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Preferred computer specs

- Discrete graphic card with minimum 2GB memory
- USB 3.0
- 16 GB memory
- Windows 7 or 10

Software pack installation

The software pack can be downloaded from:
https://www.dropbox.com/sh/cz8c18mtk7bx8u0/AACD1vQcnJqh9t8M0a8MMBPDa?dl=0

The folder structure iss

```
Software
    |--- FX3
        |--- FX3_Driver                (Drivers)
        |--- Tools
            |---- CyControl.exe         (Tools for programming FX3)
        |--- USBridge_v2.img           (FX3 firmware)
    |--- GUI
        |--- Template_Matching_GUI     (Generating templates)
        |--- USBridge_Install          (Headstage control)
        |--- directx_Jun2010_redist.exe (DirectX9 SDK required for realtime display)
    |--- Data_Processing
        |---- Python                   (Script for generating png files)
        |---- MAT_CONVERSION
            |---- bin
                |---- iprobe.exe       (Convert SD card record files to .mat)
                |---- plot_iprobe.m    (Plot spike events and raw data in .mat file )
```

To setup a new computer:

1. Plugin FX3 board and update its driver from FX3_Driver. Set search folder to FX3_Driver and windows should find the correct version on its own.
2. Install directx_Jun2010_redist.exe. The exe will unpack into a location then you need to run the setup in the unpacked folder.
3. Copy USBridge to a local folder (NOT network folder or dropbox folder), then run the installation
4. Add Template_Matching_GUI and MAT_CONVERSION/bin folder to matlab path
5. (Optional) Install Anacoda 3 for python scripts generating PNG files. You can also use another python environment.

Hardware setup

Laptop ← *USB 3.0* → FX3 ← *HDMI* → Head stage ← *FPC* → MCU extension
^
|
Battery
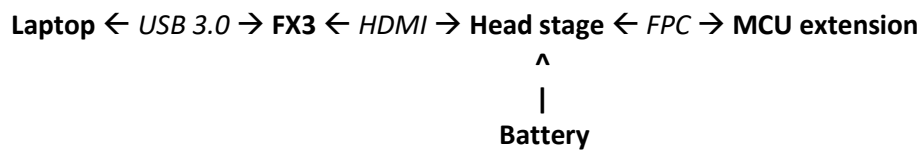
There are two methods to provide power to the system. They are mutually exclusive. Must confirm the jumper position before connecting power.
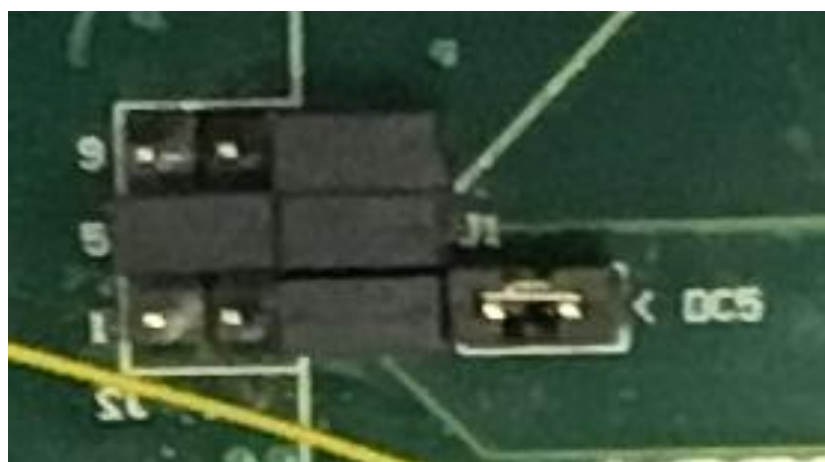
- Power from battery (mitigates the problem of SD card recording noise): **Remove jumper J1**
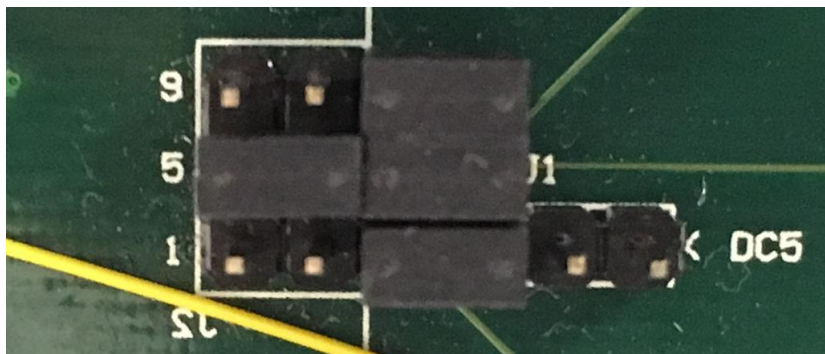

