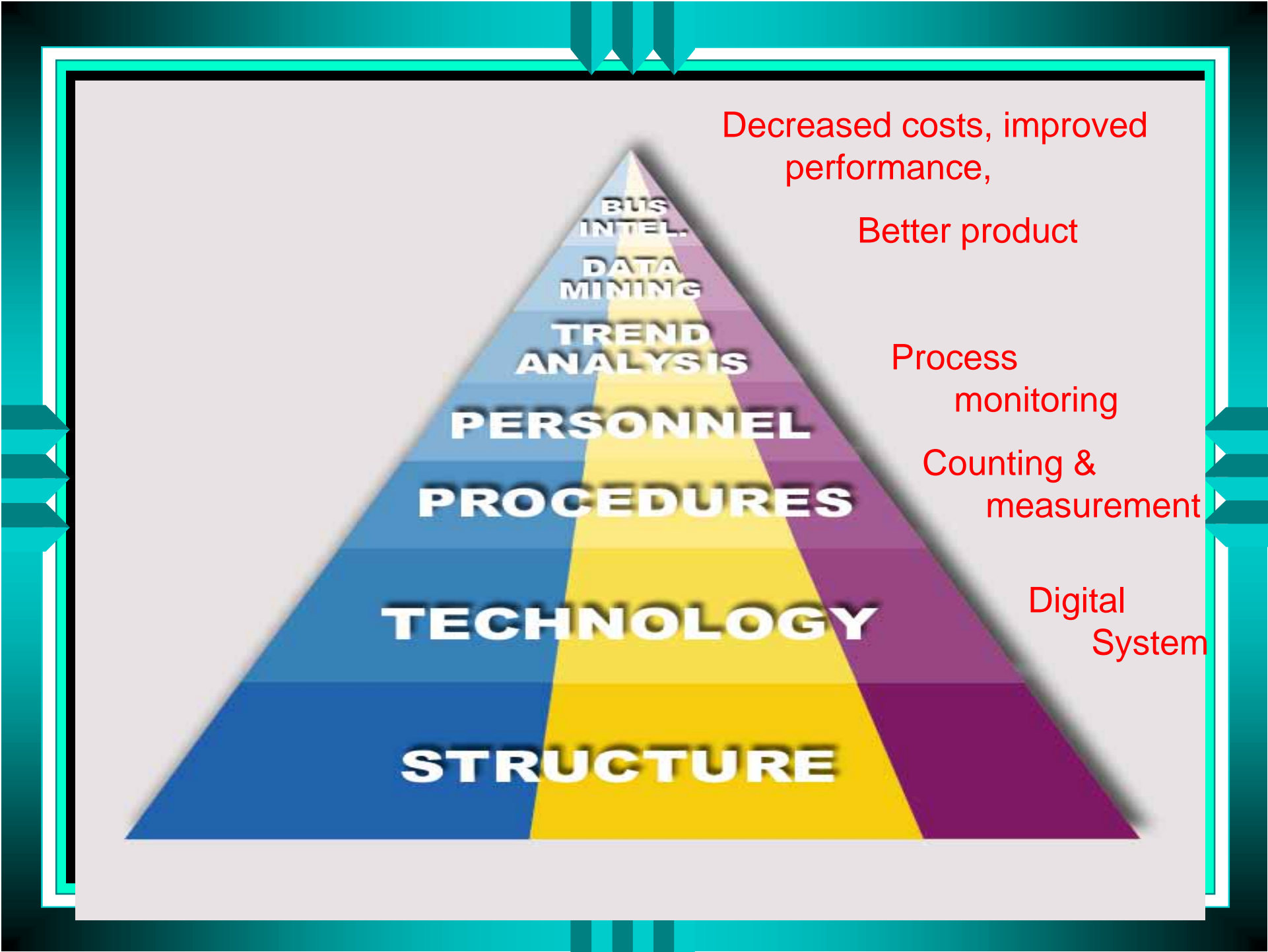
***“..any sufficiently advanced technology is
indistinguishable from magic.” Arthur C. Clark***

WORLD CLASS,

Requirement:



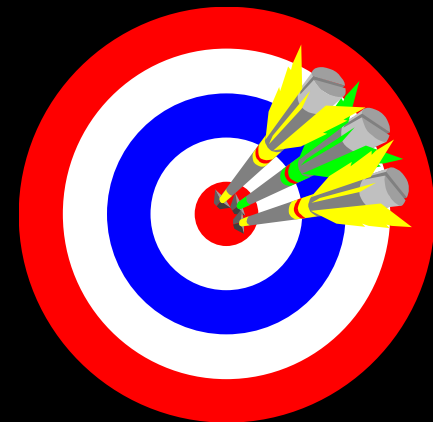
The requirement is to provide image analysis technology to facilitate IDENTIFICATION and COUNTING of ILLOVO products MONITORING and REPORTING of all products passing the camera.



