

# “Electronic Imaging Fundamentals”

**Barry T. Fryer Dudley**  
**(MBA, MSc Image Analysis)**



August 2008



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

**WORLD CLASS,**

## Requirement:

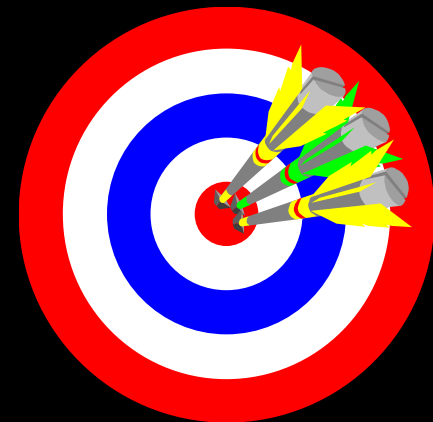


Provide image analysis technology to MONITORING the cane preparation line, REPORTING to the DCS system via a 4 mA (no cane) to 20 mA (complete coverage) output.

# Why do Image Analysis?

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

**İLLOVO İGRAND!**

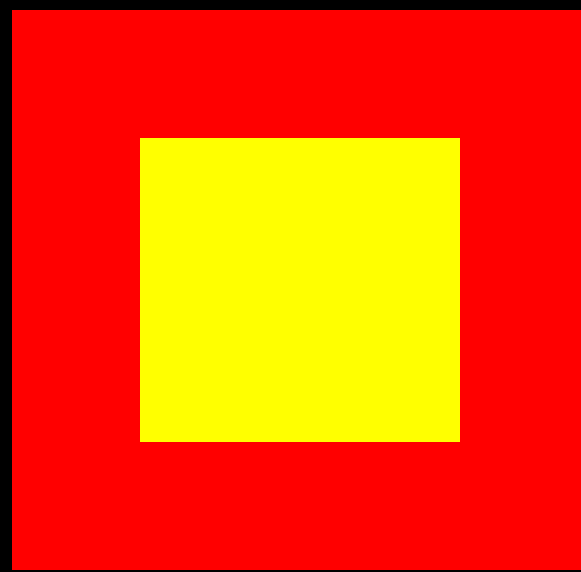
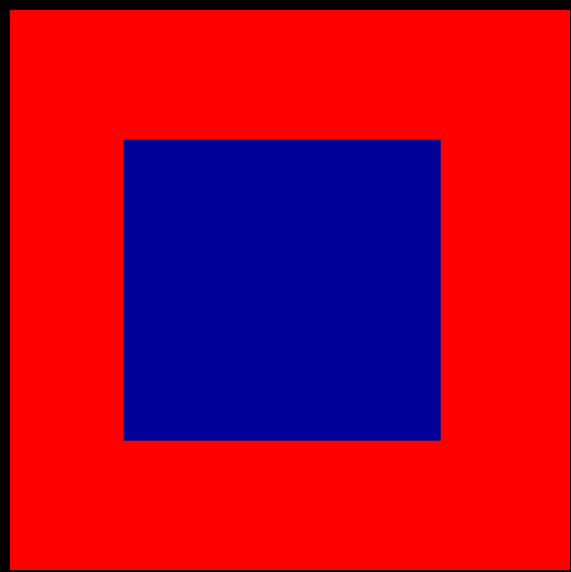


# A Word About Our Eyes

- ◆ 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



Which is BIGGER / LONGER???



# Electronic Imaging Fundamentals

Setup

Acquire

Process

Identify

Analyze

Report / Output

## SET UP

- ◆ Size of the area to be monitored?
- ◆ Housing for the camera (what are the conditions like?) Water? Dust?
- ◆ Placement of PC, existing or required locked housing?
- ◆ Wiring – protection via bosal or plastic conduiting or dedicated cable tray?
- ◆ Other areas of concern?



