An experimental FT8 decoder plugin for SDRuno

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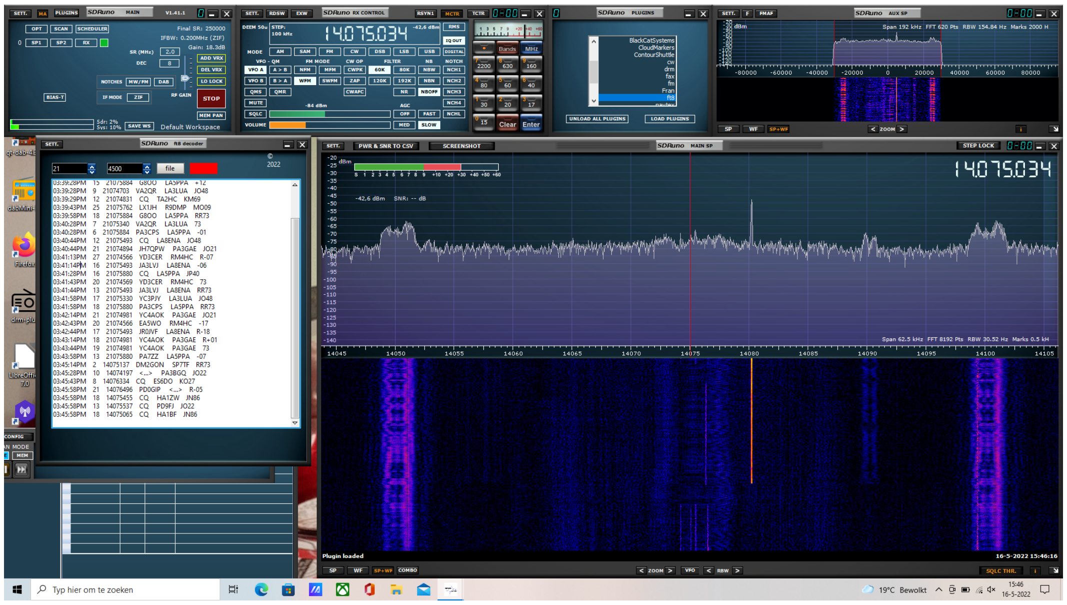