- Power from USB: **Short jumper J1**

Record to computer

This allows signal to be viewed in real-time w/o real-time spike events annotation.

1. Connect the system to computer (can be powered from either power method)
2. (Optional) Inserted a formatted SD Card if you want to record to SD card later. LED should go from blue to green.
3. Open **USBridge_WPF** from start menu
4. Click through all the debug message boxes.
5. From Windows → Add Waveform add all the windows from device.
6. From setting → Amplifier, change relevant settings to adjust bandwidth and maximise the usage of the ADC dynamic range without clipping signal. When done, click **Upload Configuration** to send settings to the headstage. You may need to change the scale settings in the waveform window to observe the whole signal.
7. From Project → Set Project Folder, select a location for storing data (preferably not a network location).
8. Use the dropdown menu to select required modes.
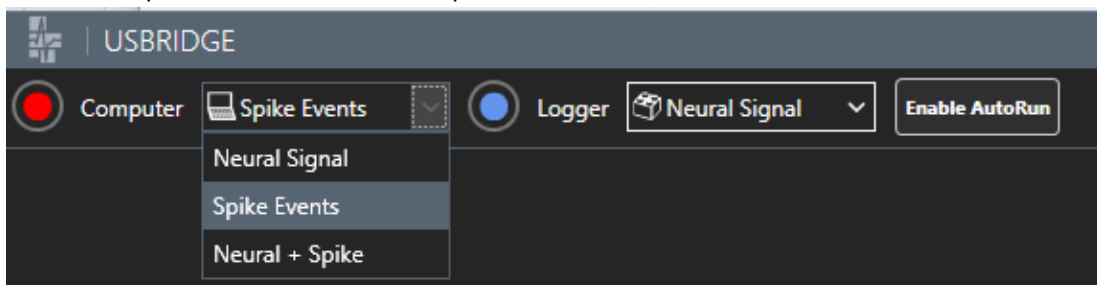
9. Click the red round button to start recording to the project folder. Click the same button (white square when recording) to stop recording.

Template generation

This step is required when spike events need to be annotated on-node in realtime.

1. Type "temp_match" in matlab to load the template matching GUI
2. Click Load Data and select the .sig file just recorded
3. You can process a selection or all the 32 channel recorded used the GUI. Once done, the GUI will show clustered results with template generated. You can tweak each channel and template individually (see more in FAQ). Once done, click **Generate config file**.

4. The configuration file is generated in the folder <timestamp>_op with the name config.bin. It can be loaded from the USBridge → Setting→Templates → Load Template

Record to SD Card from computer

This is typically used to generate "auto_cfg.bin" on the SD card and verify that SD card is operational before start chronic recording. It is however not recommended when powering from USB due to the SD card spike writing noise.

1. Insert a formatted SD Card into MCU extension. The light should go from blue to green.
2. (Optional) if you need to auto start SD recording later, toggle the "Enable AutoRun".
3. Click the blue button and select the corresponding modes when SD. Click the same button again to stop recording.

Auto start record from SD Card

This is used for chronic recording where a switching of power supply usually happens. Hence the system requires to config and start recording upon restoring power or SD card insertion. This also allows quick switching SD card or changing battery without a need of computer.

1. You should either perform **Record to computer** or have configuration files ready copied over to SD card. These files are:
   SD Root
      |--- auto_run.bin   (Required for auto start. Flag for auto start recording modes.
                                           1 -- signal, 2 – spikes, 3 – mix stream)
      |--- asic_cfg.bin   (Required for all 3 modes Contains LSB, filter and gain settings for analogue frontend)
      |--- fpga_cfg.bin   (Required for mode 2 and 3. Contains templates, detection threshold and matching threshold)

2. Switch power supply to battery and insert the SD card. The light should go from blue to green then off. It may become red if there is a problem. The system will retry for 10 times before completely stop.

