

Non-Thesis Notes

Restarted due to an earlier 'crash' of hard drive.

May 11, 2003 - Sunday

```
G = imread('Metallography-1070_neg_14_5x50.jpg');
T = rgb2gray(G);
B = edge(T,'canny'); % see above right figure
```

Prewitt edge Operation Log Method

How will I perform boundary/region detection after edge detection is performed?
It is noted that the edge detection algorithms can only go so far- as you see that the edges aren't completely connected.

The first assumption is that an interpolation method will need to be used to "connect" broken lines in the edges in order to form a border.

There are various methods:

- (1) Local Processing
- (2) Hough Global Processing
- (3) Global processing using Graph-Theoretic Techniques
- (4) Dilation

Consider that the application may also require edge enhancement at some point. This can depend on the requirement for the "enhancing". Some literature discusses using a sharpening filter. However, I can anticipate increasing the 'thickness' of a line, by changing its neighbors to closely match the intensity of the discontinuity.

May 12, 2003 – Monday

Notes from today's meeting:

Inputs

- Chemistry of the alloy
- Polishing: mechanically or otherwise.
- Thermal processing
- Cold rolled
- Etched:
 - Grain boundaries
 - Colored images
 - Illumination of the sample,

- **Isotropic/anisotropic**: Isotropic filters are rotation invariant, in the sense that rotating the image and then applying the filter gives the same result as applying the filter of the image first and then rotating.

In Metallurgical terms, it's having the same properties such as elasticity or conduction, in all directions

- Interference – contrast light

Map that the student can use –phase particles

2nd

Manganese-sulfur: flat edges/flat faces > manganese sulfide -> Fuzzy Logic?

CCLI: Objectives from earlier submittals (from other projects) did not exactly meet the specs and were, thus, rejected.

Project will concentrate on the following materials in this order:

- (1) Steel
- (2) Aluminum
- (3) Brass
- (4) Bronzes
- (5) Titanium
- (6) Superalloys, etc...

From Alan's book, "Structure and Properties of Engineering Alloys" (Smith, 1981, McGraw-Hill), here are some common definitions:

Pearlite

Martensite

Austenitic: The solid solution of carbon in α iron is designated austenite. It has a FCC crystal structure and a much greater solid solubility for carbon than α ferrite.

α ferrite: The solid solution of carbon in iron is termed α ferrite, or simply ferrite.

FCC crystal structure:

Nucleation

Etching Methods and Effects

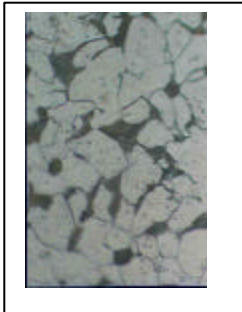
Micrograph 1 (and 2). Most etching reagents attack different phases with different rates and sharp steps will form at the phase boundaries. In the microscope they will show up as black lines. This micrograph is taken on an Fe-C alloy containing martensite, ferrite and cementite. Martensite is big white areas. A thin band of white ferrite is shown vertically. It has been attacked more than the martensite and is thus at a lower level. Thus the black contours. Cementite is found in a fine mixture with ferrite (so-called pearlite). Cementite is not at all attacked and should thus look white, also, but it is standing above the ferrite, which was attacked. The pearlite areas thus appear black when the lines cannot be resolved.

Micrograph 2. This micrograph is taken on the same area as picture 1 but with oblique illumination coming from the left. It is thus easy to see that the band of ferrite has been attacked more than the martensite.

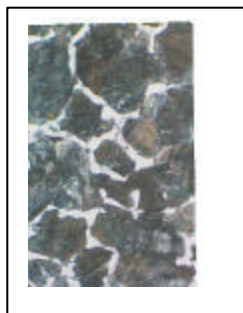
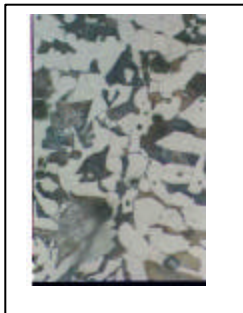
May 21, 2003 – Tuesday



Basic thermal processing
Heated to about 950 degrees centigrade
Basic Metallography Preparation
Mounted in Bakelite
The chemistry is
Pure iron (-Iron2) -- 100 percent
Ferrite (BCC Iron)



Basic thermal processing
Heated to about 950 degrees centigrade
Basic Metallography Preparation
Mounted in Bakelite
The chemistry are
Pure iron (-Iron2) -- 100 percent
Ferrite (BCC Iron)



Metallurgy and Metallography

Laboratory Services utilizes the following tests to establish the mechanical properties of solids.

