Description of Matlab routines

This document describes the Matlab routines that were implemented to facilitate the analysis of the CARABAS-II VHF SAR image data set presented in the paper “A challenge problem for detection of targets in foliage” held at the 2006 SPIE conference Algorithms for Synthetic Aperture Radar Imagery XIII in Orlando.

Files and functionality

VHF_display_image.m
The function displays a VHF SAR image and shows marks where the targets are deployed.

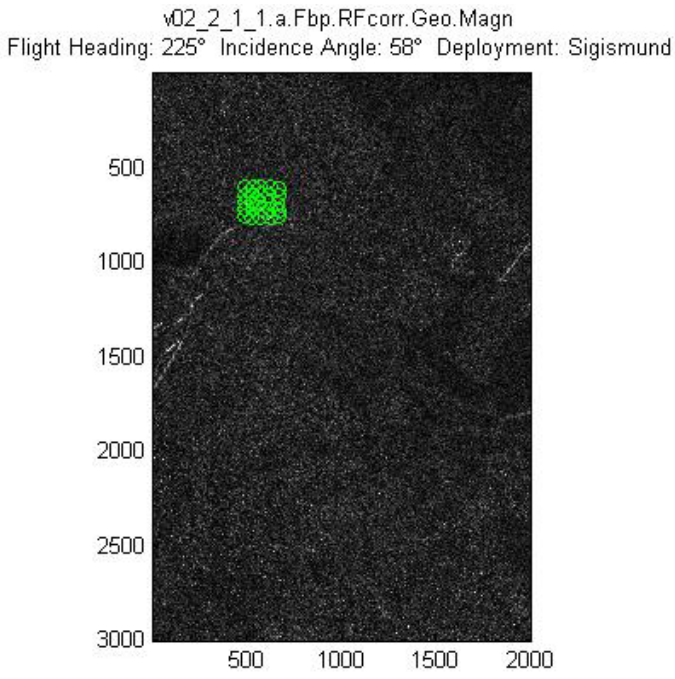
out = VHF_display_image(m,p,image_dir,tlist_dir,dlimits)

Input:
m - Flight mission number (1=v02_2, 2=v02_3, 3=v02_4, 4=v02_5)
p - Flight pass number within mission (1 <= p <= 6)
image_dir - Directory where the image data set is stored (e.g. 'C:\VHF_CD_challenge\images\')
tlist_dir - Directory where the target lists are stored (e.g. 'C:\VHF_CD_challenge\target_lists\')
dlimits - Display limits (percent of max value) (e.g. dlimits = [0 0.4])

Output:
out - handle to figure window

Example: Display image v02_2_1_1.a.Fbp.RFcorr.Geo.Magn

```
>> image_dir = 'C:\VHF_CD_challenge\images\';
>> tlist_dir = 'C:\Data\VHF_CD_challenge\target_positions\';
>> h=VHF_display_image(1,1,imdir,tlist_dir,[0 0.4]);
```



VHF_get_image_info.m

Returns image size and coordinate info

```
out = VHF_get_image_info()
```

Output:

out - Structure holding information on image size and geographic coordinates
out.n_rows - Number of rows of the image
out.n_rows - Number of cols of the image
out.east_min - minimum east coordinate of the image
out.east_max - maximum east coordinate of the image
out.north_min - minimum north coordinate of the image
out.north_max - maximum north coordinate of the image
Coordinates are given in Swedish reference system RR92

Example:

```
>> info = VHF_get_image_info()

info =

    east_min: 1653166
    east_max: 1655165
    north_min: 7367489
    north_max: 7370488
    n_rows: 3000
    n_cols: 2000
```

VHF_get_mission_info.m

Returns a structure containing information of each flight mission and the corresponding images for the CARABAS VHF data set.

```
Mission = VHF_get_mission_info()
```

Output:

The structure has the following fields:
Mission(i).Name - Name of mission i (e.g. 'v02_2')
Mission(i).Deployment - Name of the target deployment for mission i
Mission(i).Pass(j).heading - Flight heading of pass j in mission i
Mission(i).Pass(j).incidence_angle - Incidence angle at aimpoint for mission i pass j
Mission(i).Pass(j).RFI - Indicates whether the RFI level is 'High' or 'Low'
Mission(i).Pass(j).fn - Filename of the image collected during mission i pass j

There are 4 missions. Each mission have 6 passes.
Therefore 1 <= i <= 4, 1 <= j <= 6

Example:

```
>> Mission = VHF_get_mission_info();
>> Mission(1)

ans =

    Name: 'v02_2'
    Deployment: 'Sigismund'
    Pass: [1x6 struct]
```

```
>> Mission(1).Pass(1)

ans =

        heading: 225
        incidence_angle: 58
        RFI: 'High'
        fn: 'v02_2_1_1.a.Fbp.RFcorr.Geo.Magn'
```

VHF_make_target_image()

Make a target ground truth image using a target list.