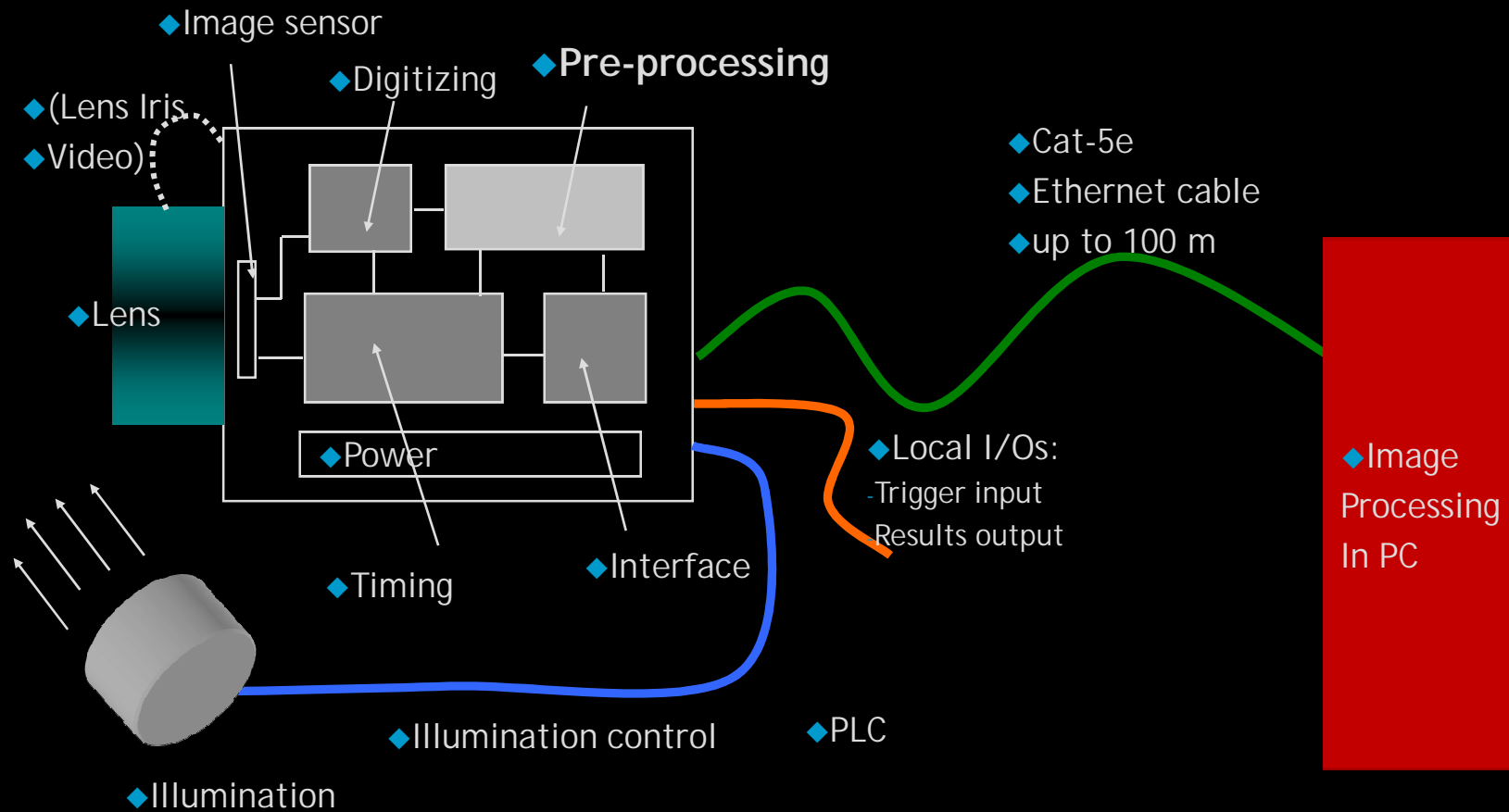
# Acquiring the Image

*Arguably, the most important aspect of all*

- ◆ Proper setup of imaging apparatus is vital
- ◆ Distance from the camera to paddle?
- ◆ Placement of the camera?
- ◆ Uniform lighting (247 operation - light?)
- ◆ Paddle presentation (does the colour change?)
- ◆ Speed (CCTV VS DIGITAL), 3 x a second?



