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Appendices

Appendix A: Cf-252 Neutron source

Figure 1 Specification of Californium source

Sources

Californium-252

Spontaneous Fission Neutron Sources

Nuclear Data

Californium-252 decays by α-emission and spontaneous fission emitting neutrons.

Half-life (α-decay):	2.73 years
Half-life (spontaneous fission):	85.5 years
Half-life (effective):	2.65 years
Neutron emission:	2.3×10^9n/sec per mg
Average neutron energy:	~2MeV
Equilibrium γ-exposure rate (from unshielded source):	1.6×10^2mR/h at 1m per mg ~Air kerma rate at 1m of 1.4mGy/h per mg
Neutron dose rate:	~2.3rem/h at 1m per mg ~23mSv/h at 1m per mg
Specific activity:	~20GBq/mg, ~536mCi/mg

Composition

Californium-252 is incorporated in ceramic material.

Encapsulation

The radioactive material is doubly-encapsulated in welded stainless steel capsules.

Nominal ^{252}Cf content	Nominal ^{252}Cf content activity	Nominal activity*	Emission n/sec*	Capsule	Code
0.01µg	0.2MBq	5µCi	0.023×10^6	X.1	CVN.101
0.1µg	2MBq	54µCi	0.23×10^6	X.1	CVN.1
0.5µg	10MBq	268µCi	1.15×10^6	X.1	CVN.2
1.0µg	20MBq	536µCi	2.3×10^6	X.1	CVN.3
2.0µg	40MBq	1.07mCi	4.6×10^6	X.1	CVN.4
5µg	100MBq	2.7mCi	1.15×10^7	X.1	CVN.5
10µg	200MBq	5.4mCi	2.3×10^7	X.1	CVN.6
20µg	400MBq	10.7mCi	4.6×10^7	X.1	CVN.7
50µg	1GBq	27mCi	1.15×10^8	X.1	CVN.10
100µg	2GBq	54mCi	2.3×10^8	X.1	CVN.11
200µg	4GBq	107mCi	4.6×10^8	X.1	CVN.12

*Tolerance -10, +20%

Recommended working life: 15 years

Quality Control

Wipe test A
Bubble test D
Immersion test L

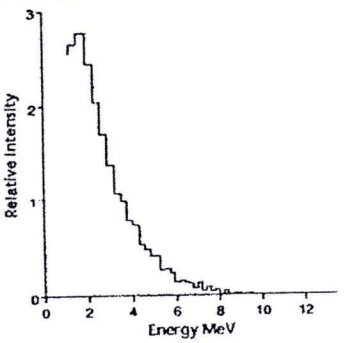
Neutron emission measured against standard using BF_3/wax moderator system.

The test report includes a statement of the neutron emission.

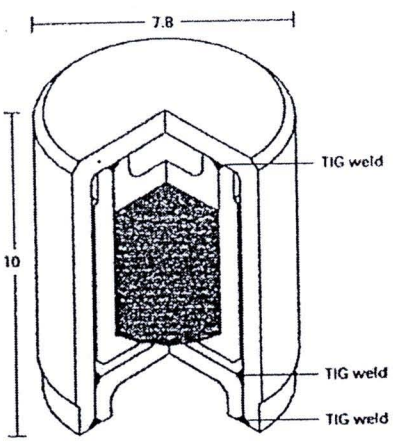
Neutron spectrum

Americium 241/beryllium source made and measured at AEA Technology using a stilbene crystal and pulse shape discrimination.

Spectrum reproduced by courtesy of: LORCH, E.A. Int. J. Appl. Radiat. Isotopes, 24, 588-9, 1973.



X.1



Safety performance testing

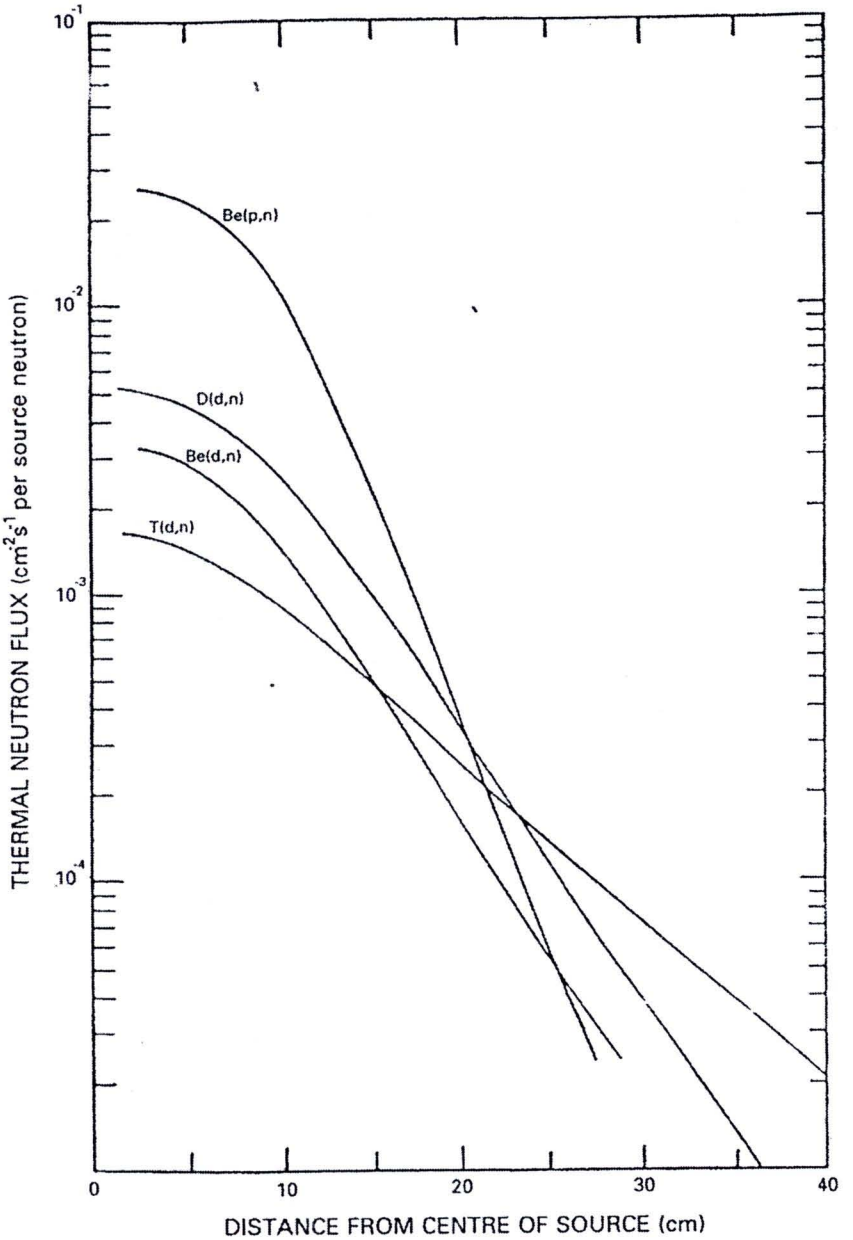
ANSI/ISO classification	IAEA special form	Model no.
C66545	GB/007/S-85	CVN.CY2