Why do Image Analysis?

- ◆ Better Definition of Contrasting Areas
- ◆ Improved Precision/Accuracy in Measurements
- ◆ Reproducibility of Results
- ◆ Higher Throughput than Manual Methods

İLLOVO İGRAND!

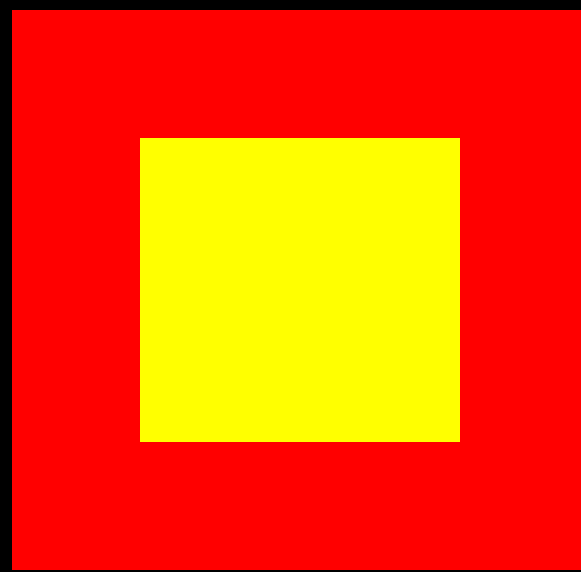
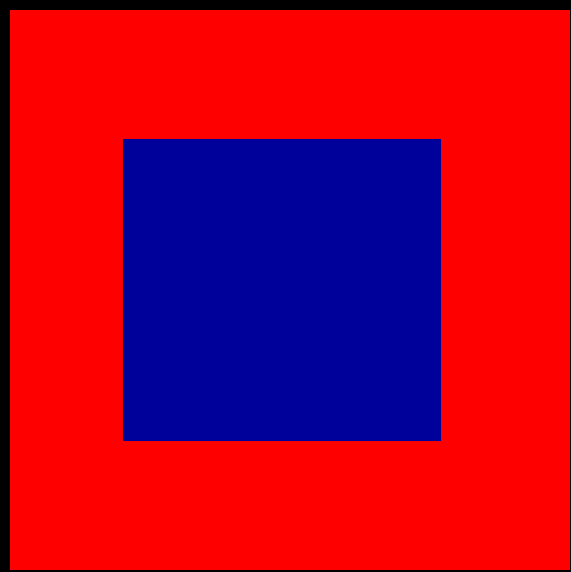


A Word About Our Eyes

- ◆ Eyes are very good contrast adjusters, but not good for distinguishing subtle variations in color
- ◆ Eyes can discern about 30 continuous levels of gray or color in a field of view
- ◆ Eyes are not good judges of distance
- ◆ Eyes cannot accurately reproduce measurements



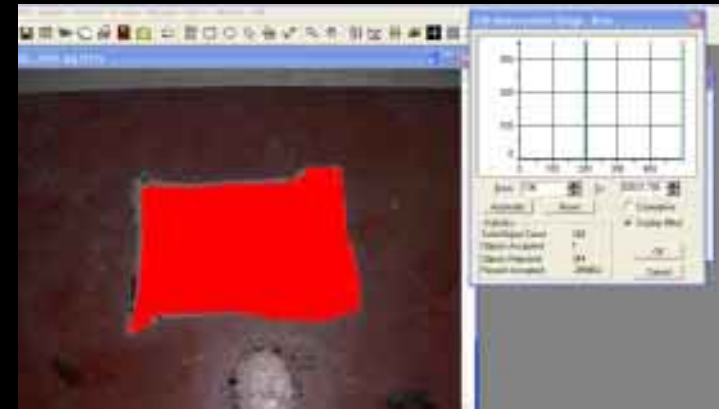
SAME SIZE???



Electronic Imaging Fundamentals



Acquire
Process
Identify
Analyze
Report



Camera Choices

Getting an Image into the computer

Video

Tube Vs CCD

Colour Vs Monochrome

1CCD Vs 3CCD

Resolution

vs.