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03:39:28PM  15  21075884  G8OO    LA5PPA  +12
03:39:28PM  9   21074703  VA2QR   LA3LUA  JO48
03:39:29PM  12  21074831  CQ      TA2HC   KM69
03:39:43PM  25  21075762  LX1JH   R9DMP   MO09
03:39:58PM  18  21075884  G8OO    LA5PPA  RR73
03:40:28PM  7   21075340  VA2QR   LA3LUA  73
03:40:28PM  6   21075884  PA3CPS  LA5PPA  -01
03:40:44PM  12  21075493  CQ      LA8ENA  JO48
03:40:44PM  21  21074894  JH7QPW  PA3GAE  JO21
03:41:13PM  27  21074566  YD3CER  RM4HC   R-07
03:41:14PM  16  21075493  JA3LVJ  LA8ENA  -06
03:41:28PM  16  21075880  CQ      LA5PPA  JP40
03:41:43PM  20  21074569  YD3CER  RM4HC   73
03:41:44PM  13  21075493  JA3LVJ  LA8ENA  RR73
03:41:58PM  17  21075330  YC3PJY  LA3LUA  JO48
03:41:58PM  18  21075880  PA3CPS  LA5PPA  RR73
03:42:14PM  21  21074981  YC4AOK  PA3GAE  JO21
03:42:43PM  20  21074566  EA5WO   RM4HC   -17
03:42:44PM  17  21075493  JR0JVF  LA8ENA  R-18
03:43:14PM  18  21074981  YC4AOK  PA3GAE  R+01
03:43:44PM  19  21074981  YC4AOK  PA3GAE  73
03:43:58PM  13  21075880  PA7ZZ   LA5PPA  -07
03:45:14PM  2   14075137  DM2GON  SP7TF   RR73
03:45:28PM  10  14074197  <...>   PA3BGQ  JO22
03:45:43PM  8   14076334  CQ      ES6DO   KO27
03:45:58PM  21  14076496  PD0GIP  <...>   R-05
03:45:58PM  18  14075455  CQ      HA1ZW   JN86
03:45:58PM  13  14075537  CQ      PD9FJ   JO22
03:45:58PM  18  14075065  CQ      HA1BF   JN86
```

1 READ THIS FIRST

It is known that the ft8 plugin sometimes causes a crash. I develop software under Linux, and some decoders I wrote for my own swradio-8 software are "translated" to plugins for SDRuno. Translation merely consists of changing the dependencies on Qt, that I use under Linux, to things for the GUI toolbox that SDRuno uses.

While in Linux I use a debugger and the address sanitizer library to convince (ensure?) myself that processing the data does not lead to memory corruption, I do not have access to Windows tools doing the same (and I am a Windows illiterate and hope to stay that for a long time).

Anyway, the plugin may crash. Feel free to use the plugin, but if you use the plugin, remember that it is your own choice, and please do not inform me on occasions that a crash occurs.

2 Introduction

The FT8 plugin is an experimental plugin for decoding FT8 messages and showing the decoded messages.

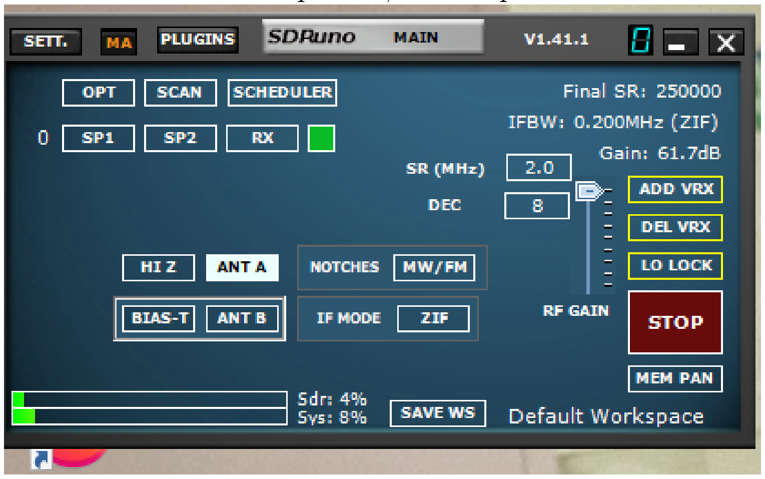
The plugin - as a community plugin - can be installed by placing it in the folder for community plugins. Ask SDRplay where the folder would be on your system, on my system the folder can be found as subfolder in "Documenten".

Note that where I live the sun is now shining abundantly, and since most neighbours around have solar panels, reception of radio during day time is sub-optimal, which may be reflected in the pictures and the results shown.

3 Selecting a samplerate

The plugin uses the SP1 output of the SDRuno platform. This output is 192000 samples per second. The plugin itself will reduce the samplerate to 12000 (and filter accordingly).

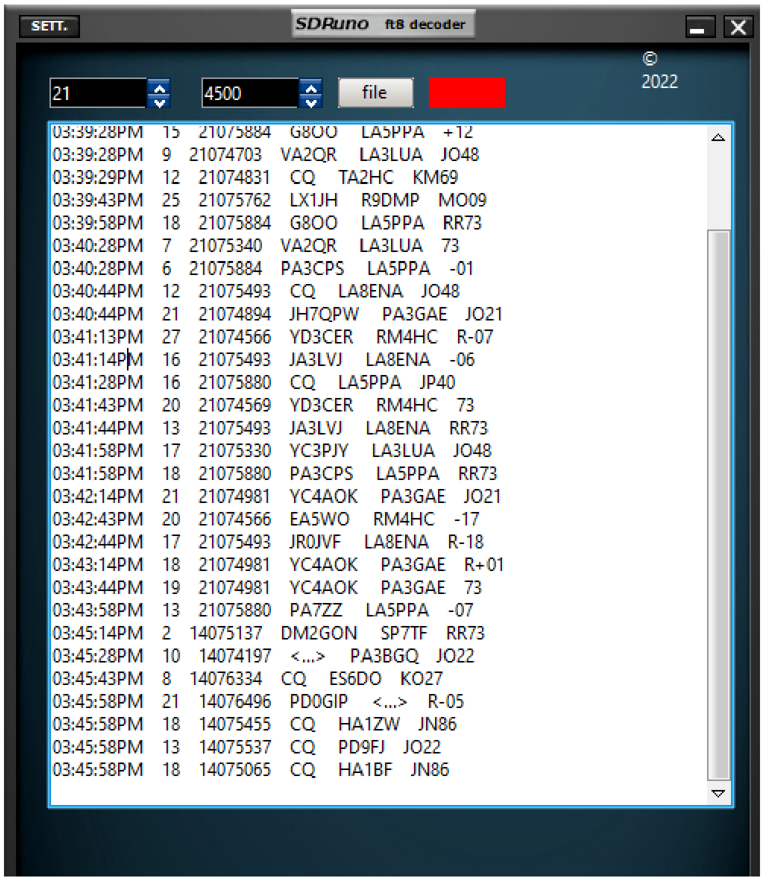
The default setting for SDRuno (at least with me) is that the input samplerate is 2 MHz, and the main spectrum display will show a spectrum of the full 2 MHz. It is advised to apply some reduction to the samplerate, see the picture.



Final SR: 250000
IFBW: 0.200MHz (ZIF)
Gain: 61.7dB
SR (MHz) 2.0
DEC 8
Sdr: 4%
Sys: 8%
Default Workspace

Even then, it is often useful to zoom in in the spectrum, after all the spectrum of the region of interest is only a few KHz wide.

4 The plugin



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03:45:14PM  2  14075137  DM2GON   SP7TF  RR73
03:45:28PM  10  14074197  <...>  PA3BGQ  JO22
03:45:43PM  8  14076334  CQ   ES6DO  KO27
03:45:58PM  21  14076496  PD0GIP   <...>  R-05
03:45:58PM  18  14075455  CQ   HA1ZW  JN86
03:45:58PM  13  14075537  CQ   PD9FJ  JO22
03:45:58PM  18  14075065  CQ   HA1BF  JN86
```