Metallurgy

- Mechanical properties of solids such as:
- Tensile Strength of Metals (ASTM E-8)
- Hardness (ASTM E-18)
- Tensile Strength of Metallic Foil (ASTM E-345)
- Coefficients of Static Friction (ASTM D-4518)
- Mechanical Properties of Fasteners (ASTM D-638)
- Microhardness of Materials (ASTM E-384)

Metallography

- Grain Size in Metals (ASTM E-112)
- Macroetching of Metals and Alloys (E-340)
- Microetching of Metals and Alloys (E-407)
- Preparation of Metallographic Specimens (E-3)

May 23, 2003 – Thursday

Glossary of thermal treatments

The temper designations outlined here are used throughout this page to indicate the various type of heat treatments. They are the same for aluminium and magnesium alloys.

Basic temper designations consist of an individual capital letter. Following digits designate, first, a specific sequence of treatments, and second, variations in these specific sequences of treatment

Temper designation

- F As- fabricated**
Applied to products which acquire some temper as the result of normal manufacturing operations (cold working, hot working or casting processes)

- O Annealed, Recrystallized**
- O Lowest strength temper of wrought products. Applied also to cast products annealed to improve ductility and dimensional stability.

- H Strain hardened**
- H Applied to wrought products only. Mechanical properties increased by strain hardening

<http://mmc-assess.tuwien.ac.at/43index.htm>

Page 92 of Image Analysis: Applications in Material Science states, "

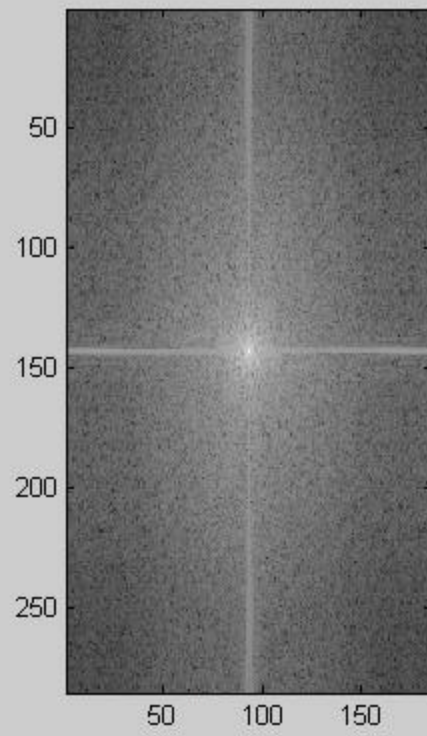
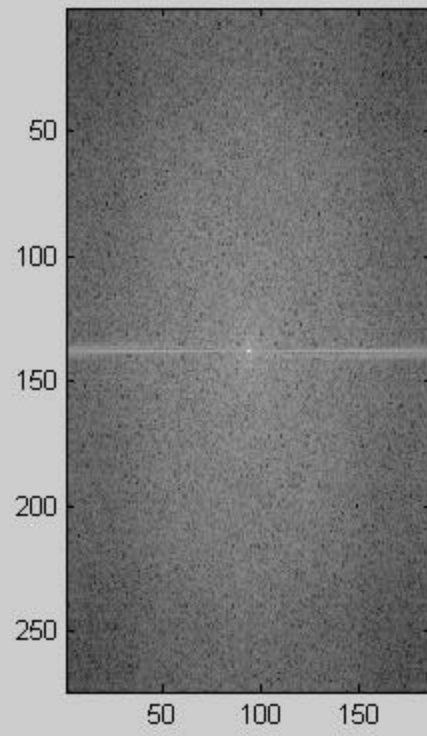
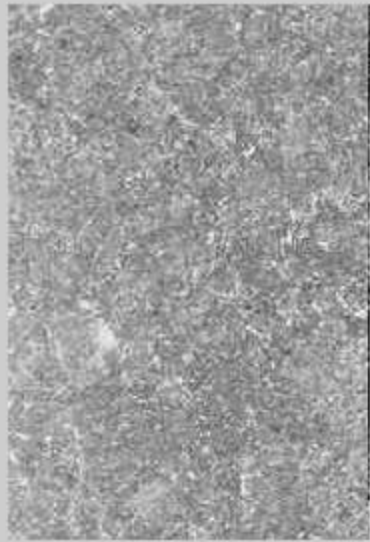
May 28, 2003 – Wednesday

