

# fNIRS實驗操作技巧

## 近紅外腦功能資料處理工作坊

[http://www.ym.edu.tw/~cflu/CFLu\\_course\\_fnirsWorkshop.html](http://www.ym.edu.tw/~cflu/CFLu_course_fnirsWorkshop.html)

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# 講習內容安排

- 09:10~11:00 fNIRS原理簡介
- 10:10~11:00 fNIRS實驗設計
- 11:10~12:00 fNIRS探頭擺放設計與位置確認
- 12:00~13:30 用餐與休息**
- 13:30~14:20 fNIRS實驗操作技巧
- 14:30~15:20 fNIRS標準訊號處理流程
- 15:30~16:20 fNIRS數據結果呈現與相關性分析

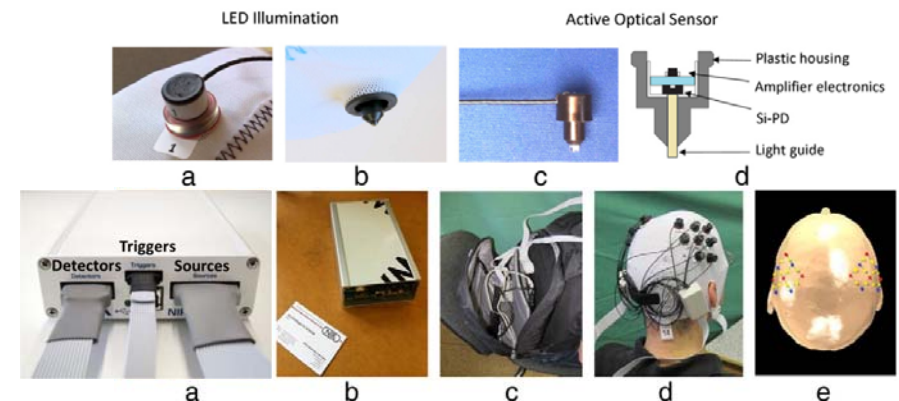
# 實驗操作技巧 以NIRSport 88, NIRx tech. 為例



### NIRSport System Specifications

- Dimensions: 105 mm x 170 mm x 40 mm (3.9" x 6.7" x 1.6")
- Weight: 350 g
- Power Consumption: 3 W
- No. of Detector Channels: 8
- Sensitivity: < 1 pW
- Dynamic Range: 60 dBopt
- Sensor Type: Si Photodiode, active sensor
- No. of Illumination Sources: 8(Time-Multiplexed)
- Wavelengths: 760 nm, 850 nm
- Sampling rate: 62.5 Hz
- Emitter Type: LED
- Host Connection: USB 2.0 data + USB 2.0 power

# Si-PD Detectors

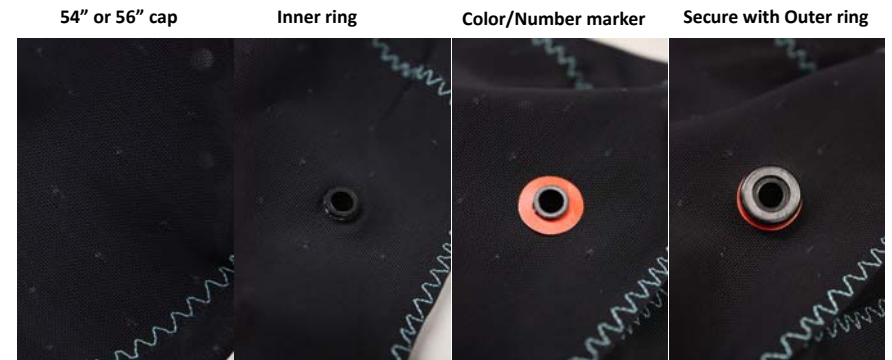


Piper et al., Neuroimage 2014.