Digital

Types of CCD

Cooled or uncooled

Download speed

Resolution

Spatial Resolution

- ◆ To resolve 2 objects side by side minimum 20 pixels required.
- ◆ To measure objects with any degree of accuracy min 100 pixels are required



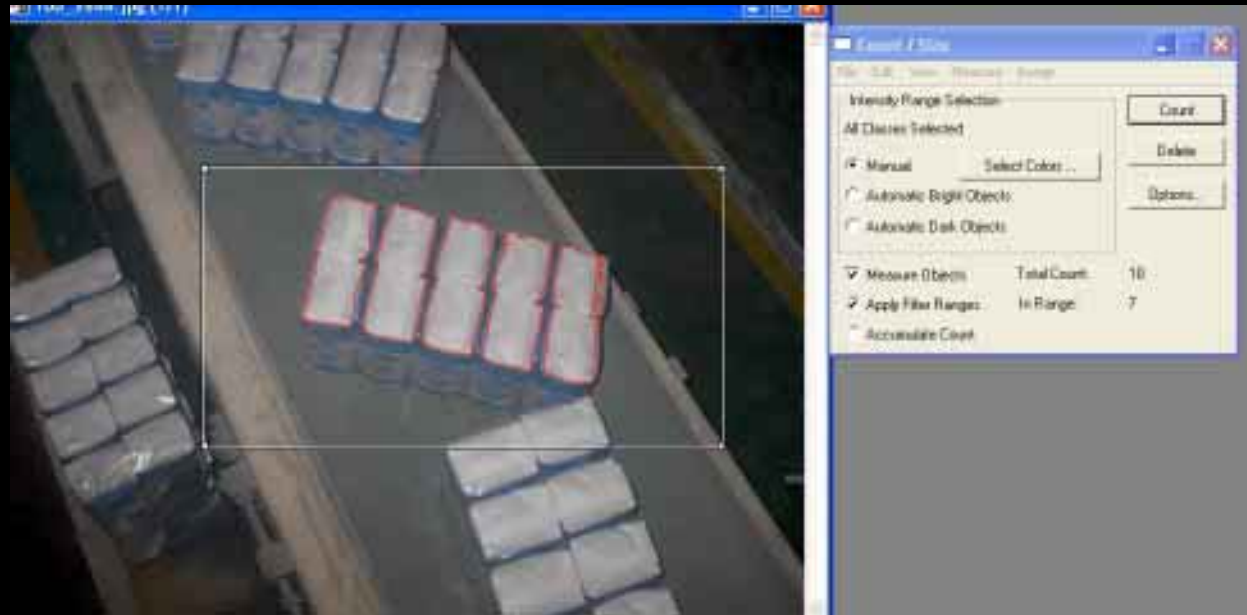
Acquiring the Image

Arguably, the most important aspect of all

- ◆ Proper setup of imaging apparatus is vital
- ◆ Obtain maximum contrast and dynamic range
- ◆ Reduce “noise” and other unwanted artifacts

Measurement

- ◆ Object Count
- ◆ Morphometric Measurements
- ◆ Thickness
- ◆ Angle



Thresholding an Image

- ◆ Select appropriate morphometric characteristics
- ◆ Identify regions of interest to analyse
- ◆ Mask regions



Reporting Data

Measurement Data

No Sort Sort Up Sort Down On: Area

Locate the object. Scroll to the object.

Obj.#	Area	Roundness	Size (length)	Size (width)
1	20056.570	1.6069028	175.26506	120.04123



Intensity Range Selection

All Classes Selected

Manual:

Automatic Bright Objects

Automatic Dark Objects

Measure Objects Total Count: 40

Apply Filter Ranges In Range: 1

Accumulate Count

Statistics

Locate the object. Scroll to the object.

Stats	Area	Roundness	Size (length)	Size (width)
Min	20056.570	1.6069028	175.26506	120.04123
Obj.#	1	1	1	1
Max	20056.570	1.6069028	175.26506	120.04123
Obj.#	1	1	1	1
Range	0	0	0	0
Mean	20056.570	1.6069028	175.26506	120.04123
Std.Dev	0	0	0	0
Sum	20056.570	1.6069028	175.26506	120.04123
Samples	1	1	1	1



Count / Size

File Edit View Measure Image

Intensity Range Selection

All Classes Selected

Manual:

Automatic Bright Objects

Automatic Dark Objects

Measure Objects Total Count: 3752

Apply Filter Ranges In Range: 1

Accumulate Count

Measurement Data

File

No Sort Sort Up Sort Down On:

Locate the object Scroll to the object.