Processing SD card data

This only applies to the data recorded on SD card. Data directly saved onto computer are processed differently. You will need the scripts from Data_Processing folder in the software pack.

Convert data to .mat files

1. Copy all the data in the date stamped folder from SD card to local drive. For instance "D:\cycle_001\2017-08-22".
2. In windows command line, change directory to Data_Processing\MAT_CONVERSION\bin
3. Run "iprobe.exe <path to the files>". For instance "iprobe.exe D:\cycle_001\2017-08-22"
4. The converted data is in the "mat" folder as the original data

View mat files

You can use the files in matlab but would recommend to do short snippets other than whole 24 hour. 24 hour data is better displayed subsampled or chopped or using the python scripts in Generate PNG files using python.

1. In matlab, use plot_iprobe('<file path>',<channel number>). E.g. plot_iprobe('cycle_003/2016-10-03/mat',1). You should see a fiure like below.
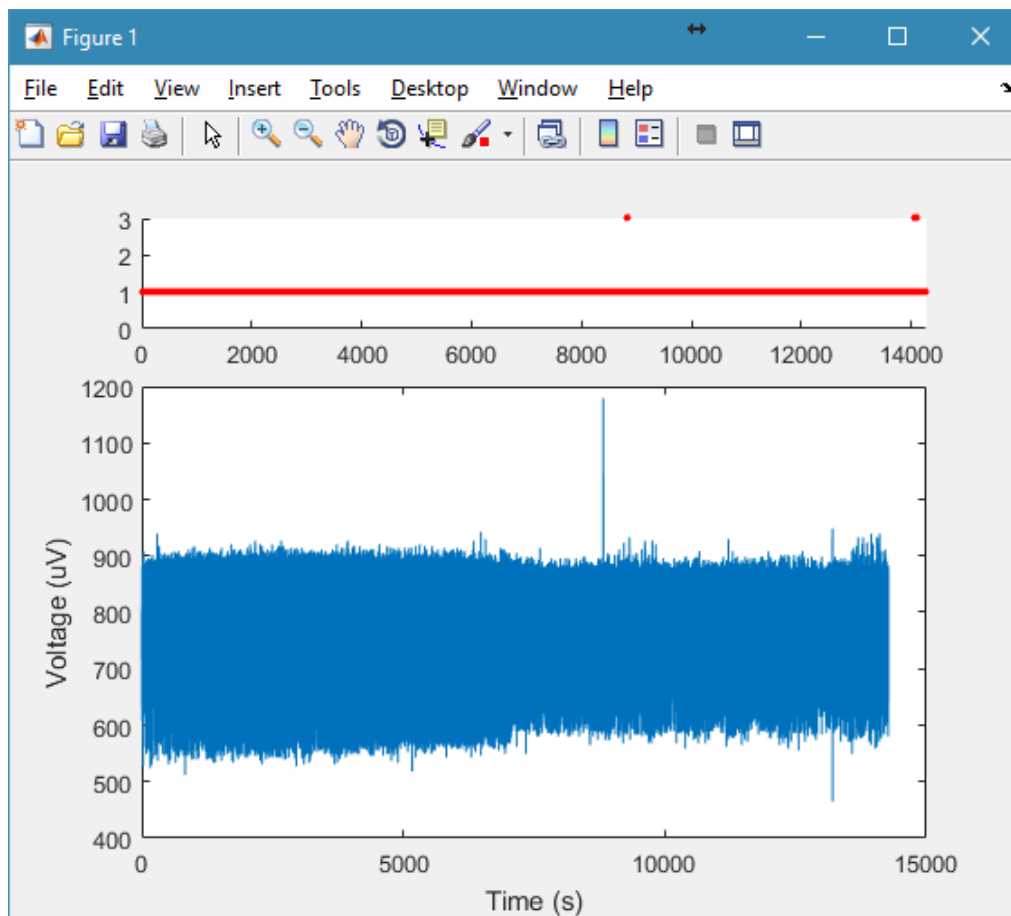
Generate PNG files using python