The pseudo algorithm for a back propagation algorithm is as such:

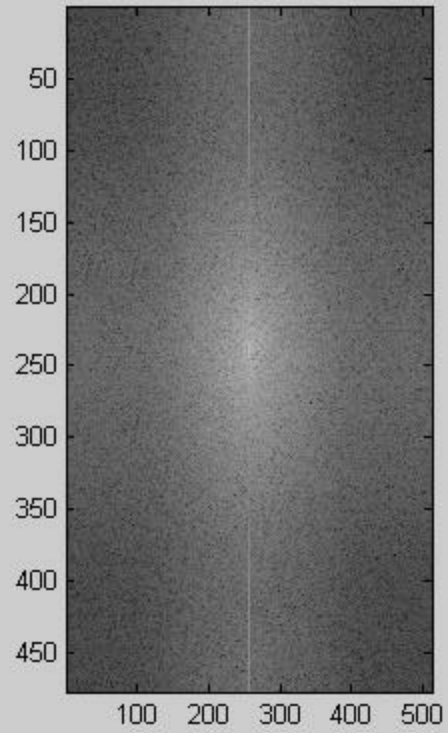
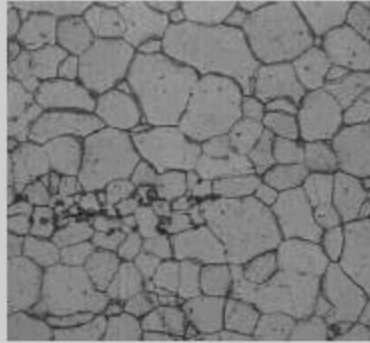
- 1) Initialize weights with small random numbers:
 - 2) Select suitable value of learning rate coefficient η in the range 0 to 1:
 - 3) repeat
 - 4) For all patterns in the training set do
 - 5) begin
 - 6) Obtain feature vector x and target output value t
 - 7) compute MLP output y
 - 8) if node is in output layer
 - then $\delta = y(1-y)(t-y)$
 - else $\delta = y(1-y) \cdot (\sum(\delta \cdot w_m))$
 - 9) adjust weights l of node j according to $w_{ij} = w_{ij} + \eta \cdot \delta \cdot y$
 - end if
- until changes are reduced to some predetermined level

May 29, 2003 – Thursday

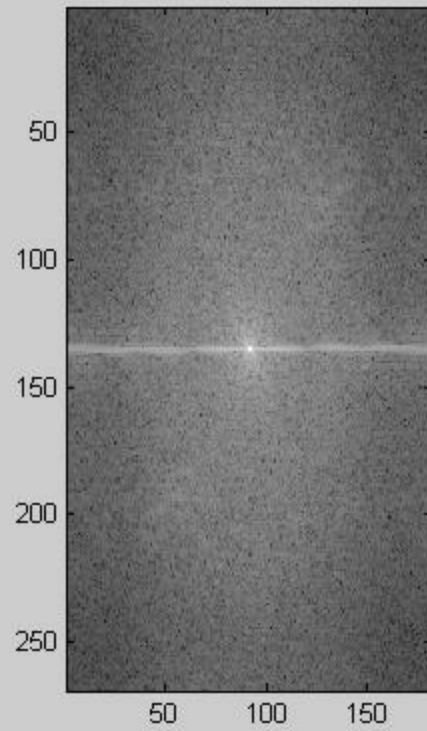
After our meeting today, it was mentioned to plot the FFT of an image for discovering the intensity frequencies.