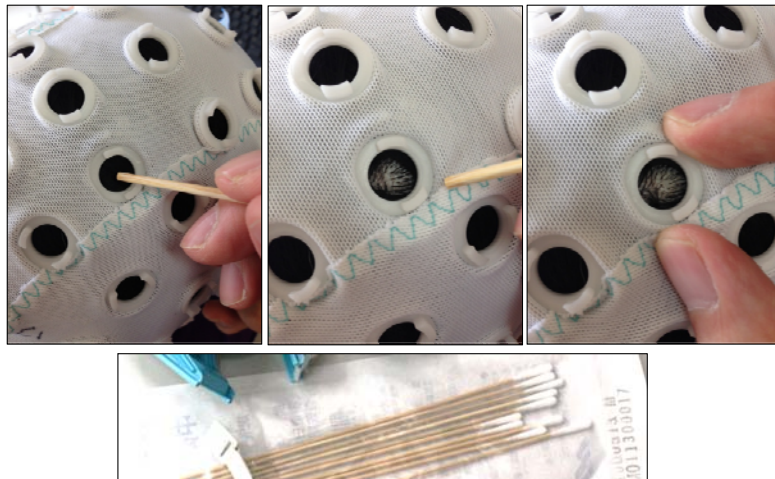
# Optode Positioning



# Optode Positioning



# Remove the interference from hair



# Optode Positioning



# Trigger Inputs

## Logic level

- Positive edge triggered (low-to-high transitions)

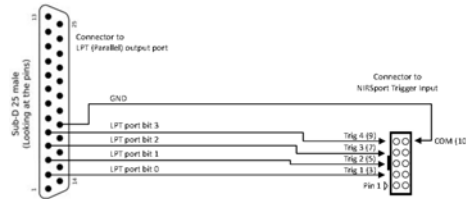
## Minimum pulse duration

- At least 10 ms long

## Maximum pulse duration

- No restriction
- Pulse separation at least 200 ms

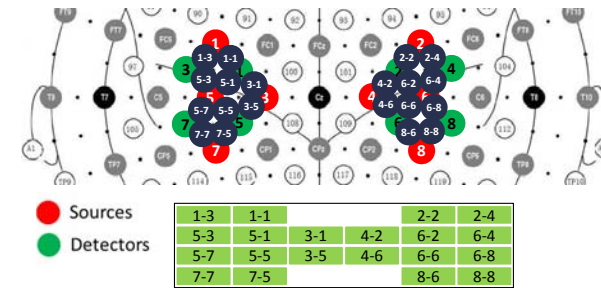
25-pin LPT parallel port



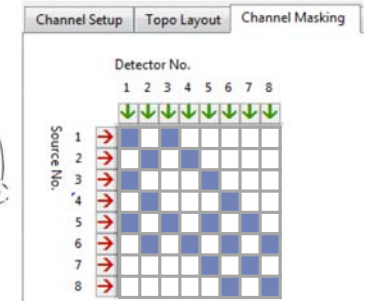
# S-D Configuration

## Channel Masking

- Only for display
- Automatically adopted from the **Topo Layout**



20 effective channels



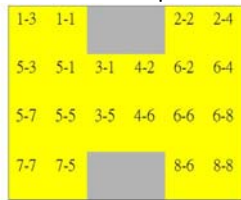
# Setup Calibration

Reduce hair interference

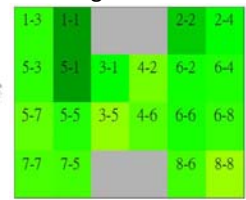
Attach optodes to scalp

Adjust LED modulation (Configure Hardware → Advanced)

