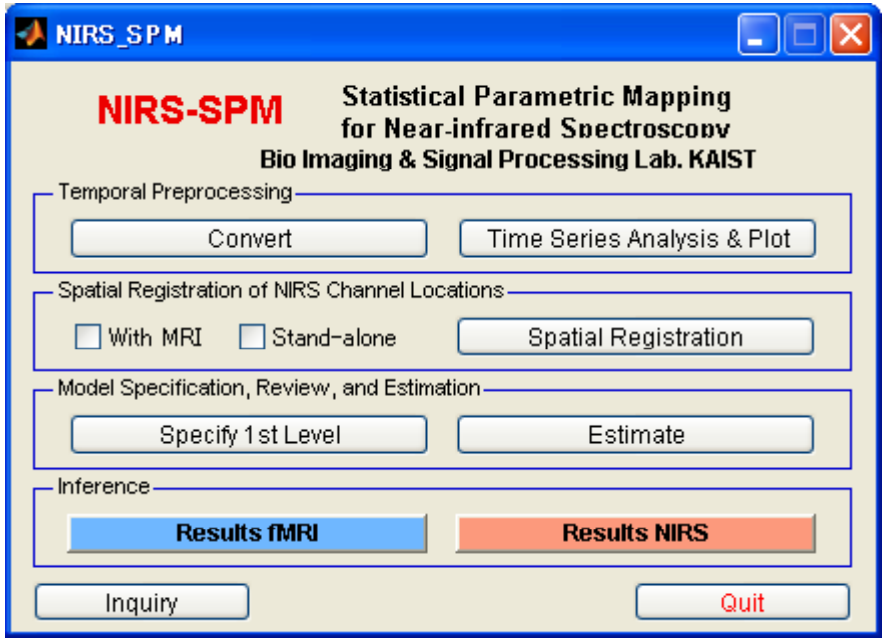
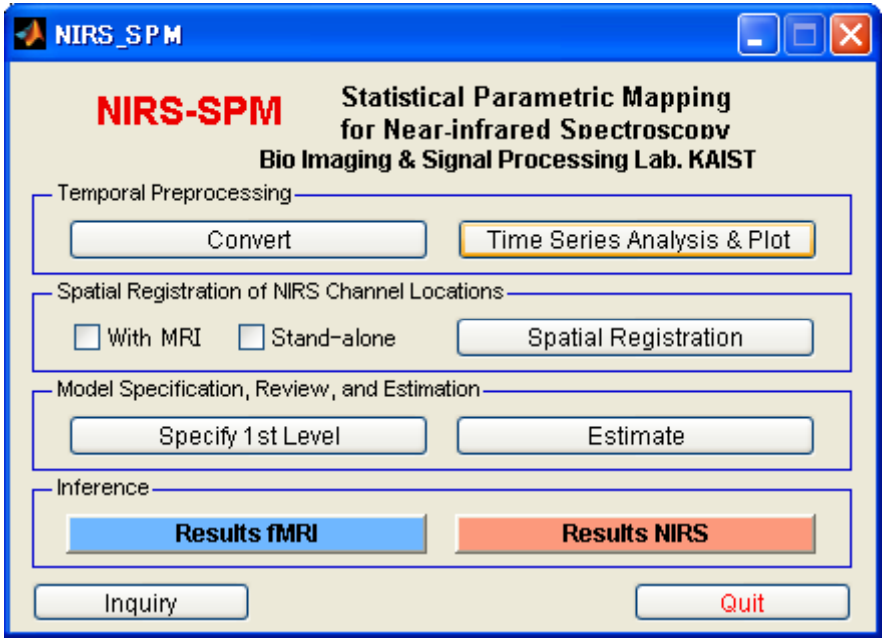
NIRS-SPM Instruction using Shimadzu Data