Obj.#	Area	Roundness	Size (length)	Size (width)
147	33835.973	3.8877087	220.89551	178.05876

untitled000 (1/1)



Count / Size

File Edit View Measure Image

Intensity Range Selection

All Classes Selected

Manual Automatic Bright Objects Automatic Dark Objects

Select Colors...

Count

Delete

Options...

Measure Objects Total Count: 2947

Apply Filter Ranges In Range: 1

Accumulate Count

100_2689.jpg (1/1)



Count / Size

File Edit View Measure Image

Intensity Range Selection

All Classes Selected

Manual:

Automatic Bright Objects

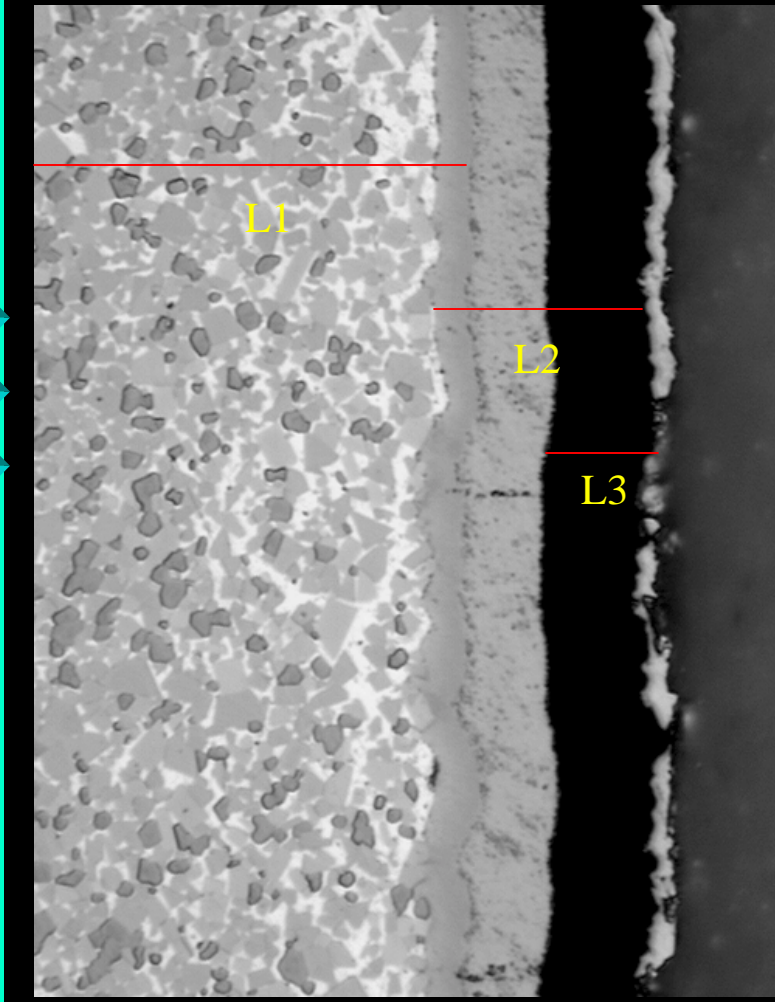
Automatic Dark Objects

Measure Objects Total Count: 162

Apply Filter Ranges In Range: 5

Accumulate Count

Determining Lengths



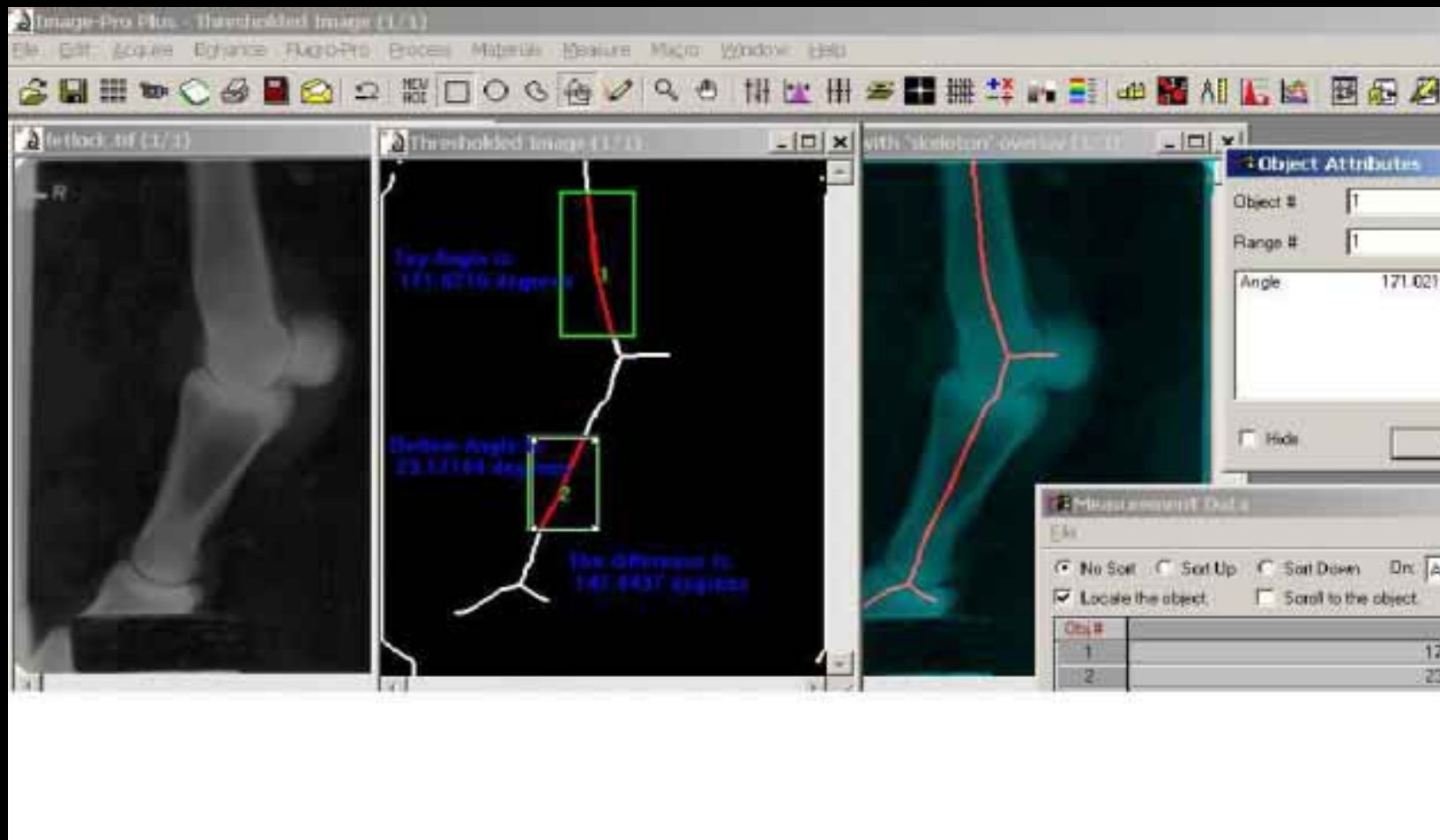
- ◆ Automatic or manual length determination
- ◆ Place markers
- ◆ Report data

The screenshot shows a software window titled 'Measurement' with a table of measurement data. The table has three columns: 'Feature', 'Measurement', and 'Value'. The data is as follows:

Feature	Measurement	Value
1 L1	Length	260.0300
2 L2	Length	120
3 L3	Length	78

Below the table, there is a 'Measurements' section with a 'Select Menu' dropdown set to 'Length' and a 'AutoField' checkbox.

Determining Angles



Summary



- Image acquisition is *Critical!*
- Enhance brightness/contrast to reveal faint regions of interest
- Apply image filters to improve image quality
- Apply measurement parameters and send resulting data
- Analyse results, trends, store images, information



Questions?

References

B.T. Dudley. "Image Analysis and Waste Technology in Africa", *Binary - Computers in Microbiology*, 5, 3-4. (1993)

B.T. Dudley, A.R. Howgrave-Graham, A.G. Bruton and F.M. Wallis. "The application of digital image analysis to quantifying and measuring UASB digester granules", *Biotechnology & Bioengineering*. 42, 279 - 283. (1993)

Castleman, K. R. 1998. Concepts in Imaging and Microscopy: Color Image Processing for Microscopy. *The Biological Bulletin*. 194 (2): 100-107.

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