Gain Maps



Signal Levels



Signal-to-Noise Ratios



Gain Level SNR 700nm 850nm

Gain Level SNR 700nm 850nm

Gain Level SNR 700nm 850nm

# Signal Recording

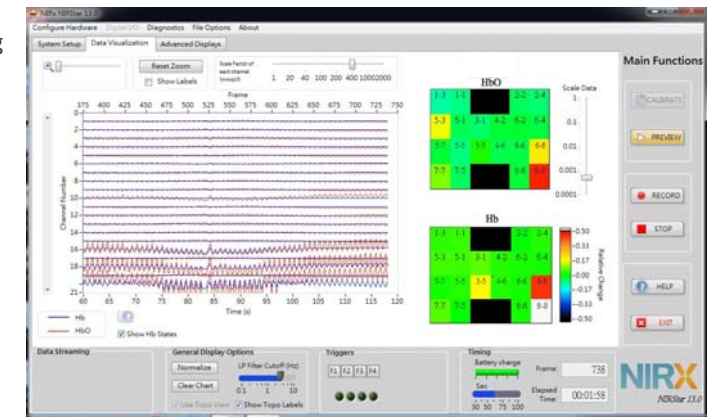
## Check signal quality

- Heart beats
- Baseline drifting
- Amplitudes

## Normalize

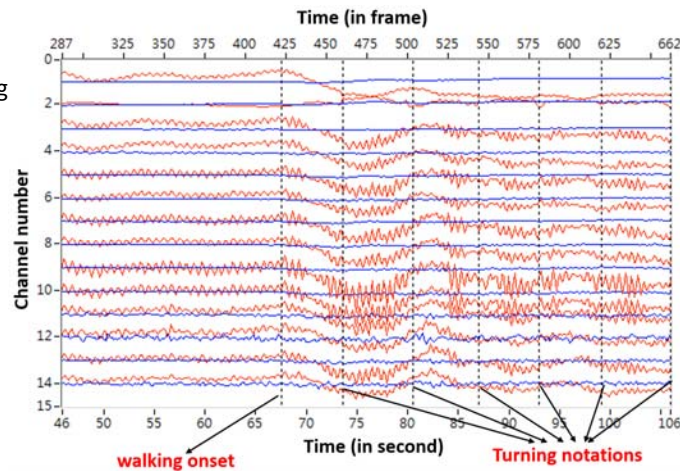
## LP filter cutoff

## Event Triggers



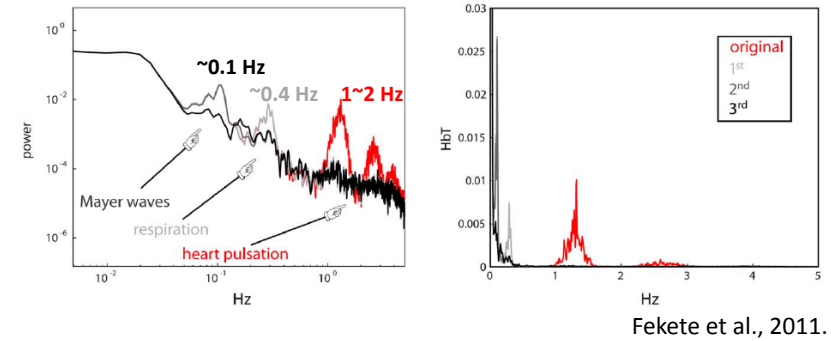
## Signal Recording

- Heart beats
- Baseline drifting
- Amplitudes
- Event triggers

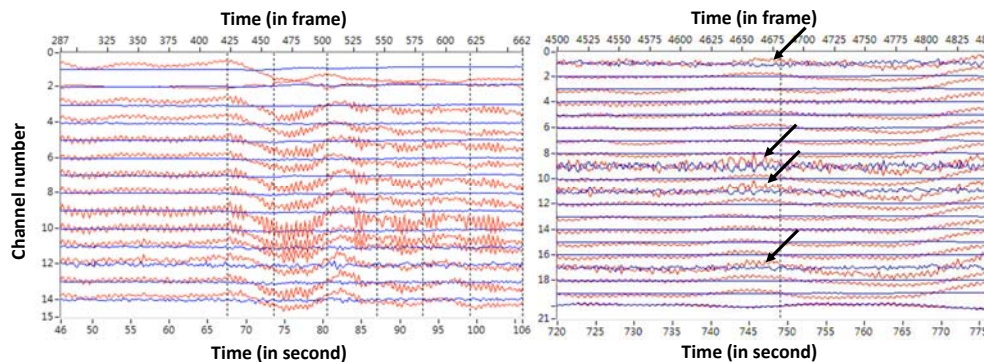


## Physiological components

- Heartbeat, respiration, and blood pressure (Mayer waves)