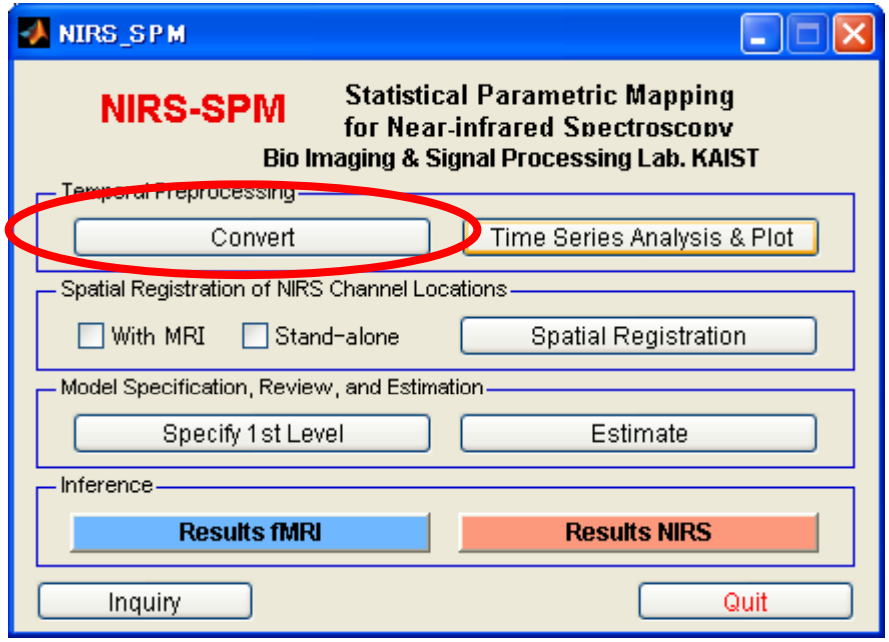


2009/12/07 Akihiro Ishikawa

Main Panel

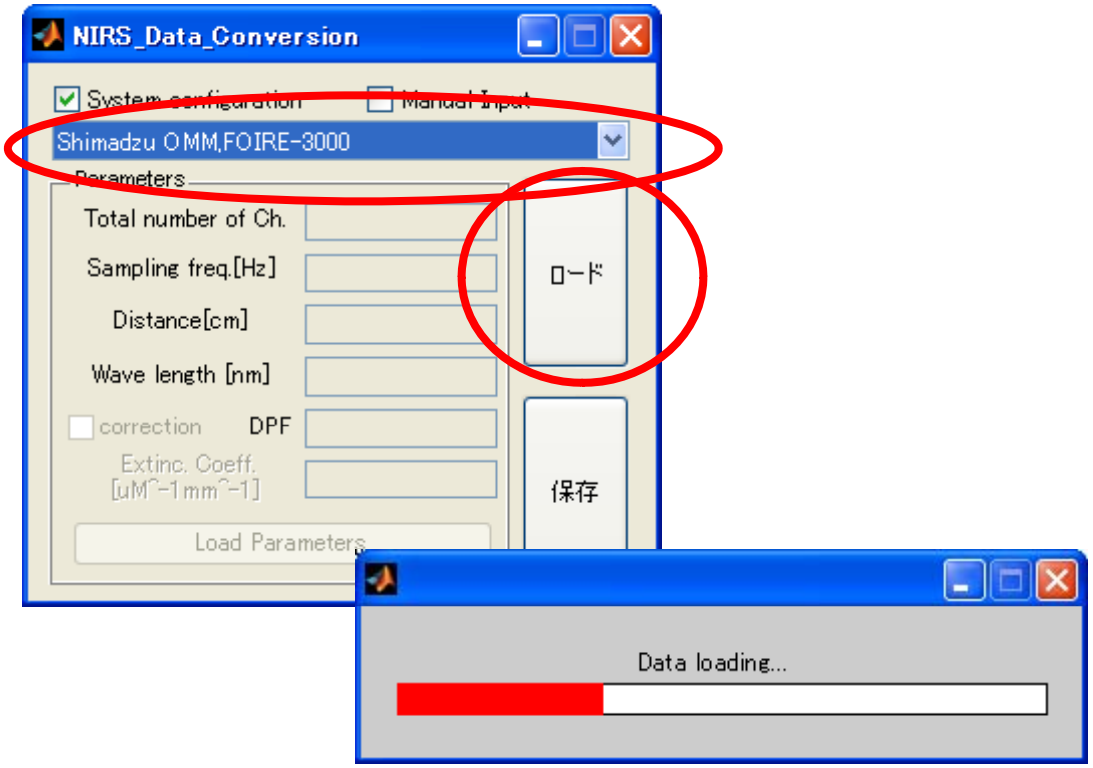

NIRS_SPM
NIRS-SPM
Statistical Parametric Mapping
for Near-infrared Spectroscopy
Bio Imaging & Signal Processing Lab. KAIST
Temporal Preprocessing
Convert
Time Series Analysis & Plot
Spatial Registration of NIRS Channel Locations
With MRI
Stand-alone
Spatial Registration
Model Specification, Review, and Estimation
Specify 1st Level
Estimate
Inference
Results fMRI
Results NIRS
Inquiry
Quit

Convert

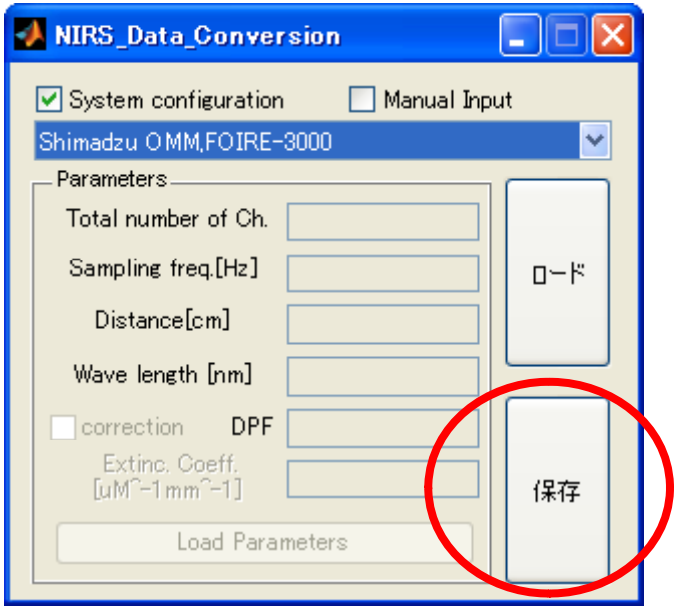

NIRS_SPM
NIRS-SPM
Statistical Parametric Mapping
for Near-infrared Spectroscopy
Bio Imaging & Signal Processing Lab. KAIST
Convert
Time Series Analysis & Plot
Spatial Registration of NIRS Channel Locations
With MRI
Stand-alone
Spatial Registration
Model Specification, Review, and Estimation
Specify 1st Level
Estimate
Inference
Results fMRI
Results NIRS
Inquiry
Quit

Convert

We support to read our data format.

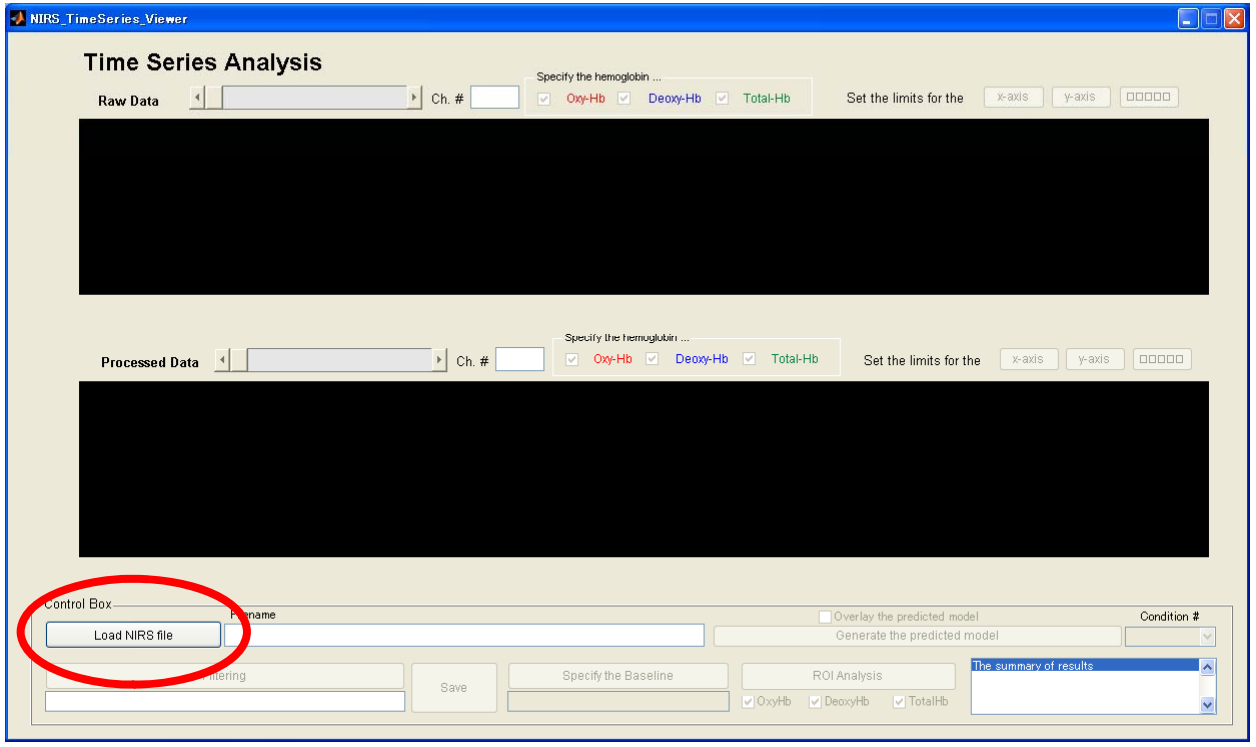


Shimadzu_FT_Right_4x4x2.TXT



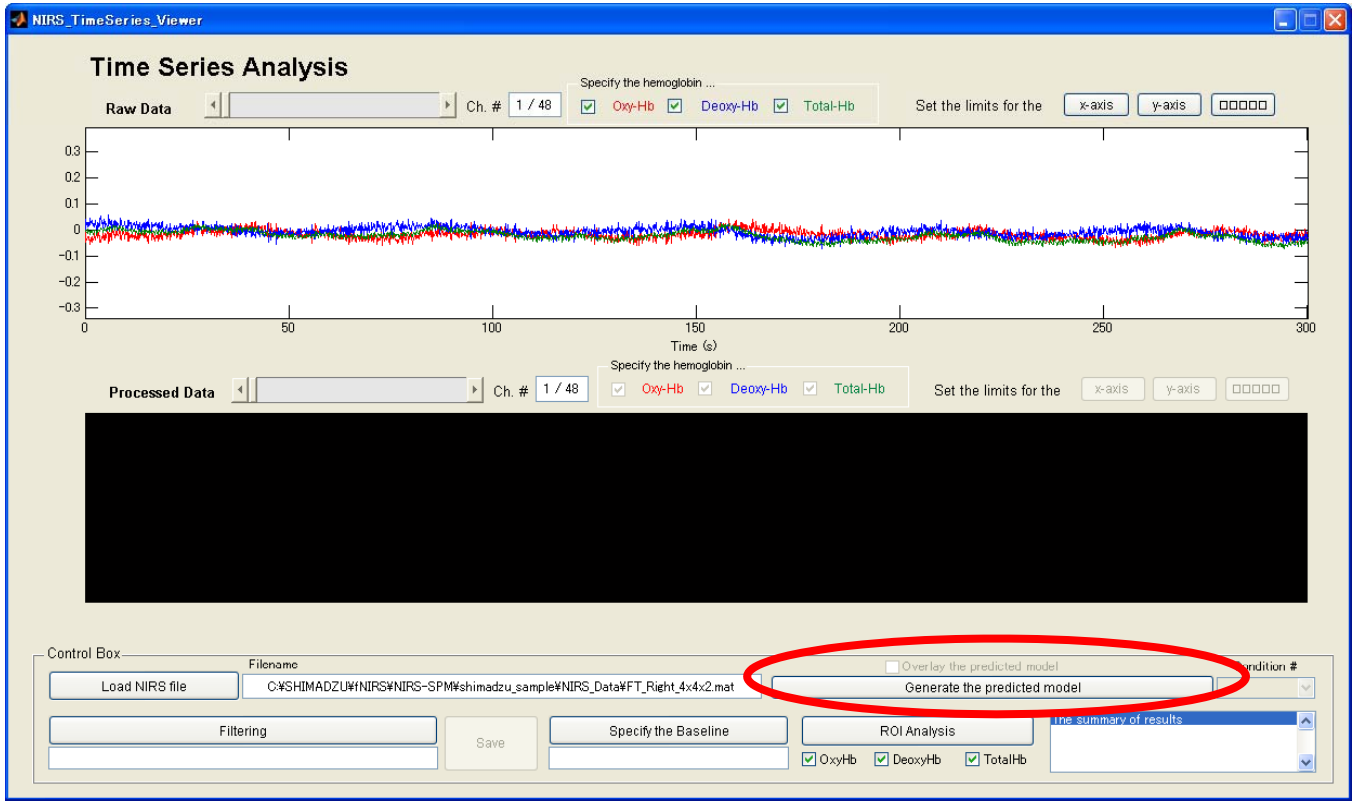
For example…
Shimadzu_FT_Right_4x4x2.mat

