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Geovisualisering och bildbehandling

Project 1 Image Processing Part

The assignment is mandatory and should be handed in due to deadline. This part is set prior to the project on visualization and thus should be finished before you start working with the Project 2. At a highest you can get 10 points for this part of the assignment and these points will be weighted into calculation of the final grade. Deadline for this part is set to January 2, 2015. Handing in later than this date will result in withdraw of 2 points. Project 2 will be posted to you later in December. You should complete both parts and present your solutions orally in January 15.

Problem definition and data description

On July 07, 2011 a state of emergency in British Columbia (Canada) has been declared in parts of Peace River Regional District. Several hundred homes were damaged by torrential rains and flooding. 150 mm of rain fell on northeastern B.C. in just a few days. Hundreds of homes were flooded by the summer downpour, wells were polluted and the main highway between Prince George and Dawson Creek was washed out in several places. Similar disasters occurred in year 2013 and 2014. Some visuals on how it looked like in the region of flooding are below. There is a reason to assume that this flooding can happen again and thus it could be of importance to see if some land area will be at risk to be flooded.

In this project we will use satellite imagery (Landsat 7) to extract parts belonging to Peace River. In Project 1 we will concentrate on the extraction of the river boundaries and sorting them out. This is a necessary step before we can input the boundaries to the visualization block. The main goal is to visualize the flooding in time space so that it will be possible to monitor the changes of the river basin.

Objective

There is Landsat 7 with SLC-off imagery from different years and different months over region of Peace River in Canada. Give a short presentation of **Landsat 7 with SLC-off** discussing the amount of bands and the sensitivity of each band. What band/combination of bands is especially useful for water and wet soil imaging? Read metadata and readme files that accompanying each set of data and see what geo-referencing is used and how each band is presented. Select a proper band for river segmentation.

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Note! There is a common approach in the Remote Sensing field to create a ratio image for processing, see example below. You can divide the pixel values of one band by those of another at each corresponding pixel site. This produces a band ratio image. Shown here is Landsat MSS band 7 divided by band 4, giving a new set of pixel values for growing vegetation that cluster around 1. These values are then expanded by a stretching program and assigned gray levels. In this scene, growing vegetation is shown in nearly white tones, because the growing vegetation in band 4 and band 7 has similar pixel value intervals. Dividing those values will produce the result 1 or close to 1. New color images can be made from sets of three band ratios.

Using the band of your choice, create a Matlab code to extract only the Peace River. Note! The image is huge, you might need to resample it a bit using imresize();

First of all you need to remove/diminish the periodic noise. After that you need carefully investigate what image processing techniques can be useful in order to enhance/suppress some features in the image prior to the segmentation. To accomplish this you should consider investigating the intensity values of the river and the other parts of your image. As a next step you could take a look at color segmentation part in lab 3 and think of some similar approach. After that, using knowledge on edge direction apply the most appropriate edge detector. To make final adjustments, use morphological filters to fill the gaps or remove noise.

As a last step you will create a text file with the coordinates of the boundaries of the extracted river. The coordinates of one side of the river should have a corresponding x,y coordinate on the other side. This can be handled by the code below:

```
function sortingEdges(im)
str=inputname(1);
BW=im;
BW=im2bw(BW);
[B,L,N,A] = bwboundaries(BW);
figure; imshow(BW), hold on;

boundary1 = B{1};
plot(boundary1(:,2),...
boundary1(:,1),'g','LineWidth',2); hold on;
```

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```
boundary2 = B{2};
plot(boundary2(:,2),...
boundary2(:,1),'r','LineWidth',2);

fName = strcat('textFilesEdges/',str,'1.txt'); %A file name
fid = fopen(fName,'wt');
%boundary har symmetriska replikerade värden på koordinaterna därför måste
%vi dela längden av varje linje med 2.
size(boundary1,1)/2
for k=1:size(boundary1,1)/2
   if boundary1(k,1)==1
      fprintf( fid, '%d,%d\n', boundary1(k,:));
      break
   end
fprintf(fid, '%d,%d\n', boundary1(k,:));
end
fclose(fid);
fName = strcat('textFilesEdges/',str,'2.txt'); %A file name
fid = fopen(fName,'wt');
size(boundary2,1)/2
for j=1:size(boundary2,1)/2
   if boundary2(j,1)==1
      fprintf( fid, '%d,%d\n', boundary2(j,:));
      break
   end
      fprintf( fid, '%d,%d\n', boundary2(j,:));
end
fclose(fid);
```

After this you will need to make sure that the amount of points on the boundaries is the same in each side. You can use the code below for that purpose.

```
function newvector=resampleVec(vector,newlen)

%%%%%%%%%%%%%%%%%%%%
%This function uses linear interpolation to change the number of samples
%%%%%%%%%%%%%%%%%%%%

len=length(vector);
x=1:len;x=x';y=vector;
xx=1:(len-1)/(newlen-1):len;
xx=xx';
yy=interp1(x,y,xx,'linear');
newvector=yy;
end
```

Grades

10 points. You hand in the Assignment due to deadline. In your report there is a discussion on Landsat 7 imagery and a motivated choice of band/bands. Your code works on all the images that you take into account. Band comparison is done and the motivation to the band choice is given. Accurate and motivated pre-processing is done. Modification of Canny edge detector is described

and motivated. The algorithm with all the steps is described. Own ides of processing techniques/modification of the provided techniques are tested and implemented if working. Your code is generally applied on all the images. Report is well illustrated and the discussion on possible improvements is provided.

8 points. All of the above, but deadline is not held. Or in case of held deadline, the report is less comprehensive and the new functions are not done. You should implement pre-processing and explain your steps. The result should be according to the instructions without failure. Your code is generally applied on all the images and if it is failing on some images, explain why and suggest solution.

7 points. Calculations are performed on the wrong band. The code is working according to the requirements. Some failure is allowed. Exclude those images from the candidates. The approach is straight forward without any own functions. Report is missing some parts.

6 points. Calculations are done, however, due to missing pre/after processing steps, some parts of a river are not included ant thus no conclusion can be done. Some insignificant amount of noise is allowed. Points of river boundaries are saved, but some specific for this image modification is done, e.g. cutting out the noise parts using that image morphology. Discussion on possible solution is provided.

5 points. Canny is implemented and Intensity segmentation is done. Some false results are accepted. In the report you give a discussion on what difficulties you met. You don't need to evaluate. Some level of noise that affects the segmentation is allowed. Your code works at least on two images.