## High-Frequency Noise



## Motion Artifacts

Movement of head, eyebrows, or the jaw

- A decoupling between the source/detector optodes and the scalp

Signal artifacts

- A high-frequency spike
- A shift from the baseline intensity
- Low-frequency variations

## Motion Artifacts

Different shapes, frequency content, and timing

High amplitude, high frequency spikes

- Easily detectable

Lower frequency content

- Be harder to distinguish from normal hemodynamic signals

Data-dependent motion correction technique is demanded

## Motion Artifacts

Variations between machines, subjects and channels

Machines with miniature design

- Little inertia in inducing optode-scalp decoupling

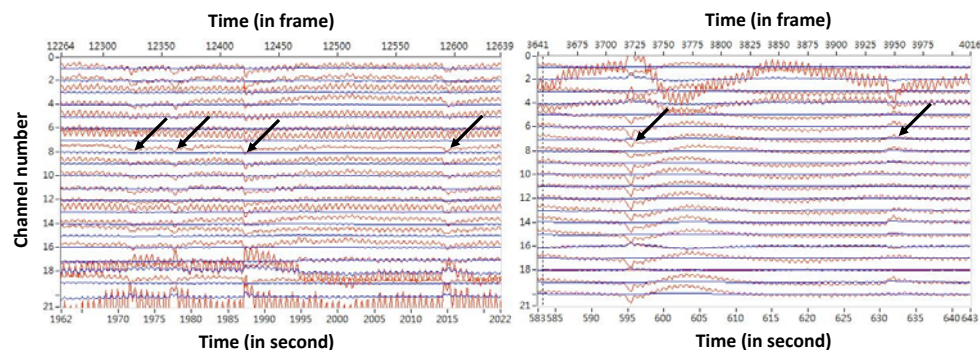
Participants with less hair

- Fiber holder placed more tightly to the head
- Less artifacts motion

Channel variation

## Cross-Channel Artifacts

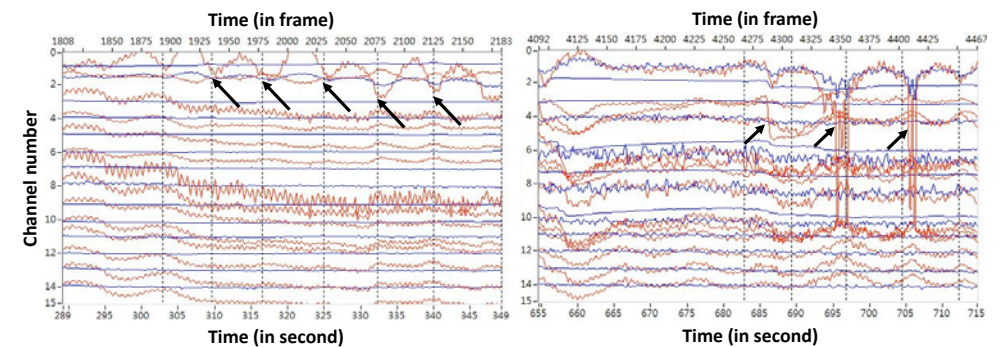
Likely Induced by a head movement.



## Noise/Artifacts

Artifacts caused by the posture changes (turning, sit-to-stand.. etc).

Fractal waves caused by the high-frequency noise.



## Check Data

Confirm the data size and contents.