B15

United Kingdom: 329 Harwell, Didcot, OX11 0QJ. Tel: +44 1235 431267
United States: 40 North Avenue, Burlington, MA 01803. Tel: 781-272-2000
[illegible] GmbH, Gieselweg 1, D-38110 Braunschweig. Tel: 0049 - (0) 5307 - 932113
Hong Kong: Suite 1208 12/F, Central Plaza, 18 Harbour Road, Wanchai. Tel: 00 852 2519 3966
AEA Technology is a trading name of AEA Technology plc

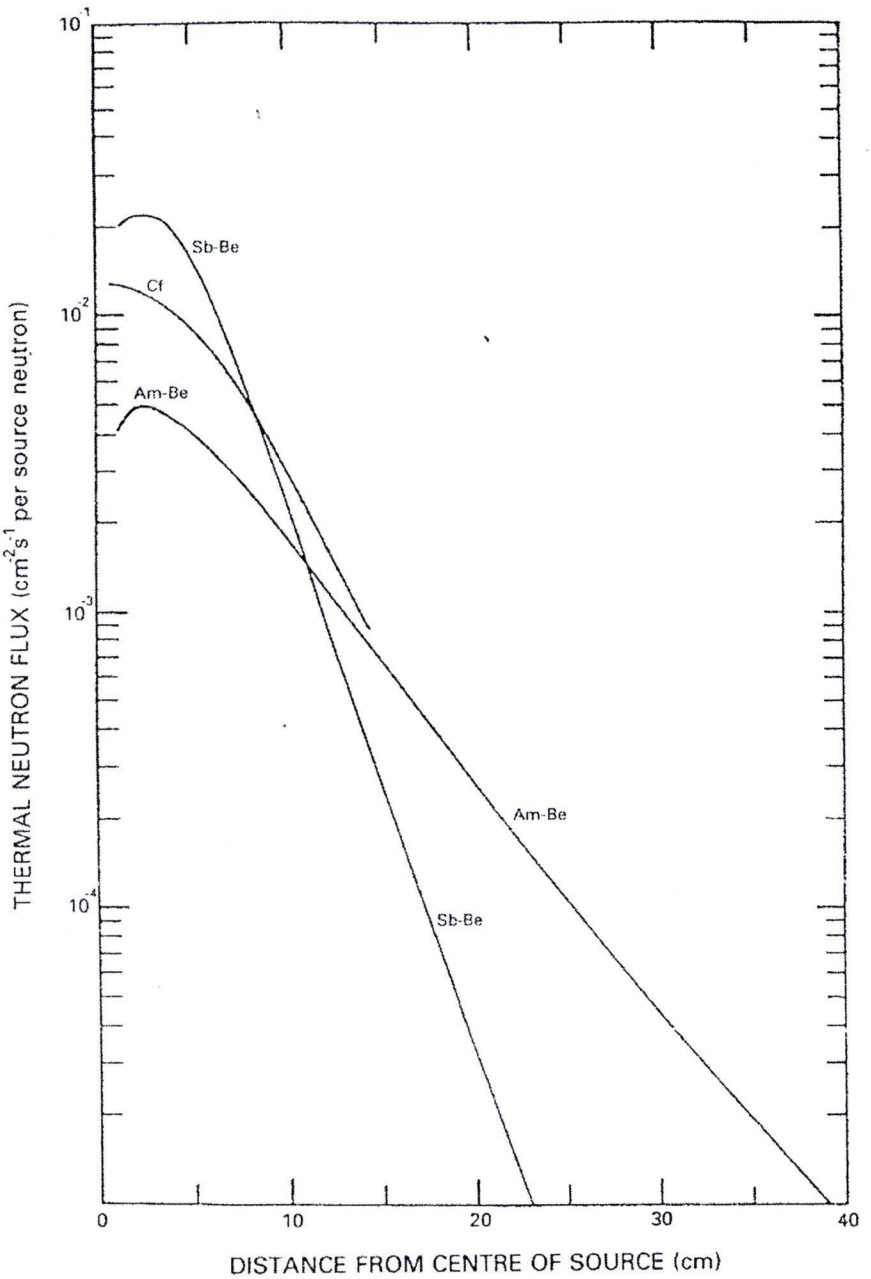
AEA TECHNOLOGY
QUALITY

Figure 2 Thermal neutron flux distributions (experimental) produced by various accelerator neutron source in a water moderator [32].



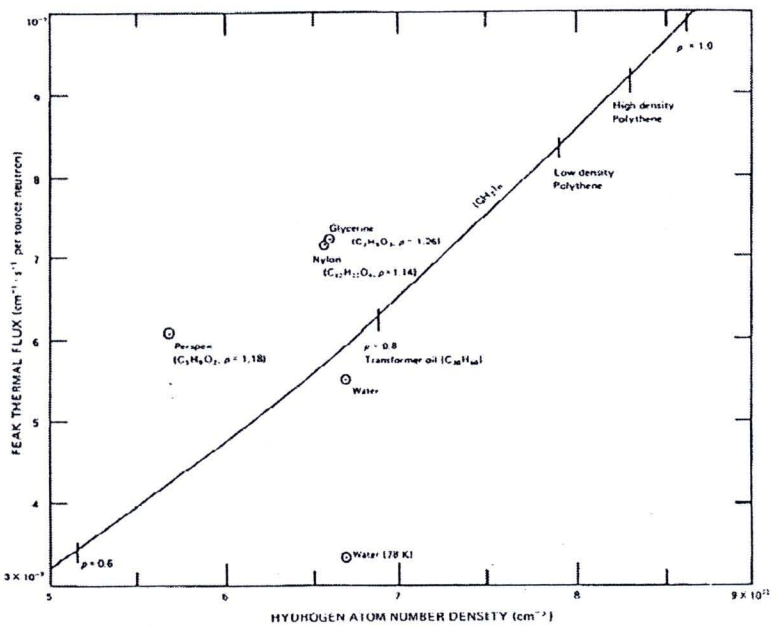
Thermal neutron flux distributions (experimental) produced by various accelerator neutron sources in a water moderator. The beryllium-target reactions refer to a bombarding ion energy of 2.8 MeV and a thick stainless-steel target chamber of 6 cm outside diameter, the hydrogen-taget reactions refer to a bombarding energy of 150 keV and a light aluminium target chamber 2.5 cm in outside diameter.

Figure 3 Thermal neutron flux distributions (experimental) produced by various radioisotope neutron source in a water moderator [32].



Thermal neutron flux distributions (experimental) produced by various radioisotope neutron sources in a water moderator. The source strengths used were 0.05 Ci (Sb-Be), 10mCi (^{252}Cf), and 1 Ci (Am-Be), the larger source required for neutron radiography will depress the normalized centre flux conciderably in the case of Sb-Be and Am-Be but not in the case of ^{252}Cf.

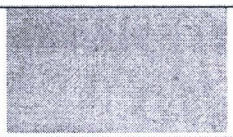
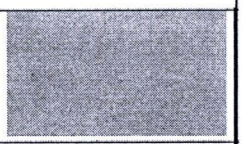
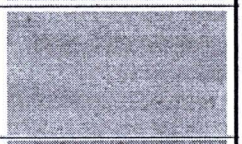
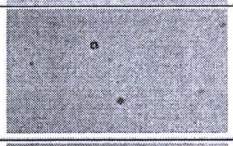
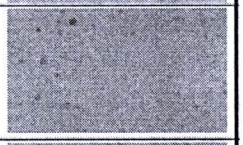
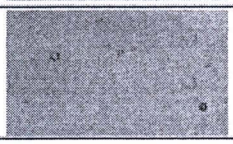
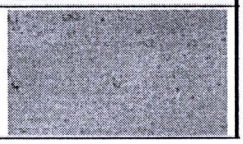
Figure 4 Peak thermal neutron flux produced and various density of hydrogen atom



Appendix B: Previous study

Proton track using thermal neutron from Thai research reactor on polycarbonate plastic at different etchant condition

This previous experiment, polycarbonate was irradiated with thermal neutron from Thai research reactor for 60 and 100 min. The etchant conditions were NaOH 6.25N at 70°C and 90°C and PEW at 70°C.

Condition	Irradiated 1 h	Irradiated 2 h
NaOH,90°C,40 m		
NaOH,70°C, 100 m		
PEW,70°C,30 m		
PEW,70°C,60 m		

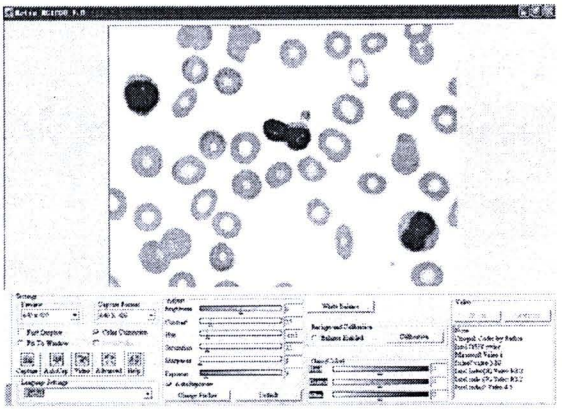
The results showed that proton track at PEW solution at 70°C can observed better than both of NaOH conditions.

Appendix C: **Motic MC1000**

1. Before using Motic MC1000, select MC1000Camera.exe from the Settings options.

2. Upon starting MC1000, the Exposure and White Balance operations will be carried out automatically to make the quality and color of images in the Preview window similar to those of actual images. The interface will then

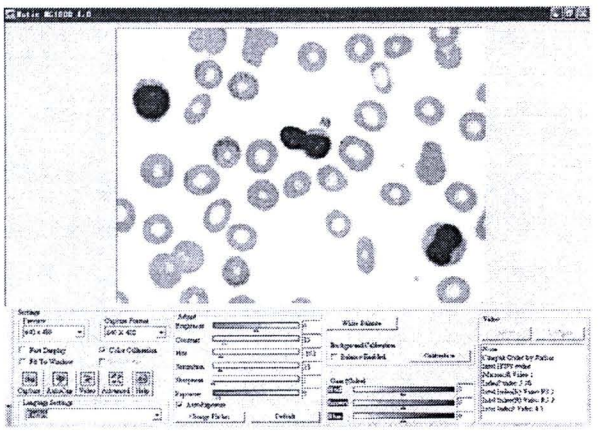
appear as it does on the left 3. Through the Control panel easily alter the quality and effects of the image shown in the Preview window.



3. Through the Control panel easily alter the quality and effects of the image shown in the Preview window.

4. From the Toolbar, click the Capture button 

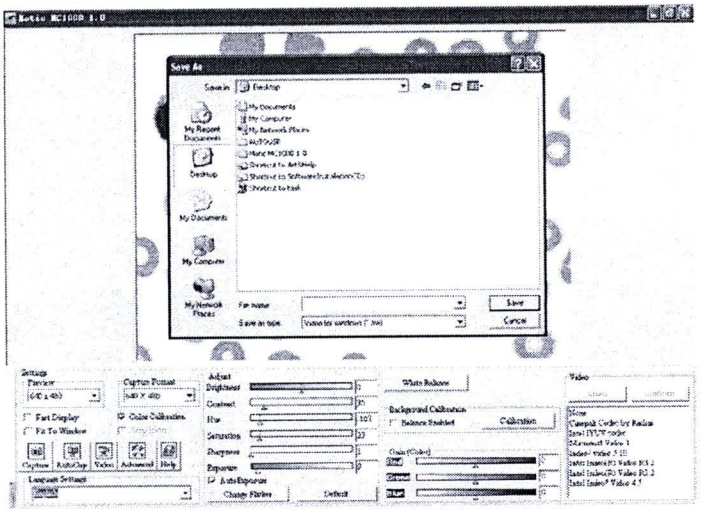
to capture the real-time image shown in the Preview window.



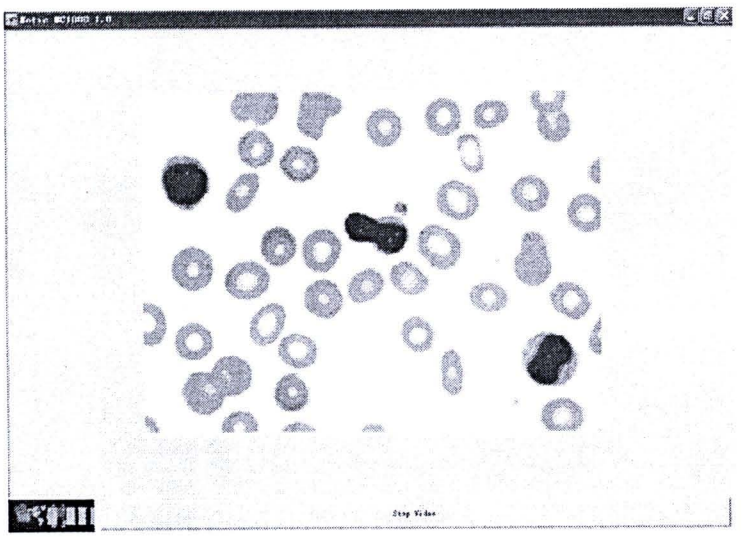
The image captured will be saved in the current user.s Temp folder.

5. Click the Auto Capture button (next to the Capture button) to automatically capture a number of images.

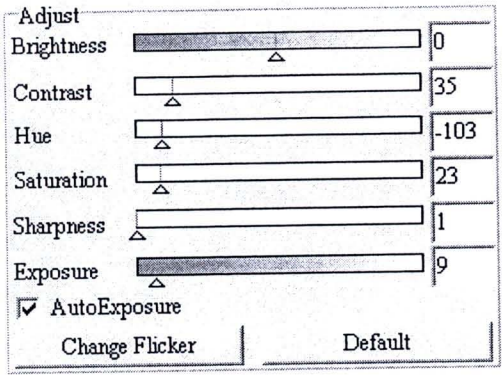
6. Motic MC1000 enables you to record video. From the Toolbar, click the Video button, fill in the name and path and click .OK. to save the video.



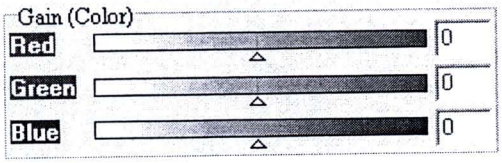
Video will then start recording; click the STOP button to stop recording.



7. Motic MC1000 enables you to adjust Brightness, Contrast and Saturation. If you alter the brightness or switch specimens during observation, use Auto Exposure and White Balance to adjust the image.



8. The Gain (Color) function may also be adjusted. Move the corresponding scroll bar of the color you wish to adjust and the image will change accordingly.



Appendix D: A Quick Guide to ImageJ

Introduction

ImageJ is a public domain Java image processing software that was developed by Wayne Rasband and others at the National Institutes of Health. Refer to the ImageJ homepage http://rsb.info.nih.gov/ij/ for further information. ImageJ runs with a Java 1.1 (or later) virtual machine and is available for Windows, Mac OS, Mac OS X and Linux.

ImageJ is designed under aspects of open architecture. It can be extended by user-written Java plugins for special acquisition, analysis and processing tools.
This feature has been used for specific extensions in the practical trainings of the Image Processing master course at the FH-Aachen/Jülich. Therefore, in the context of our Image Processing course we strongly recommend to use our (!) ImageJ Installation Version that includes all the special plugins.