Time Series Analysis

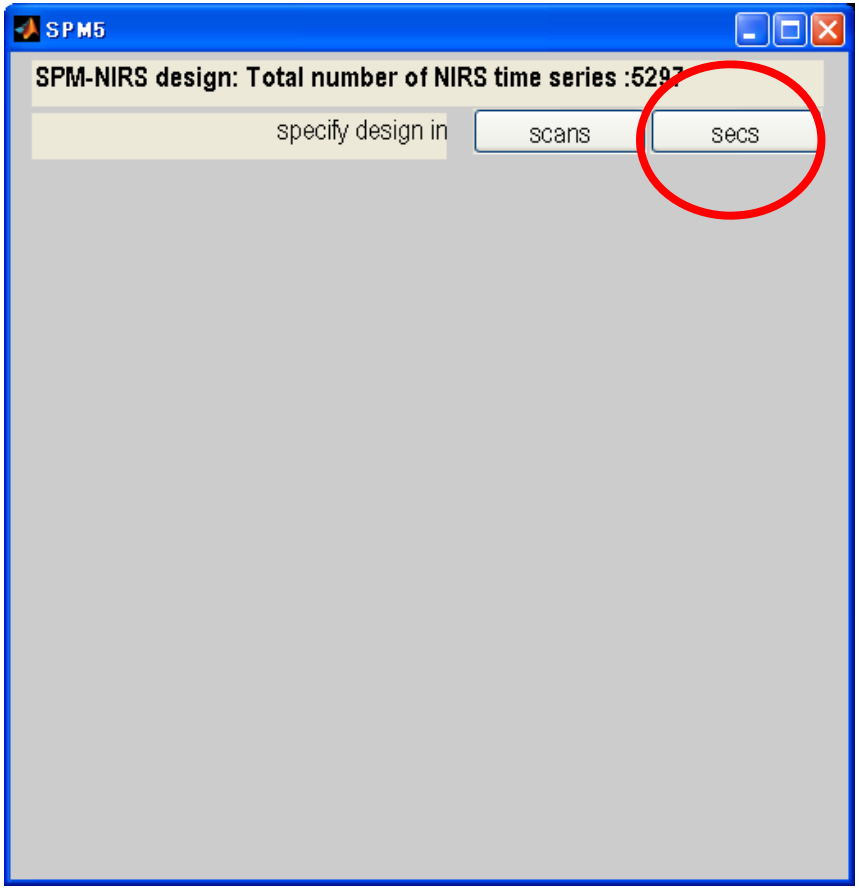


