

**6<sup>th</sup> Annual Short Course and Workshop Computer-Assisted  
Image Analysis and Measurement**



**Instructor: Dr. John C. Russ**

***Tuesday June 24 – Friday June 27, 2008***

**Computer Laboratory (To Be Announced)  
University of Missouri Columbia, MO 65211**



***Tuesday June 24***

8:00 – 8:15 Welcome  
8:15 – 9:30 Photoshop for Scientific Imaging  
9:30 – 9:45 Break  
9:45 – 10:45 Photoshop for Scientific Imaging  
10:45 – 11:00 Break  
11:00 – 12:00 Photoshop for Scientific Imaging  
12:00 – 1:00 Lunch  
1:00 – 2:15 The Program Environment  
2:15 – 2:30 Break  
2:30 – 3:45 The Program Environment  
3:45 – 4:00 Break  
4:00 – 5:00 Correction of Image Defects  
5:30 Opening Reception (TBA)

***Wednesday June 24***

8:00 – 9:15 Thresholding of Image Features  
9:15 – 9:30 Break  
9:30 – 10:45 Thresholding of Image Features  
10:45 – 11:00 Break  
11:00 – 12:00 Binary Image Processing  
12:00 – 1:00 Lunch  
1:00 – 2:15 Binary Image Processing  
2:15 – 2:30 Break  
2:30 – 3:45 Binary Image Processing  
3:45 – 4:00 Break  
4:00 – 5:00 Lab time  
5:30 – 7:00 Cocktails/Dinner Banquet (TBA)

***Wednesday June 24***

8:00 – 9:15 Correction of Image Defects  
9:15 – 9:30 Break  
9:30 – 10:45 Correction of Image Defects  
10:45 – 11:00 Break  
11:00 – 12:00 Enhancement of Image Detail  
12:00 – 1:00 Lunch  
1:00 – 2:15 Enhancement of Image Detail  
2:15 – 2:30 Break  
2:30 – 3:45 Enhancement of Image Detail  
3:45 – 4:00 Break  
4:00 – 5:00 Lab time

***Wednesday June 24***

8:00 – 9:15 Measurements  
9:15 – 9:30 Break  
9:30 – 10:45 Measurements  
10:45 – 11:00 Break  
11:00 – 12:00 Measurements  
12:00 – 1:00 Lunch  
1:00 – 2:30 Automation/Batch Processing  
2:30 – 5:00 Open Lab time

## Detailed Course Outline

The course generally follows the sequence of topics in "**The Image Processing Handbook**" (5th edition, John C. Russ, CRC Press) and the information on stereology parallels the material in "**Practical Stereology**" (2nd edition, J. C. Russ & R. T. Dehoff, Plenum Press). All of the images and software used in the course are supplied to attendees on CD-ROM (**Fovea Pro**" version 4, Reindeer Graphics), along with a printed set of lecture notes and an extensive hands-on lab manual. Each topic is covered both by lectures and hands-on lab exercises.

- **Introduction to Adobe Photoshop for Scientific Imaging**
- **Image Acquisition and Storage** - Comparison of the various technologies used to acquire digitized images provides a basis for the image processing.
  - Video and Slow Scan Methods
  - Single Chip, Three Chip and Filter wheel cameras,
  - Digital Cameras, Cooled Cameras
  - Printing and Storage
- **Image Processing** - Modification of the stored pixel values based on global considerations and on local neighborhoods is considered, for both linear and non-linear methods. Processing in frequency space using the FFT is also covered.
  - Adjustment of Contrast, Color Balancing
  - Correction of Image Defects (Illumination, Focus, Point of view, etc.)
  - Enhancement of Edges, Textures, etc.
  - Spatial and Frequency Domain Processing
- **Discrimination** – Image segmentation into foreground and background pixels is a key step that can be difficult in some cases. Various algorithms are compared, and the post-processing of the resulting binary images is thoroughly covered.
  - Thresholding: Manual and Automatic methods, Color Spaces
  - Morphological Operations (Erosion, Dilation, Opening, Closing, Skeletonizing)
  - Euclidean Distance Map, Watershed Segmentation of touching objects
  - Boolean Operations for combining multiple images
- **Measurement** - Obtaining quantitative data from images includes stereological-based techniques (lines, points, and planes) and feature-specific measurements.
  - Global Image and Structural Properties, Automatic and Manual Stereological Procedures
  - Automatic Measurement of Feature Size, Shape, Position, Brightness
  - Densitometry and Color Measurement
- **Interpretation** - The data obtained from measurement represent two-dimensional image information. In most cases this must be interpreted to describe the three-dimensional structure of the original samples.
  - Stereology - rules for determining volumes, surface areas, lengths and curvature
  - Sampling Strategies for obtaining unbiased information
  - Statistical Treatment of data