The widget for the FT8 plugin is straight forward, it will show for each decoded FT8 message a few fields

- the time of decoding the message;
- the relative strength of the FT8 message, relative to the average signal strength during reception of the FT8 message.
- the frequency of the message with an accuracy of 3.125 Hz (tone distance is 6.25 Hz).
- the message itself

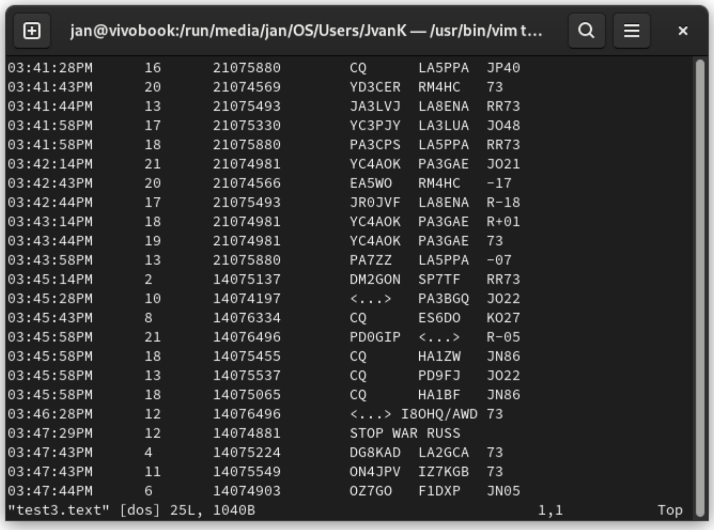
On top of the widget there are two selectors and a button

- The *first* selector sets the value for the number of iterations, to be applied in the LDPC decoding (see later on). Higher values may lead to better decoding but are expensive in terms of CPU load; Default value is 20.
- the *second* selector sets the bandwidth in the spectrum in which ft8 messages are searched for. Default value is 4 KHz. Note that the plugin starts with band filtering the incoming signal on a band of 5 KHz, the assumption is that the width of the region for FT8 signals is less than 5 KHz.