ImageJ can display, edit, analyze, process, save and print images of various formats including TIFF, GIF, JPEG, BMP, DICOM. It supports standard image processing functions such as contrast manipulation, filtering (i.e. sharpening, smoothing), edge detection and others. It can calculate area and pixel value statistics of a user-defined region of interest (ROI). Measurements of distances and angles are ossible. It can create density histograms and line profile plots. It does geometric transformations such as scaling, rotation, flips and zooming. Spatial calibration (in units such as millimeters) as well as density or grey scale calibration is available. The program supports any number of images (display in separate windows) simultaneously.
Starting ImageJ on the PC's of the Medical Informatics Lab.
After starting the computer and booting Windows (please cancel the network login-dialog) you can start ImageJ by double-clicking the ImageJ Symbol on the desktop. The program will start with the ImageJ main window (Fig.1):

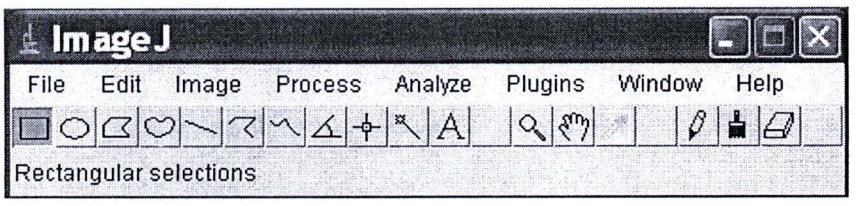


Fig.1: ImageJ main-window

Basic features of ImageJ

Fig.2 shows a typical ImageJ desktop with the ImageJ main-window (top left) together with different image- and result-windows simultaneously opened.

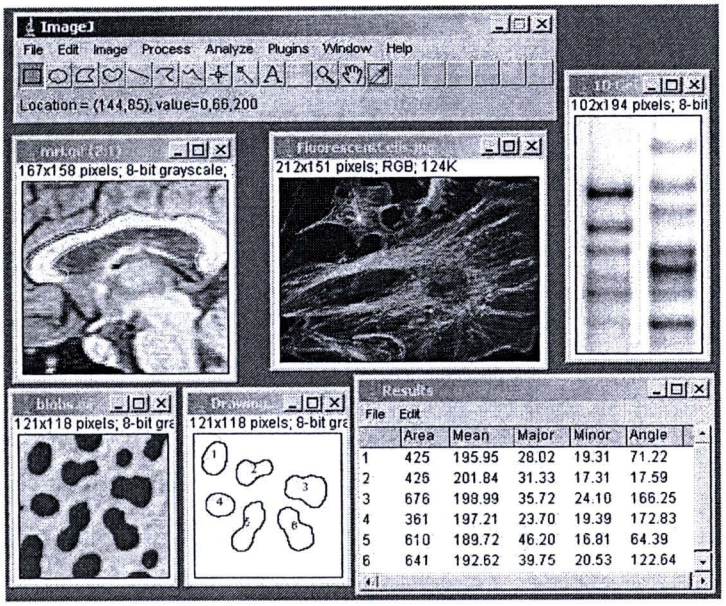


Fig.2: ImageJ desktop example with ImageJ main-window (top left)

The ImageJ main-window - a window that can not be resized or maximized - contains (compare Fig.1):

- menu bar (at the top) "File", "Edit", "Image", ...
- tool bar (in the middle row)
- status and progress bar (at the bottom)

Opened images, histograms, measurement results etc. are displayed in additional windows. These windows can be positioned and resized on the screen as usual. They can be copied (to the Windows-Clipboard), edited, printed and saved. In the following some basic operation topics are described which are relevant for all practical studies of the Image Processing course. The more specific tools are explained in the individual practical training manuals. Further information is given in the ImageJ documentation (http://rsb.info.nih.gov/ij/docs/index.html).

Menu Bar: File

File / New: (not used in the course)

Creates a new image window or stack. A dialog box allows you to specify the image title, type, dimensions and initial content.

File / Open:

Opens and displays an image in a separate window.

Remark: All image files for the practical training are stored on the Medical Imaging master course CD.

File / Close:

Closes the currently active image window.

File / Save:

Saves the active image

Remark: Do NOT save an image to avoid data garbage on our hard disks unless the practical training manual asks you to do so !!!

File / Print..:

Prints the active image.

Remark: In our Image Processing course we prepared for each topic a special blank image that can be used as a "print-form". With copy and paste commands (see below) you can arrange images and other results like histograms together with text annotations on the print-form for final printout and documentation. Only these print-forms should be used for printing !

Menu Bar: Edit

Edit / Undo (Strg+Z) :

Reverses the most recent image editing or filtering operation. Only one "undo" step is possible.

Edit / Copy (Strg+C) :

Copies the contents of the selected region of interest (ROI) of an image or any other window to the clipboard. If there is no ROI-selection, the entire active image/window is copied.

Edit / Paste (Strg+V) :

Inserts the contents of the clipboard into the active image. The pasted image is automatically selected, allowing it to be dragged with the mouse.

Click outside the selection to terminate the paste. Select Edit/Undo to abort the paste operation.

Remark: With copy and paste you can arrange selected image areas and other results like histograms on the print-form.

Setting of a ROI (region of interest)

The selection of a well defined section of an image (region of interest, ROI) is a basic operation for image analysis and is very important in our Image Processing course. It can be done in the following ways:

Edit / Selection / Select All (or better: Strg+A):

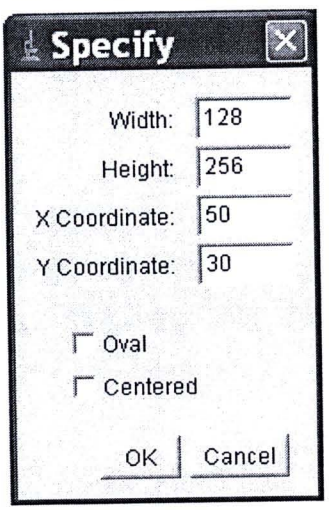
Creates a rectangular ROI that has the same size as the image.