1. Edit *DataPath* and *timeStamp* in NGNI_JNE_SpikePlot.py and run it.
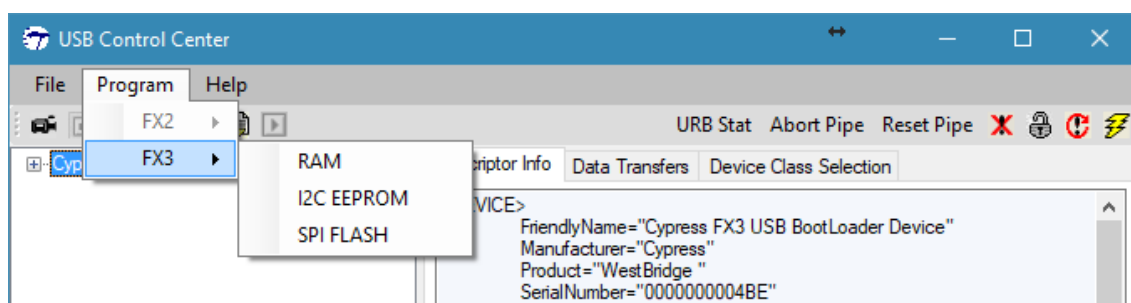2. A PNG image like the one below will be generated in the work directory.
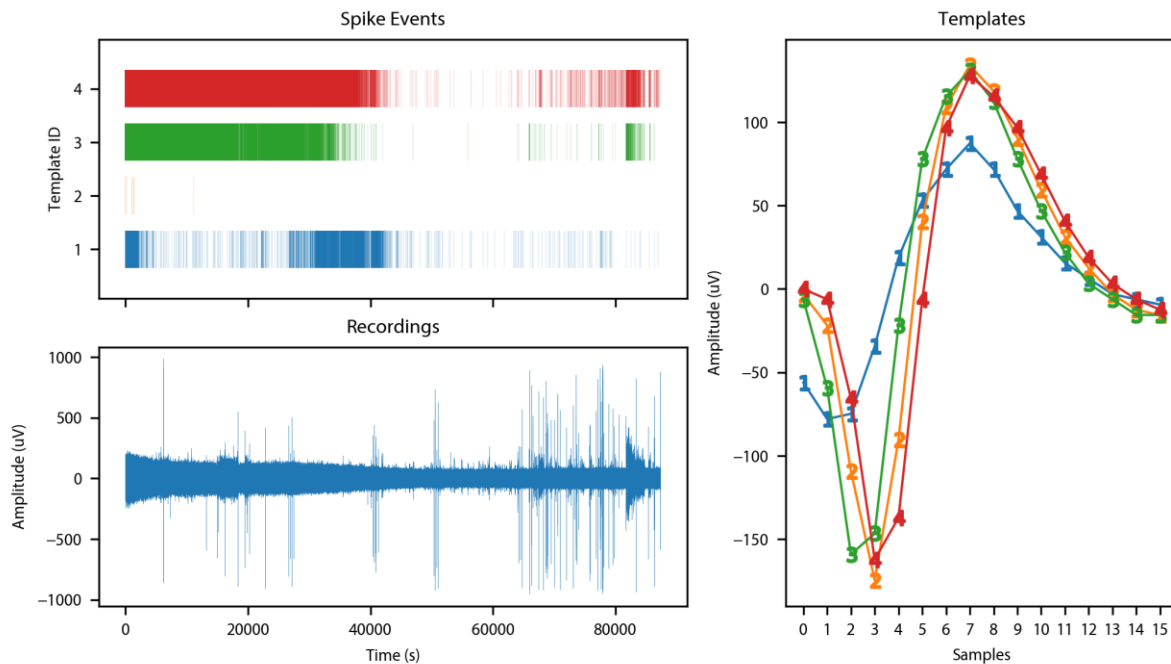
FAQ

FX3 loses its firmware

In rare cases, the EEPROM in FX3 gets corrupted and requires reprogramming.

1. Short PMODE J4 on the the blue FX3 board.
2. Open CyControl.exe. Select Cypress FX3 USB BootLoader Device
3. Then select Program → FX3 → I2C EEPROM

4. Then in the browse image window select "USBridge_v2.img" and wait for the programming to finish.
5. Remove jumper on PMODE J4 and power cycled the board. It should now populated as "Cypress FX3 USB BulkloopExample Device"

Realtime display doesn't show any track

Press reset button next to the USB connector on FX3 and power cycled the system incl. headstage.