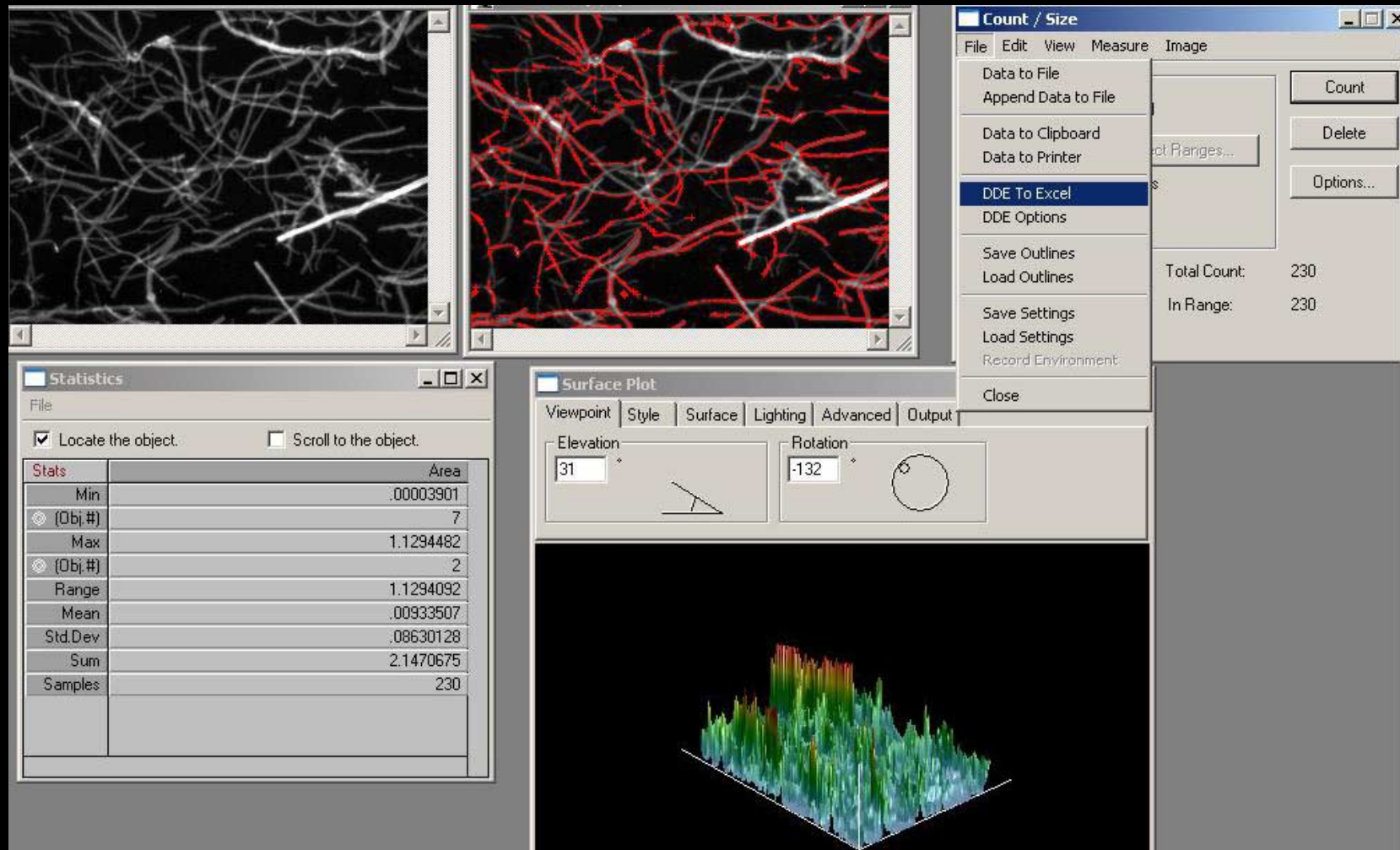
# Acquire



## IMAGE CAPTURE

- ◆ Speed of cane?
- ◆ Number of measurements per second?
- ◆ No of systems / lanes required per site?
- ◆ Video recorded for later review or all images discarded once measured?
- ◆ Other areas of concern?

# POSSIBLE IMAGE ANALYSIS STEPS



# Thresholding an Image



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

- ◆ Colour not required
- ◆ Size
- ◆ Shape
- ◆ Intensity



## IMAGE ANALYSIS STEPS

- ◆ Process image, segment,
- ◆ Looking for cane within image
- ◆ Determine / measure % of cane coverage



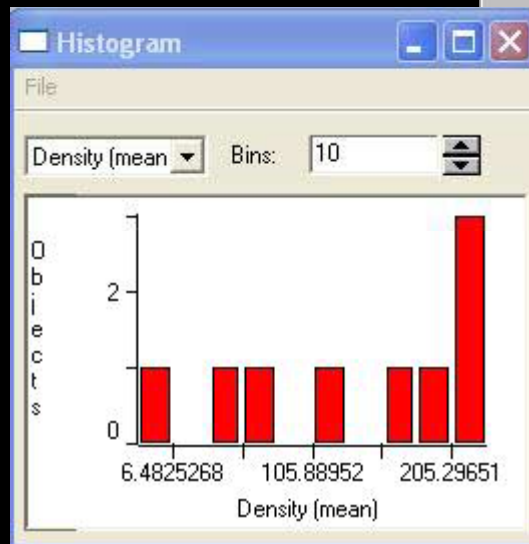
## REPORT / OUTPUT

- ◆ Recorded / logged or only output of 4 to 20 mA output to DCS?
- ◆ Linked to recording of all activity?
- ◆ Video history required: min / hours / days / weeks / season?
- ◆ Video displayed with results?