Edit / Selection / Select None (or better: Strg+Shift+A) :

Deactivates the selection in the active image.

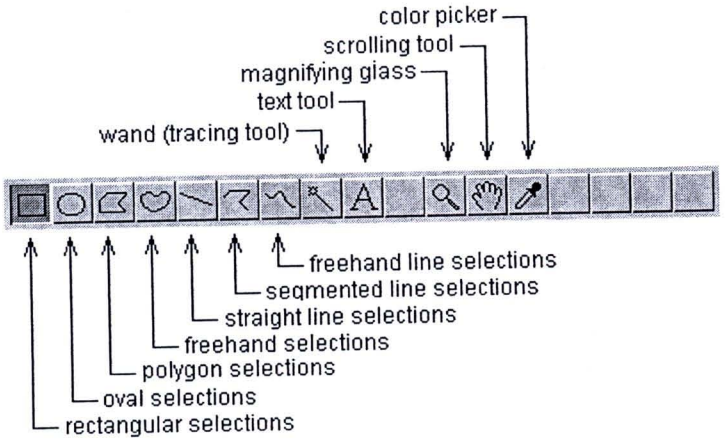
Edit / Selection / Specify ... :

This command allows you to position a ROI precisely. The ROI is defined by specifying (in terms of pixels) the size of the ROI box (width and height) and the position of the upper left corner of the ROI (x- and ycoordinates). The values can be selected in the "Specify-window" shown below:



Manual ROI setting (with the button "rectangular selection" on the tool bar):

Manual ROI setting is performed with the „rectangular selection" tool button (left button in tool bar, see Fig. below).



Creating the selection is done by a mouse-drag. After a ROI selection use the points in the corners to resize. With the shift key held down during the drag the ROI is fixed to a square. As a selection is created or resized, its location, width and height are displayed in the status bar.

Using the arrow keys you can move the ROI box. With the arrow keys and the alt key held down you can change the width or the height of the ROI.

Text Annotations (with the button "text tool" (A) on the tool bar):

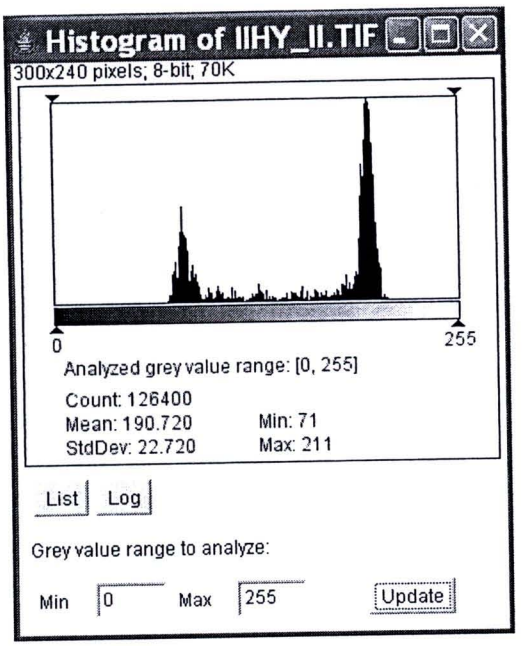
Use the text tool to add text to images. Left mouse click on the text-tool-button and double-click on the image where the text should be positioned creates a rectangular selection containing one or more lines of text. Use the keyboard to write the text and the backspace key to delete characters. The final position of the text can be selected by a mouse drag. Use Edit/Draw (better: Strg+D) to permanently draw the text on the image. Use Edit/Options/Fonts, or double-click on the text tool, to specify the typeface, size and style.

Remark: All images, histograms, LUT-boxes and other results should be labeled by text annotations on the print-form. So, the final print-form contains a clear description of all displayed components and a short specification of the applied analysis or evaluation.

Grey Value Histogram

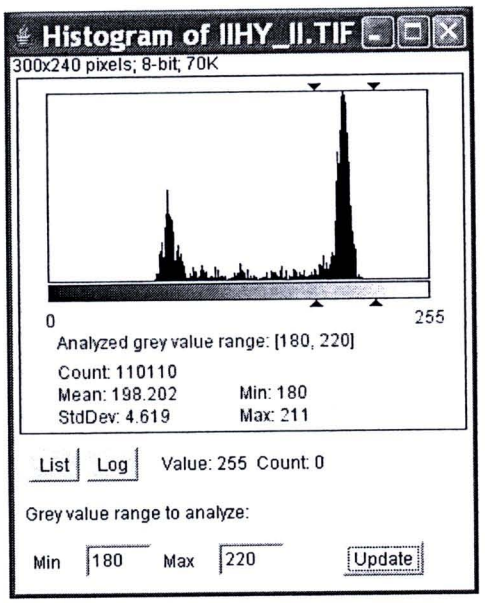
ImageJ calculates and displays a grey level histogram of the active image respectively an image part defined by the ROI. To display the histogram select Analyze / Histogram (or: Strg+H). In the histogram window the x-axis represents the gray values and the y-axis shows the number of pixels found for each gray value. The total pixel count is also calculated and displayed, as well as the mean, standard deviation

(StdDev) and the minimum / maximum gray value. The Log-button displays an overlay with a logarithmic scaled histogram. The List-button shows a table of the histogram values.



Remark: The histogram and the statistical data are not automatically updated when you alter the ROI. To update the histogram and the statistical calculations press the Update button.

You can define the range that is used to compute the statistical data in the Min and Max fields of "Grey value range to analyse:". After pressing the Update button the selected range is marked in the histogram plot and the statistical data are calculated according to the defined grey value interval between Min and Max.



Grey Level Operation

With the tool "LUT Operations" (Image / LUT Operations, or: Strg+L) the brightness and contrast of the active image can be altered. Brightness and contrast are changed by updating the image's look-up table (LUT), so pixel values remain unchanged. Linear and non-linear LUT's can be selected with the LUT Operation window.