- Next a button labeled ”file” is there. As the name suggests, a file can be selected in which the data is stored. If the data is being written the label next to the button will be colored red, if no data is written the color of the label will be green.

Settings for the LDPC number of iterations and the searchwidth are maintained between invocations of the plugin.

The widget will show up to 50 of the last received messages. Of course all messages are saved in a file whenever a file is selected


jan@vivobook:/run/media/jan/OS/Users/JvanK — /usr/bin/vim t...

```
03:41:28PM      16      21075880        CQ      LA5PPA  JP40
03:41:43PM      20      21074569        YD3CER  RM4HC   73
03:41:44PM      13      21075493        JA3LVJ  LA8ENA  RR73
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03:42:44PM      17      21075493        JR0JVF  LA8ENA  R-18
03:43:14PM      18      21074981        YC4AOK  PA3GAE  R+01
03:43:44PM      19      21074981        YC4AOK  PA3GAE  73
03:43:58PM      13      21075880        PA7ZZ   LA5PPA  -07
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03:45:58PM      18      14075455        CQ      HA1ZW   JN86
03:45:58PM      13      14075537        CQ      PD9FJ   JO22
03:45:58PM      18      14075065        CQ      HA1BF   JN86
03:46:28PM      12      14076496        <...> I8OHQ/AWD 73
03:47:29PM      12      14074881        STOP WAR RUSS
03:47:43PM      4       14075224        DG8KAD  LA2GCA  73
03:47:43PM      11      14075549        ON4JPV  IZ7KGB  73
03:47:44PM      6       14074903        OZ7GO   F1DXP   JN05
"test3.text" [dos] 25L, 1040B                           1,1           Top
```

5 A note on FT8 decoding

FT8 decoding is essentially based on a - more or less - ”intelligent” brute force approach (sounds like a ”Contradictio in terminis”). In a first step an attempt is made to preselect ”potentials”, i.e. potential messages based on matching the input with a costas array of 7 tones.

In the second step for each of these potentials an LDPC based error detection/recovery mechanism is applied. First the 79 subsequent tones are collected, the 58 non-synchronization tones are mapped upon 174 soft bits and the LDPC algorithm is asked to make that into ”hard” bits. Finally, in a third step the resulting message is subjected to a CRC check. If the check succeeds the bits are translated into a message.

Note that the parameters in the first stage may be too strict, and not all messages are in the set of potentials, or they may be too loose, and the set of potentials is too large. Some criteria have to be applied to do the selection, but it is not obvious that a single set of criteria is optimal under all circumstances.

An encoded FT8 message is 91 bits (including the CRC), and 83 error correction bits are appended. Of course, the probability that on receiving a transmission, the error correction bits contain - roughly - the same amount of errors as the message bits is pretty large.

The net effect is that the result of the application of the error correction may be that incoming garbage is transformed to something resembling a message, and the other way, a correct message may suffer from errors in the error correction bits and may be transformed into garbage. A CRC check is therefore absolutely needed.

Anyway, the decoder may - and probably will - miss some messages in the transmitted band, and I am still looking for the "best" parameter settings for the different functions.

6 Future work

While, as said, the plugin contains apparently an error, it sometimes causes a crash, and the Linux version does not, no garantees can be given that newer - improved - versions of the plugin will even appear.

For the Linux version it holds that current work is on optimizing parameter settings and extending the encoding.

7 Copyright and acknowledgments

The code in the plugin uses parts of the code of the FT4FT8 decoding software of Karlis Goba. Especially the LDPC decoder is a copy of his code, and the copyright to the parts taken or derived from his code are gratefully acknowledged.

The Copyrights of the code - not covered by the above - is by me. The software is available under a GPL V2. Note that under this license you are free to use the plugin, and you can even get the source, but the software is provided "as is", and no garantees are given that the software meets your requirements.

Note that - as the title of this document states - the plugin is still experimental, implying that the search for optimal parameter settings continues.