[timage, tlist] = VHF_make_target_image(tlist_fn,info,radius)

Input:

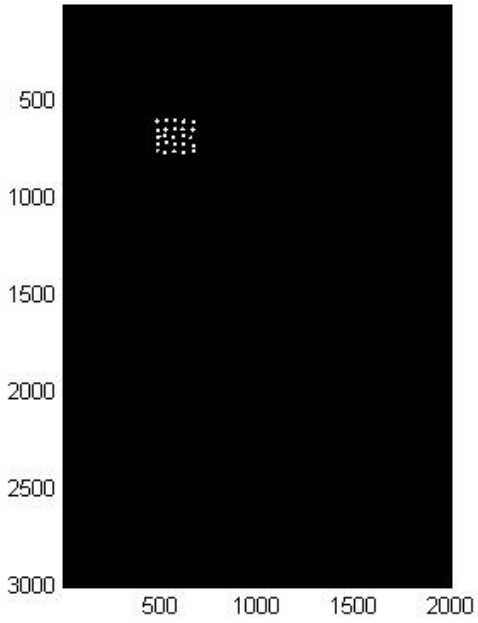
tlist_fn - Filename of target list to be used
(e.g. 'C:\VHF_CD_challenge\target_positions\Fredrik.Targets.txt')
info - Structure holding the image size and coordinates of an image.
This is the structure returned from the function VHF_get_image_info.
(e.g.)
info.n_rows - Number of rows of the image stored in file filename
info.n_rows - Number of cols of the image stored in file filename
info.east_min - minimum east coordinate of the image
info.east_max - maximum east coordinate of the image
info.north_min - minimum north coordinate of the image
info.north_max - maximum north coordinate of the image
Coordinates are given in Swedish reference system RR92.
radius - Radius of target object in resulting image.

Output:

timage - Array holding the target image. This image will have the size and coordinates specified by the info structure. For each target in the target list a circle with a radius specified by radius will be placed at the right position in the target image. The circle will be filled by the value corresponding to the target index in the file.
tlist - Structure holding information of each target in the target list file.
(e.g.)
tlist.N_targets - Number of targets in the list
tlist.N_coord(i) - Northern coordinate for target i (Swedish RT90 coordinates)
tlist.E_coord(i) - Eastern coordinate for target i (Swedish RT90 coordinates)
tlist.target(i) - Target type for target i
In the above: 1 <= i <= tlist.N_targets

Example: Make and display the target image for deployment Sigismund

```
>> tlist_fn = 'C:\VHF_CD_challenge\target_positions\Sigismund.Targets.txt';
>> info = VHF_get_image_info();
>> radius = 10;
>> [timage, tlist] = VHF_make_target_image(tlist_fn,info,radius);
>> imagesc(timage > 0)
>> axis image;
>> colormap gray;
```



VHF_print_mission_info.m
Displays mission info for all flight missions and passes for the VHF SAR image data set.
Uses the funtion VHF_get_mission_info().

Example:

```
>> VHF_print_mission_info

Mission Information
**********************************************************

----------------------------------------------------------
Mission nr: 1
Mission Name: v02_2
Deployment: Sigismund

Pass nr: 1
Heading: 225
Incidence angle: 58
RFI level: High
File name: v02_2_1_1.a.Fbp.RFcorr.Geo.Magn

Pass nr: 2
Heading: 135
Incidence angle: 58
RFI level: Low
File name: v02_2_2_1.a.Fbp.RFcorr.Geo.Magn
```

VHF_read_image.m

Reads an image stored as IEEE floating point with big-endian byte ordering.

out = VHF_read_image(infile,N_cols,N_rows,col_start,col_end,row_start,row_end)

Input:

infile - File to read
N_cols - Number of columns of the image stored in the file
N_rows - Number of rows of the image stored in the file
col_start - Start reading from this column
col_end - End reading at this column
row_start - Start reading from this row
row_end - End reading at this row

Output:

out - Output data matrix of size (row_end-row_start+1)x(col_end-col_start+1)

Valid values for col_start/col_end [1 <= col_start <= col_end <= N_cols]
Valid values for row_start/row_end [1 <= row_start <= row_end <= N_rows]

Example: Read and display image v02_2_1_1.a.Fbp.RFcorr.Geo.Magn

```
>> fn = 'C:\VHF_CD_challenge\images\magn_images\v02_2_1_1.a.Fbp.RFcorr.Geo.Magn';
>> info = VHF_get_image_info();
>> im = VHF_read_image(fn,info.n_cols,info.n_rows,1,info.n_cols,1,info.n_rows);
>> imagesc(im);
```

VHF_read_target_list.m

Reads a target list (ground truth) and returns a structure with info for each target in the list.

out = VHF_read_target_list(fn)

Input:

fn - Filename of target list file (e.g. 'C:\VHF_CD_challenge\target_positions\Fredrik.Targets.txt')

Output:

out - Structure holding info on each target in the list
(e.g.)
out.N_targets - Number of targets in the list
out.N_coord(i) - Northern coordinate for target i (Swedish RT90 coordinates)
out.E_coord(i) - Eastern coordinate for target i (Swedish RT90 coordinates)
out.target(i) - Target type for target i
In the above: 1 <= i <= out.N_targets

Example:

```
>> tlist_fn = 'C:\Data\VHF_CD_challenge\target_positions\Sigismund.Targets.txt';
>> tlist = VHF_read_target_list(tlist_fn);
>> tlist

tlist =

    N_coord: [1x25 double]
    E_coord: [1x25 double]
    target: {1x25 cell}
    N_targets: 25
```

VHF_show_marks.m

Shows marks in an (image) axes at positions specified by row and col.

out = VHF_show_marks(ax, row, col, c, m);

Input:

ax - handle to axes
row - array with row indexes (same length as col)
col - array with column indexes (same length as row)
c - color of marks ('r'-red, 'b'-blue, 'g'-green, 'k'-black, etc.)
m - symbol used to mark ('o'-rings, 'x'-crosses, etc.)

Output:

out - handle to current axes

Example: Show a green cross at row 50 column 100 in figure h

```
>> h=imagesc(im);
>> ax=VHF_show_marks(get(h,'Parent'),50,100,'g','x');
```