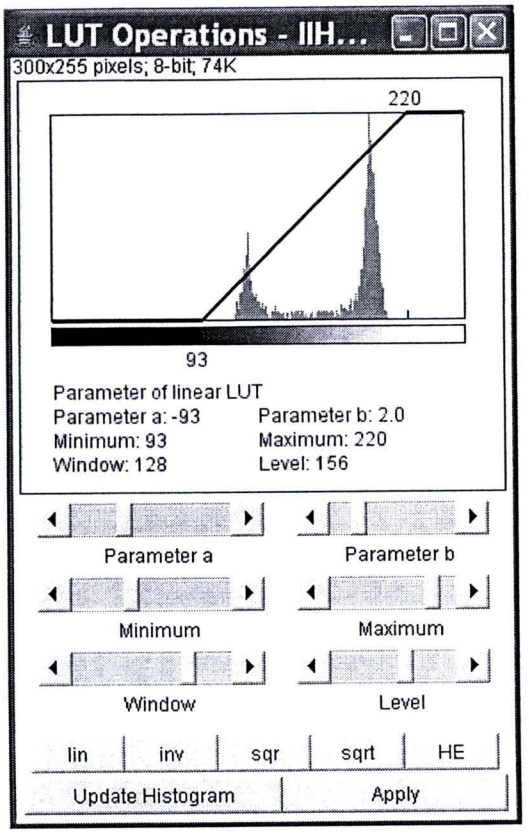
Linear LUT's can be modified as follows:

• a- and b-Paramerters can be selected according to the point transformation

I'(x,y) = (I(x,y) + a) * b.

• The display range can be determined by a min- and max-value.

• A window-width (Window) and the center of the window (Level) is chosen. The individual parameters (a, b, min, max, Window, Level) are selected by six sliders. Each parameter selection may affect the values of other parameters which are modified automatically. The parameter values of a, b, min, max, Window, Level and the resulting LUT are displayed below the histogram. The LUT shows how pixel values are mapped to 8-bit (0- 255) display values. The two numbers at the LUT plot define the display range: Pixels with a value less than the lower number are displayed as black and those with a value greater than the upper number are displayed as white.



The LUT plot is superimposed on the image's histogram (respectively the histogram of the ROI if a ROI is selected). After modifying the ROI in the active image the displayed histogram in the LUT Operation window can be updated by the button Update Histogram.

Buttons of the LUT Operation window and non linear LUT selection:

lin Allows the selection of a linear LUT by means of the six sliders as described above. Click on lin also resets the LUT (original brightness of pixel values is displayed).

Inv LUT for grey level inversion.

sqr Square LUT.

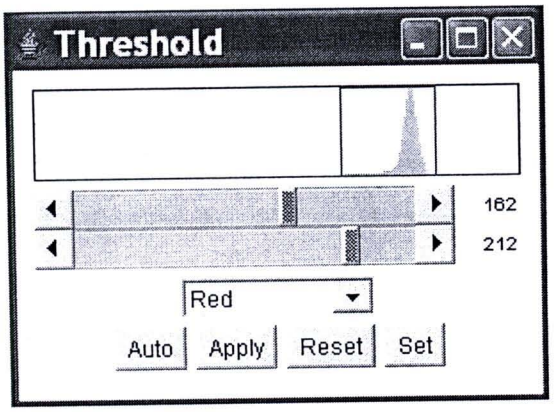
sqrt Square root LUT.

HE Histogram equalization: The histogram equalization is calculated on the basis of the display histogram (if a ROI is selected the ROI's histogram is used for histogram equalization)

Apply Click on Apply to apply the current LUT mapping function to the pixel data. If there is a ROI selection, only image data within the selection are changed. After modifying the pixel values according to the given LUT a LUT reset takes place.

Thresholds

In the active image lower and upper threshold values can be selected interactively with the threshold tool Image / Adjust / Threshold. The threshold values segments the image into features of interest and background. Pixels with grey values greater than or equal to the lower threshold and less than or equal to the upper threshold are displayed in red.

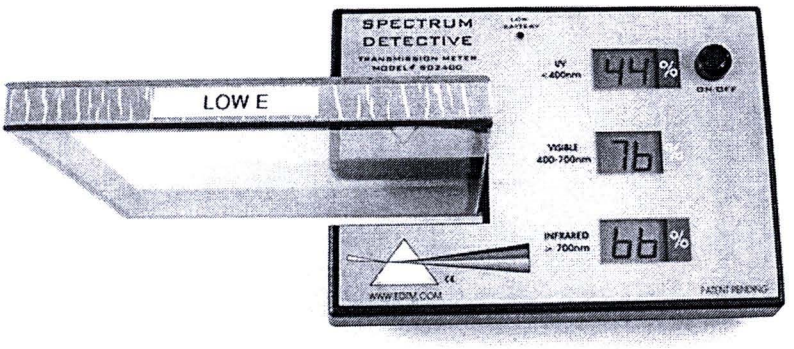


• The Auto button automatically sets the threshold levels based on an analysis of the displayed histogram This is used for **bimodal histogram segmentation**. If a ROI is selected the displayed histogram corresponds to the actual ROI settings (press Reset to update the displayed histogram after changing the ROI).

• Apply sets the thresholded pixels to black (or a given foreground color) and all other pixels to white (or a given background color).

• Reset disables thresholding (removes the red overlay of the thresholded pixels) and updates the displayed histogram (important - especially after changing the ROI selection).