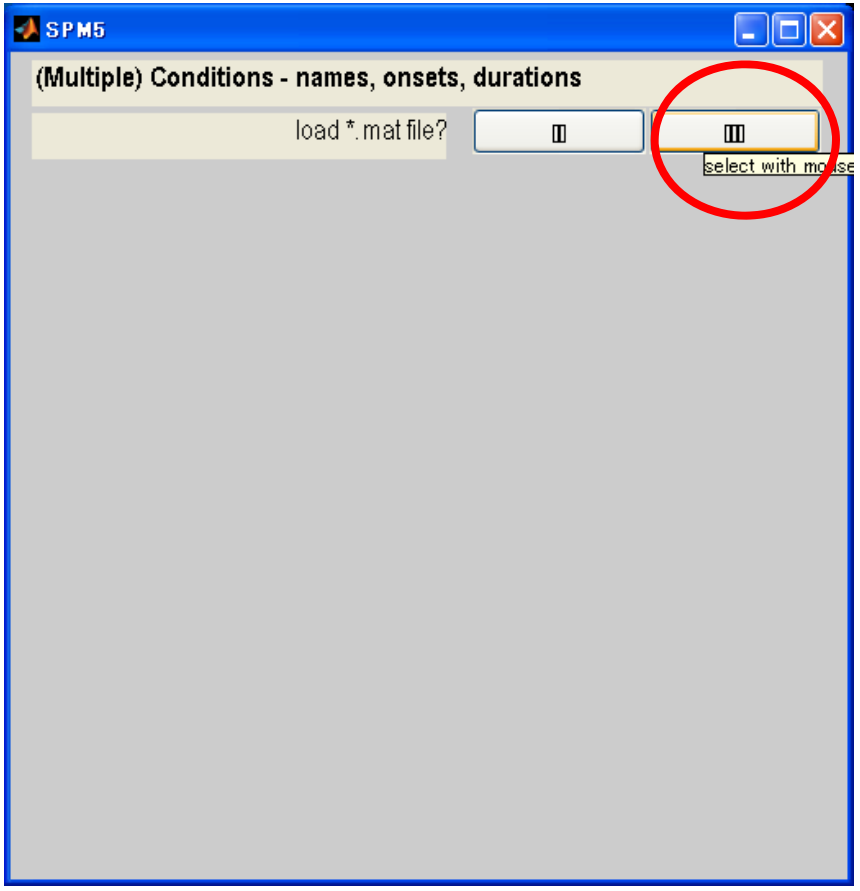
Shimadzu_FT_Right_4x4x2.mat

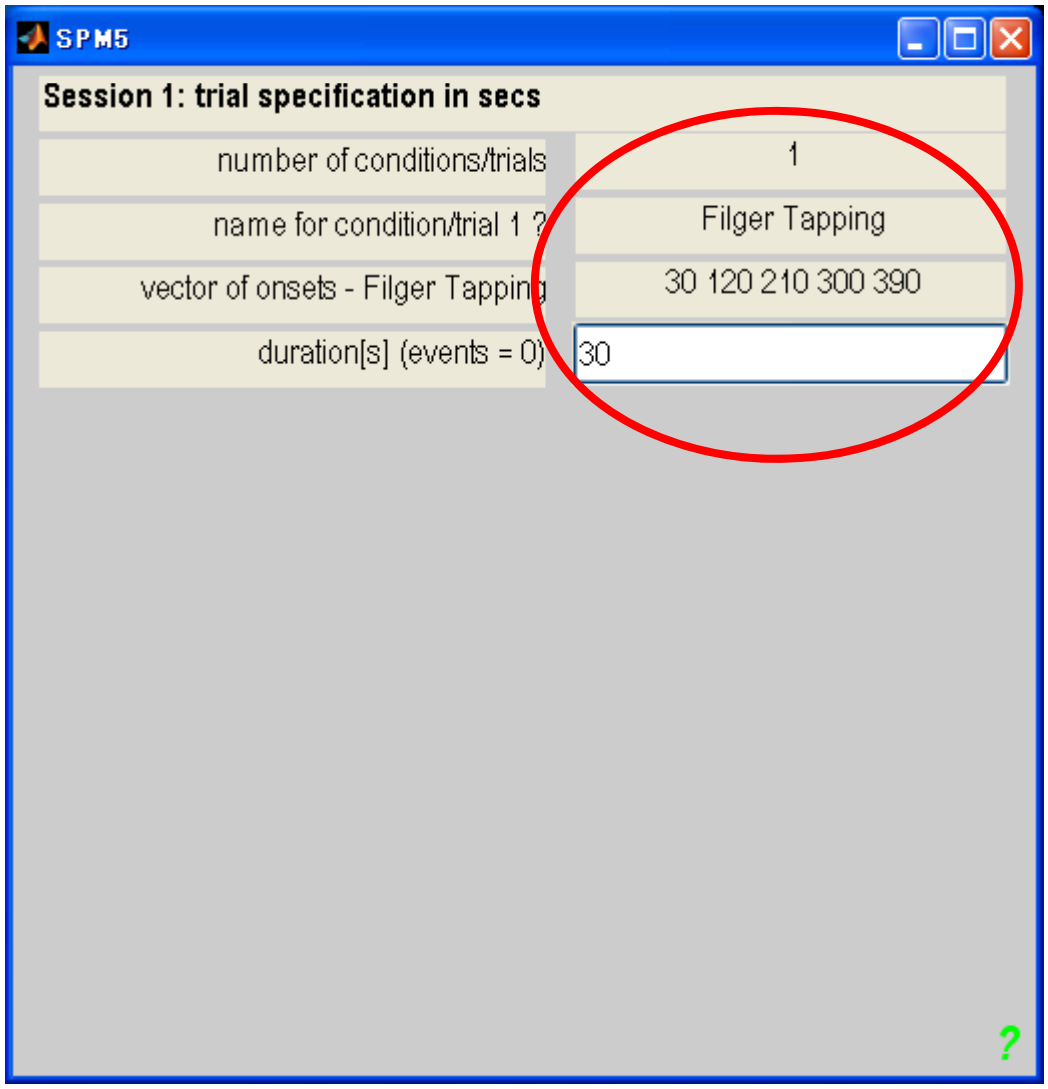