How to undo template generation changes

There is no method to undo changes in this version. You must reprocess the data again using the GUI. The generated working folder <timestamp>_op must be deleted first before reclustering.

SD card recording keep overflow (red light constantly on)

Make sure the SD card is U3 grade. Then use SD Formatter from https://www.sdcard.org/downloads/formatter_4/index.html to format the SD card with Format Size Adjustment on in the option. If Full Erase (Quick) is supported by the host system, it should also be set to on. Note that some microSD card adapter might not populated the microSD card as a SD card but as a Mass storage device which can cause problem doing Full Erase.

SD card recording doesn't start (green light does not go off)

Make sure the SD card is properly formatted otherwise see How to undo template generation changes

There is no method to undo changes in this version. You must reprocess the data again using the GUI. The generated working folder <timestamp>_op must be deleted first before reclustering.

1. SD card recording keep overflow (red light constantly on) for formatting advice.
2. Make sure auto_run.bin and asic_cfg.bin are in the root of SD card for recording raw signal; auto_run.bin and asic_cfg.bin and fpga_cfg.bin are in the root folder for recording spike events or mixed stream of raw signal and spike events.
3. Make sure auto_run.bin can be opend in a text editor and there is only a number which is either 1 or 2 or 3.
4. If problem not resolved, send Song (s.luan@ic.ac.uk) an email with all three binary files.

SD card recording files are created but has 0kB size

1. Make sure FX3 is not connected to the headstage when you want to auto start recording from SD card.
2. Try to reset FX3 and power cycled the whole system

Change a SD card or formatted SD card following advice in How to undo template generation changes

There is no method to undo changes in this version. You must reprocess the data again using the GUI. The generated working folder <timestamp>_op must be deleted first before reclustering.

3. SD card recording keep overflow (red light constantly on)
4. If problem not resolved, send Song (s.luan@ic.ac.uk) an email with all three binary files.

Data corrupted by SD card recording spike noise

Try not to record to SD card when power is supplied from USB.