名稱	修改日期	類型	大小
NIRS-2015-03-20_001.evt	2015/3/20 下午 0...	傳統事件記錄檔	1 KB
NIRS-2015-03-20_001.hdr	2015/3/20 下午 0...	HDR 檔案	2 KB
NIRS-2015-03-20_001.set	2015/3/20 下午 0...	SET 檔案	1 KB
NIRS-2015-03-20_001.wl1	2015/3/20 下午 0...	WL1 檔案	3,785 KB
NIRS-2015-03-20_001.wl2	2015/3/20 下午 0...	WL2 檔案	3,785 KB
NIRS-2015-03-20_001_config.txt	2015/3/20 下午 0...	文字文件	1 KB

## Event Logfile (\*.evt)

(381-256)/6.25Hz  
= 20s

檔案(F)	編輯(E)	格式(O)	檢視(V)	說明(H)
256	1	0	0	0
381	0	0	1	0
494	1	0	0	0
619	0	0	1	0
732	1	0	0	0
858	0	0	1	0
970	1	0	0	0
1096	0	0	1	0
1209	1	0	0	0
1334	0	0	1	0
1447	1	0	0	0
1572	0	0	1	0
1685	1	0	0	0
1811	0	0	1	0
1923	1	0	0	0
2049	0	0	1	0
2162	1	0	0	0
2287	0	0	1	0
2400	1	0	0	0
2525	0	0	1	0

frames  $2^0$   $2^1$   $2^2$   $2^3$

## Load Signal Data

Load \*.wl1 or \*.wl2 using MATLAB

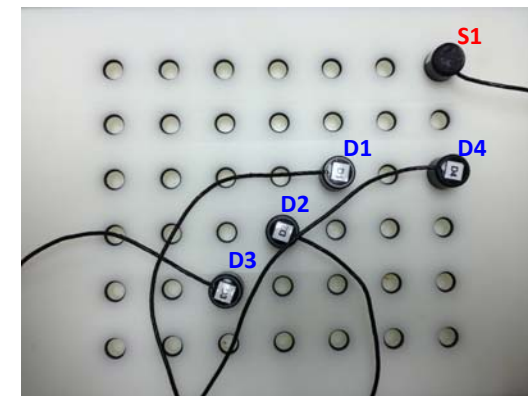
```
>> load('NIRS-2015-05-07_002.wl1')
```

NIRS\_2015\_05\_07\_002 <2655x64 double>

	1	2	3	4	5	6	7	8	9
1	0.1267	0.0055	0.2760	0.0043	0.0069	1.8160e-04	0.0051	0.0085	0.0
2	0.1269	0.0025	0.2770	0.0032	0.0019	6.1700e-05	0.0027	0.0029	0.0
3	0.1269	0.0048	0.2781	0.0042	0.0031	1.6680e-04	0.0023	0.0064	0.0
4	0.1281	0.0031	0.2847	0.0024	0.0030	1.2100e-04	0.0028	0.0041	0.0
5	0.1270	0.0046	0.2760	0.0060	0.0032	1.5530e-04	0.0041	0.0053	0.0
6	0.1255	0.0047	0.2720	0.0046	0.0063	1.4910e-04	0.0046	0.0062	0.0
7	0.1259	0.0021	0.2751	0.0020	0.0032	1.0410e-04	0.0027	0.0056	0.0
8	0.1265	0.0036	0.2804	0.0052	0.0066	1.2870e-04	0.0053	0.0051	0.0
9	0.1271	0.0037	0.2789	0.0031	0.0029	1.2490e-04	0.0031	0.0040	0.0
10	0.1246	0.0036	0.2724	0.0036	0.0043	1.0390e-04	0.0025	0.0046	0.0
11	0.1246	0.0037	0.2727	0.0029	0.0052	1.5860e-04	0.0024	0.0047	0.0
12	0.1250	0.0019	0.2740	1.5430e-04	0.0016	6.3000e-05	0.0014	0.0031	0.0

Time frames x overall channels (8\*8)

## QA of Optodes - Phantom test



- Signal level
- Gain setup
- Noise level



盧家鋒 Chia-Feng Lu, PhD

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## Q & A

Thanks for your attention : )