Appendix E: SD2400 Energy Transmission Meter User Manual



General Description

Expanding on our success with sales demonstration tools, our new "Spectrum Detective" product is able to simultaneously display UV, Visible and Infrared transmission values. Being a self-contained syste , there are no additional light sources or power chords necessary, and no adjustments to make. Simply slide the glass sample into the opening and watch the resulting performance data appear on the display. Perform LIVE demonstrations of the performance of your Energy Efficient window products. Simple, fast and convincing; this instrument will take sales demonstrations to a whole new level!

Features

- Three performance values displayed simultaneously
- Single, double or triple pane testing easily accomplished
- Test any sample width up to 2" thick
- Sash/spacer width up to 1.25"
- No additional light sources needed
- Auto-calibration at start-up: NO manual adjustments required
- Battery operated: no power chord required
- Automatic power-off feature for extended battery life
- Replace Battery Indicator
- Continuous measurements
- Professional Image
- Simple operation
- Convenient push-on/push-off power switch

- Small, portable convenient size
- Protective, custom carrying case

Basic Operation

Place the SD2400 on a flat, stationary surface. Turn the instrument on and wait for the system to self-calibrate. After each of the displays show 100%, you can place any sample into the opening to measure the performance characteristics. Here are a few helpful reminders for conducting transmission measurements. Always hold the glass perpendicular to the opening. Do not tilt the glass at angles. For the most accurate transmission measurements, the glass should be held perpendicular to the sensors (as shown in the picture above). It is also recommended that the samples being tested are positioned in the center of the opening. Be aware that fingerprints on the glass can slightly affect the transmission values.

When you slide the glass into position, move the glass all the way into the opening, resting against the stop location. Pay attention to the spacer/sash of your window. Make sure the glass is slid far enough into the opening so the spacer/sash is not blocking one of the sensors.

The instrument will continually monitor its calibration during measurements. If the instrument detects any problems with the calibration, it will reset itself in between measurements. If you mistakenly turn the instrument on with a piece of glass already in position, the displays will calibrate to read 100% with the glass in place. Simply remove the glass sample and wait a few moments. The instrument will re-calibrate itself shortly after the glass is removed. After the displays have returned to 100% after the removal of the glass, you may continue with your measurements.

Spectrum Specifications

The SD2400 displays energy transmission values in three spectrums. The light sources used for each spectrum have a peak response at the following wavelengths:

UV: 365nm

VISIBLE: Full Weighted Spectrum

INFRARED: 950nm

Battery Replacement

The SD2400 is powered by a 9 volt alkaline battery. When the battery voltage is getting too low to operate the meter, the low battery indicator will turn on. The detector can still be used at this point, however it is recommended that the battery be replaced soon. The lights in the meter will begin to grow dim and make it more difficult to conduct easy measurements. Alkaline batteries are recommended for this product.

Auto-Power-Off

The SD2400 instrument is equipped with an automatic power-off feature to extend the life of your battery. The instrument will automatically shut off after approximately 5 minutes.

Warranty

The manufacturer warrants all models of the SD2400 to be free from defects in material and workmanship under normal use and service as specified within the operator's manual. The manufacturer shall repair or replace the unit within twelve (12) months from the original date of shipment after the unit is returned to the manufacturer's factory, prepaid by the user, and the unit is disclosed to the manufacturer's satisfaction, to be thus defective. This warranty shall not apply to any unit that has been repaired or altered other than by the manufacturer. The aforementioned provisions do not extend the original warranty period of the unit which has been repaired or replaced by the manufacturer. Batteries are not covered by warranty. EDTM, Inc. assumes no liability for the consequential damages of any kind through the use or misuse of the SD2400 product by the purchaser or others. No other obligations or liabilities are expressed or implied. All damage or liability claims will be limited to an amount equal to the sale price of the SD2400, as established by EDTM, Inc.

Appendix F: Physical property test report

Tensile test report

SCIENTIFIC AND TECHNOLOGICAL RESEARCH EQUIPMENT CENTRE, CHULALONGKORN UNIVERSITY, Chulalongkorn Soi 62 Phaya Thai Rd. Bangkok 10330 Thailand Tel 0-2218-3032 Fax. 0-2254-0211
ศูนย์เครื่องมือวิจัยวิทยาศาสตร์และเทคโนโลยี จุฬาลงกรณ์มหาวิทยาลัย อาคารสถานีที่ 3 จุฬาลงกรณ์ซอย 62 พญาไท กรุงเทพฯ 10330 โทร. 0-2218-3032 โทรสาร 0-2254-0211

Test Report

Report no. 323/2011 Date of Issue : May 6, 2011 page 1/1

STREC sample code :	MTL/11/172 - 177
Sample type :	Polycarbonate Plastic
Description of specimen :	suitable for testing
Sample owner address :	Miss Sawwanee Asavaphatiboon Department of Nuclear Technology Faculty of Engineering Chulalongkorn University Bangkok Thailand

Objective :	To test mechanical properties
Test method :	ASTM D638 : 1998
Specimen preparation :	ASTM D638 : 1998
Instrument :	Universal testing machine, (Hounsfield H10KM)
Test date :	May 2, 2011
Analyst :	Mr. Somchit Chummuangyen

Mechanical properties

Sample name	Ultimate strength (Kgf/mm^2)	Yield strength (Kgf/mm^2)	% Elongation	(Note)
1. No 1	5.43	5.34	112.00	
2. No 2	6.32	0.45	36.88	
3. No 3	6.35	6.35	13.79	
4. No 4	5.15	5.15	52.80	
5. No 5	6.41	6.41	19.12	
6. No 6	6.01	0.49	34.00	

(Mr.Somchit Chummuangyen) Analyst

(Mr. Utai Tiyawisutsri) Technical manager

(Assoc. Prof. Dr. Anorn Petsom) Acting Director

Remarks : 1. The results are valid exclusively for those samples analysed. 2. The report shall not be reproduced partly, except in full, without written approval of the organization.