How to delete a template

Since the template is auto generated by wave_clus, changing temperature cannot guarantee the deletion of the selected template. The best way is to set matching threshold to 0 in the corresponding template and click Apply in the corner of that section.
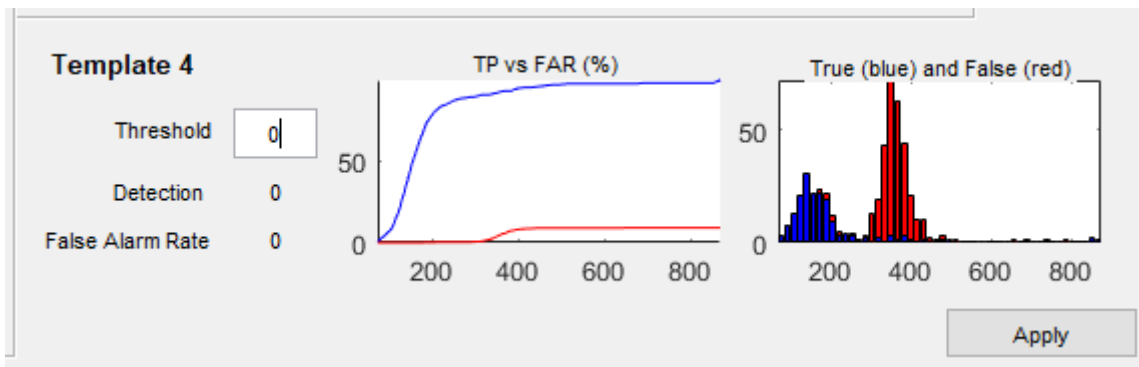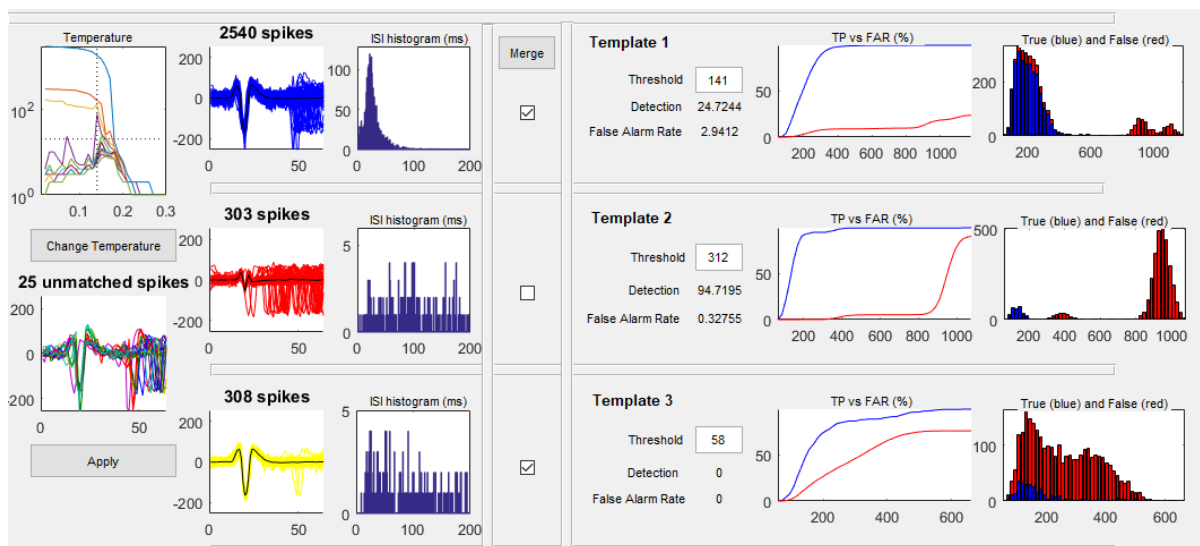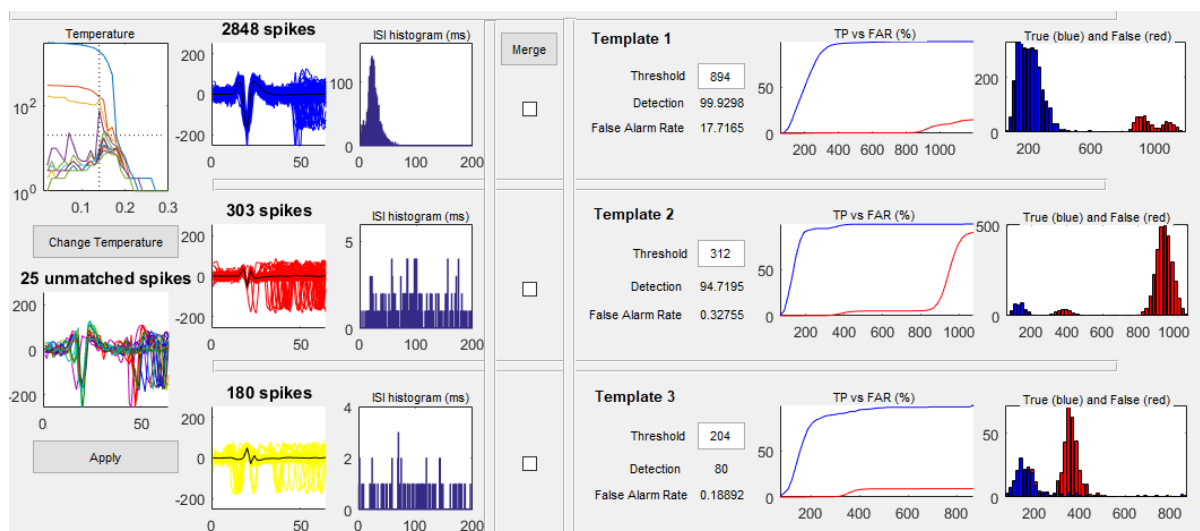
How to merge templates

Tick the templates that you want to merge and then click merge. Note that the merge cannot be undone. It is based on the average of two generated templates and a relaxed matching threshold.

For example, a merge of template 1 and 3 are shown as before merging:

After merging: Note the change in matching threshold.

Revision History

R0.1   2017/08/22   Created by Song Luan