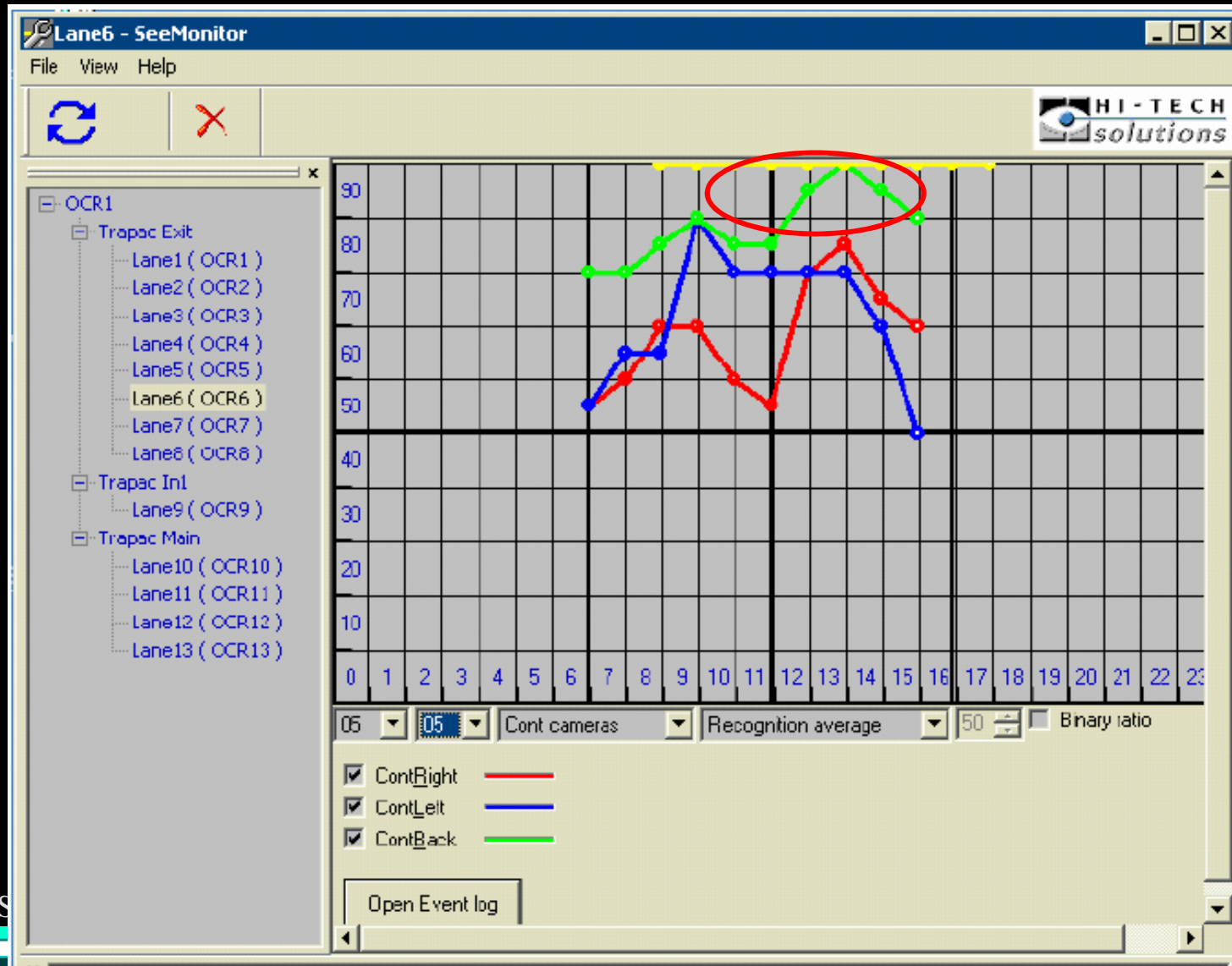


# Recording

The screenshot displays a video recording application interface. At the top, three small video frames are shown, each with a timestamp and date: 07:57:25 20/02/2001, 07:57:40 20/02/2001, and 07:58:40 20/02/2001. The frames show a smokestack emitting smoke against a blue sky. Below these frames is a large video player window showing a full frame of the same scene. The video player has a timeline at the bottom with time markers: 00:05.229, 00:10.458, 00:15.687, 00:20.916, 00:26.145, 00:31.374, 00:36.603, 00:41.832, 00:47.061, 00:52.290. The timeline is labeled "Time nn:ss.zzz".



# Data Analysis







INTEGRATED • INTELLIGENT • IMAGING

**I-CUBE**

# Contact Details

## Barry Fryer Dudley

Cell: 082 562 8225

email: [images@i-cube.co.za](mailto:images@i-cube.co.za)

# 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.

Russ, J.C. 1995. *The Image Processing Handbook*. 2nd ed. CRC Press.  
Boca

Raton, FL.

Inoue, S. (1986). Video Microscopy. Plenum Press

Internet: [www.I-Cube.co.za](http://www.I-Cube.co.za)