Iron Image



Metallography-1₄Carbon_neg₁7₅x50.jpg



May 30, 2003 – Friday

ALISA: http://www.seas.gwu.edu/~pbock/ALISA_Summary.html

```
function y=imfftplot(imagename)
%
% imfftplot plots spectrum of image and of regions selected by user
%
% WRITTEN BY   William Martin, will@rapidnet.com
%
% Purpose     Plots spectrum of image, of selected region (rectangular or polygon),
%             plots histogram of area, and edge detects image and overlays
%             that edge detected (and thresholded part) with original image.
%
% USAGE       imfftplot('filename.ext');
%             Where filename is the name of the file you want to use, extension is
%             an extension that Matlab handles. For a list of supported file types,
%             type "help imread" in the matlab command window
%
% OUTPUT      These are the steps that will occur when you call this script.
%             Figure(1): Original Image and Spectrum of image
%
%             Menu: Select either Rectangle or Polygon for selection method.
%
%             The rectangle method assumes you are selecting while
%             holding down the left mouse button. When you let up, that
%             will select the region.
%
%             The polygon method works by selecting points using the left
%             mouse button to select your points. Once you are finished,
%             right click to select the region of interest(ROI).
%
%             Figure(2): Selected region is displayed along with its spectrum.
%
%             Figure(3): Histogram of selected region (ROI).
%
%             Figure(4): Edge detected regions overlaid on original image.
%
% NOTE       To clear all windows after you have run this several times, use
%             'close all', in the command window.
%
% SEE ALSO:  imread, imagesc, imshow, imhist, fft2, fftshift, edge

% read in image and its color map
[A,map]= imread(imagename);

A = rgb2gray(A); % convert to grayscale
figure
% plot image and its fourier spectrum.
F = fftshift(fft2(A));
subplot(1,2,1),imshow(A), title(strcat('Filename:', imagename));

% display menu
answer = menu('Select method to use for spectrum analysis','Rectangle','Polygon');
% do Rectangle selection
if(answer==1)
    % get ROI.
    copied = imcrop;
    %colormap('jet'); % uncomment for "pretty colors"
    subplot(1,2,2),imagesc(log(1+abs(F)))
    figure
```

```

copiedfft=fftshift(fft2(copied));
%colormap('jet');      % uncomment for "pretty colors"
subplot(1,2,2),imagesc(log(1+ abs(copiedfft))),title('spectrum of selected');

figure, imhist(copied);
title('Histogram of selected area');
end
% do Polygon selection
if(answer==2)

    [selected,xi,yi]=roipoly;
    % plot the spectrum of the first image (done after selecting region).
    subplot(1,2,2),imagesc(log(1+abs(F)))

    [r,c]=find(selected);
    ind=sub2ind(size(A),r,c);
    J=zeros(size(A));
    J(ind)=A(ind);
    figure
    subplot(1,2,1),imshow(J,map),title('Selected Area');
    subplot(1,2,2),imagesc(log(abs(fftshift(fft2(J))))), title('Plot of spectrum of a
polygon');
    selected=im2uint8(J);
    figure, imhist(selected);
    title('Histogram of selected area');
end

% perform edge detection on image
r=edge(A,'canny');
% convert binary image to pseudo grayscale
r=im2uint8(r);
% do a linear combination of images
A=imlincomb(1,r,1,A,'uint8');

figure
imshow(A);
title('Edges overlaid original image');

y=F;
end

```

May 31, 2003 – Saturday

What can the frequency spectra tell us about an image? How is this related to the Fourier descriptors?

Summary

- Edge Detection
- Edge Enhancement
- **Texture**: Regions of variation in brightness.

Links

Chapter 6 Electronic Structure at Grain Boundaries in Iron

<http://www-mp.phy.cam.ac.uk/people/vlad/Chapter6.html>

<http://www-mp.phy.cam.ac.uk/people/vlad/chapter1.html>

Etching and Other Terms

<http://www2.arnes.si/~sgszmera1/others/help/terms.html>

Chapter 7 - Global measurements and stereology

<http://www.reindeergraphics.com/tutorial/chap7/global01.html>

Introduction to Optical Microscopy, Digital Imaging, and Photomicrography

<http://micro.magnet.fsu.edu/primer/>

Search keywords:

introduction to quantitative metallography

stereology

Glossary

Delineation: