CYGNSS DDM Processor Makefile build and run guide

Scott Gleason
December, 2020.

1) Summary:

This document provides some very basic information on building and running the CYGNSS DDM Processor in a Makefile environment.

2) Build Information:

The program requires the math (-lm) and fftw3 development FFT library (libfftw3-dev). In Linux, this can be downloaded and installed using most Linux package managers (i.e. synaptic on Ubuntu).

The program can be built on the command line with the GCC compiler.
> make

And then run with,
> ./CYGNSS_DDM_Processor

The output is then save in the file “Processed_DDMs.bin” and post processed with the Octave script “plot_FFT_DDMs_binary1.m” (See below)

3) Run Information

Basically the information read in from the GUI in the Qt version has been moved to the configuration file and is read in at run time.

The configuration file “CYGNSS_DDMP_config.dat” contains the following entries which completely configure the processing and outputs.

Entries are “commented in” using the “^” character.

```
% Cold Search Flag
% Processes all 32 PRNs, according to parameters below. Default Off
^ C 0
C 1

% Define Time processing (relative to start of file, second 0.0)
% start second, end second, second step
^T 1.0 1.0 1.0

% Define Input Raw IF File Name, Two examples shown below (first one “commented in”)
% Obs8, ocean
^F ../Input_DMR_Data/cyg08_raw_if_20170825_141629_data.bin
% Obs8, Amazon
F ../Input_DMR_Data/cyg08_raw_if_20180125_141649_data.bin
```

% Define PRN and second by second center Doppler frequencies
% D PRN, antenna, Doppler range Hz, Doppler step Hz, Doppler Start, First Derivative Doppler, Second Derivative Doppler
% For Obs8 Ocean signal
^D 28 3 3000 200 1000 0 0
% For Obs8 Amazon raw IF file
D 20 3 6000 200 5000 0 0

% Notes: antenna 1=zenith, 2=starboard, 3=port.
% Above entry will start at center Doppler 5000, End Doppler 11000 (5000+6000) in steps of 200 Hz. If the 'T' entry indicated several seconds of processing, the center Doppler will be adjusted according to the first and second derivative parameters. This is useful for processing whole 60 second tracks where the center Doppler changes significantly per second.

% Define General Processing Parameters
% sampling freq, IF freq, num channels (3), non-coh averaging interval (ms), down sample delay resolution
% down sample=1=sampling freq=approx 1/16 chip delay steps, down sample=2=approx 1/8 chip delay steps, etc
% Second entry longer 3000 (3s) integration (used for Amazon signal)
^P 16036200 3872400 3 1000 2
P 16036200 3872400 3 3000 2
% Direct signal cold search entry, only 10ms integration
P 16036200 3872400 3 10 2

%Note: sampling and IF frequencies determined by instrument, num channels is (currently) always 3. Non-coherent averaging interval is nominally 1000 (1s) but can be longer (as in example above) or shorter (for direct signals). The on-board down-sample delay resolution is 4. Values of 2 and 1 provide finer delay spacing, while greater than 4 provided coarser spacing. Only following values have been tested! (1=1/16 chip,2=1/8 chip,4=1/4 chip,8=1/2 chip,16=chip).

4) Post-Processing Output Files

When the CYGNSS DDM Processor is finished processing all DDMs that is was configured to do, it will output a binary file of all the processed DDMs in the execution directory called,

Processed_DDMs.bin

This file can be processed with an Octave script (which should work in Matlab but has not been tested). The Octave script to process the output DDMs is called,

plot_FFT_DDMs_binary1.m

And is included in the code release. This file performs peak detection and cropping of the Full DDMs and displays both the cropped DDM image and a series of delay waveforms. (and the Full DDM if you really want to comment that in!).