Load NIRS File



Generate the predicated model

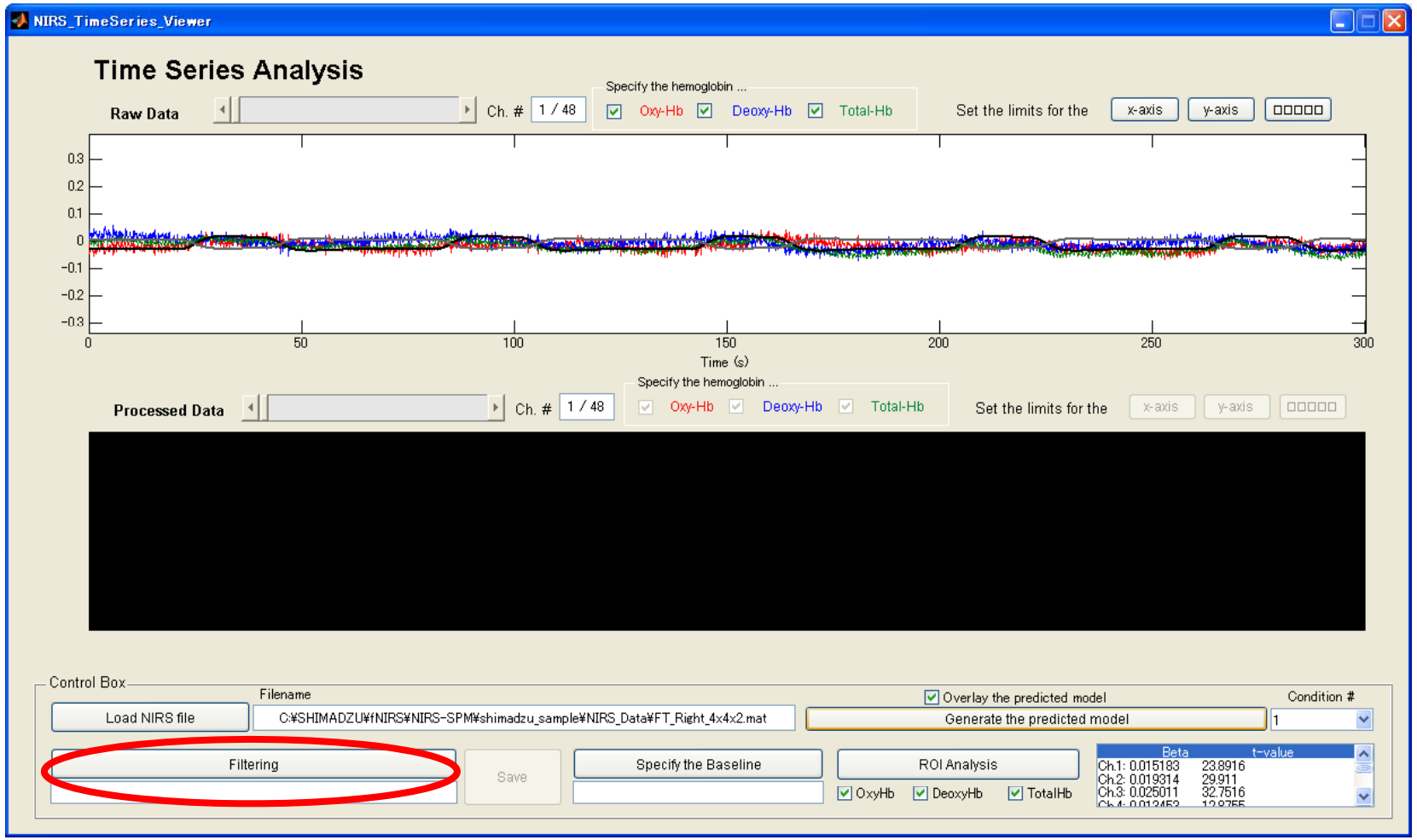




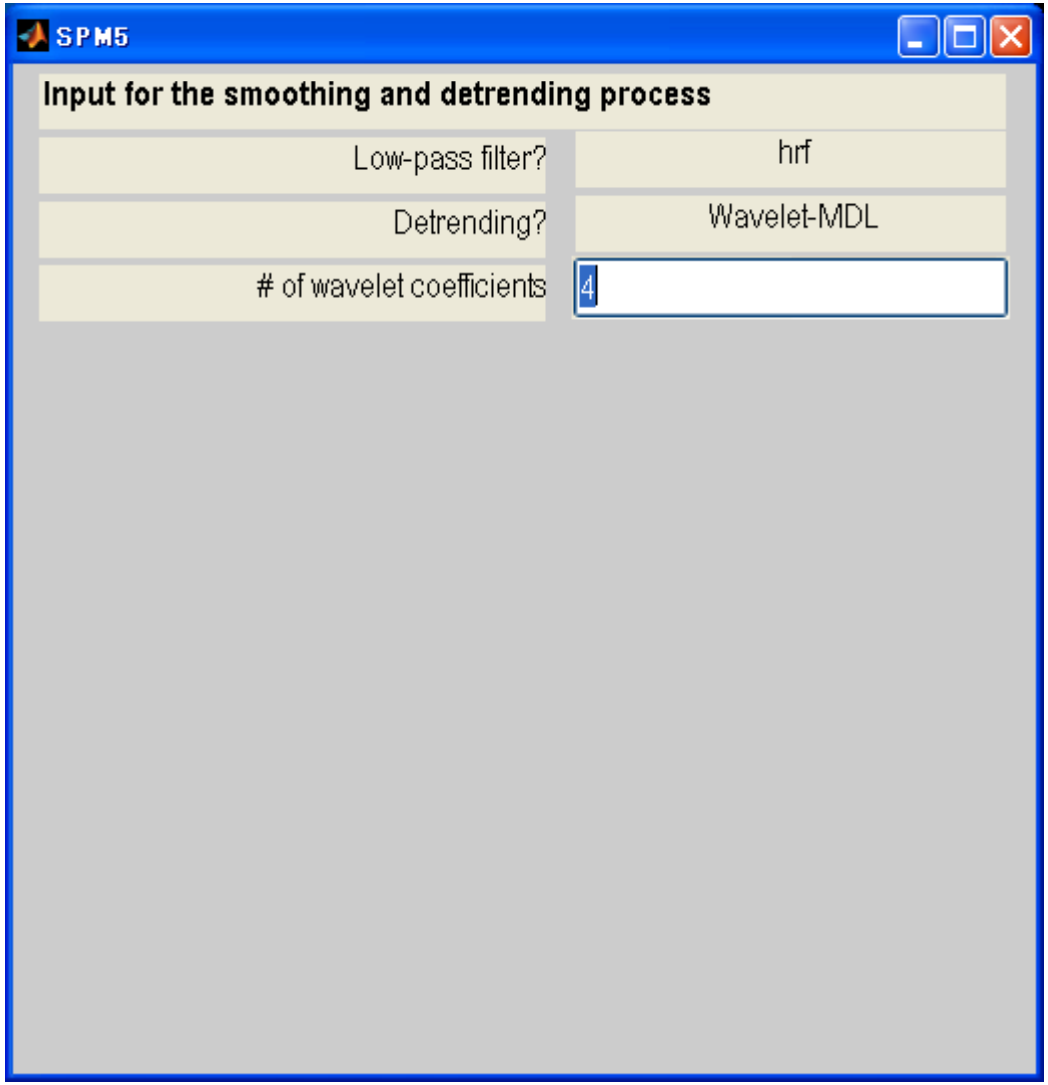


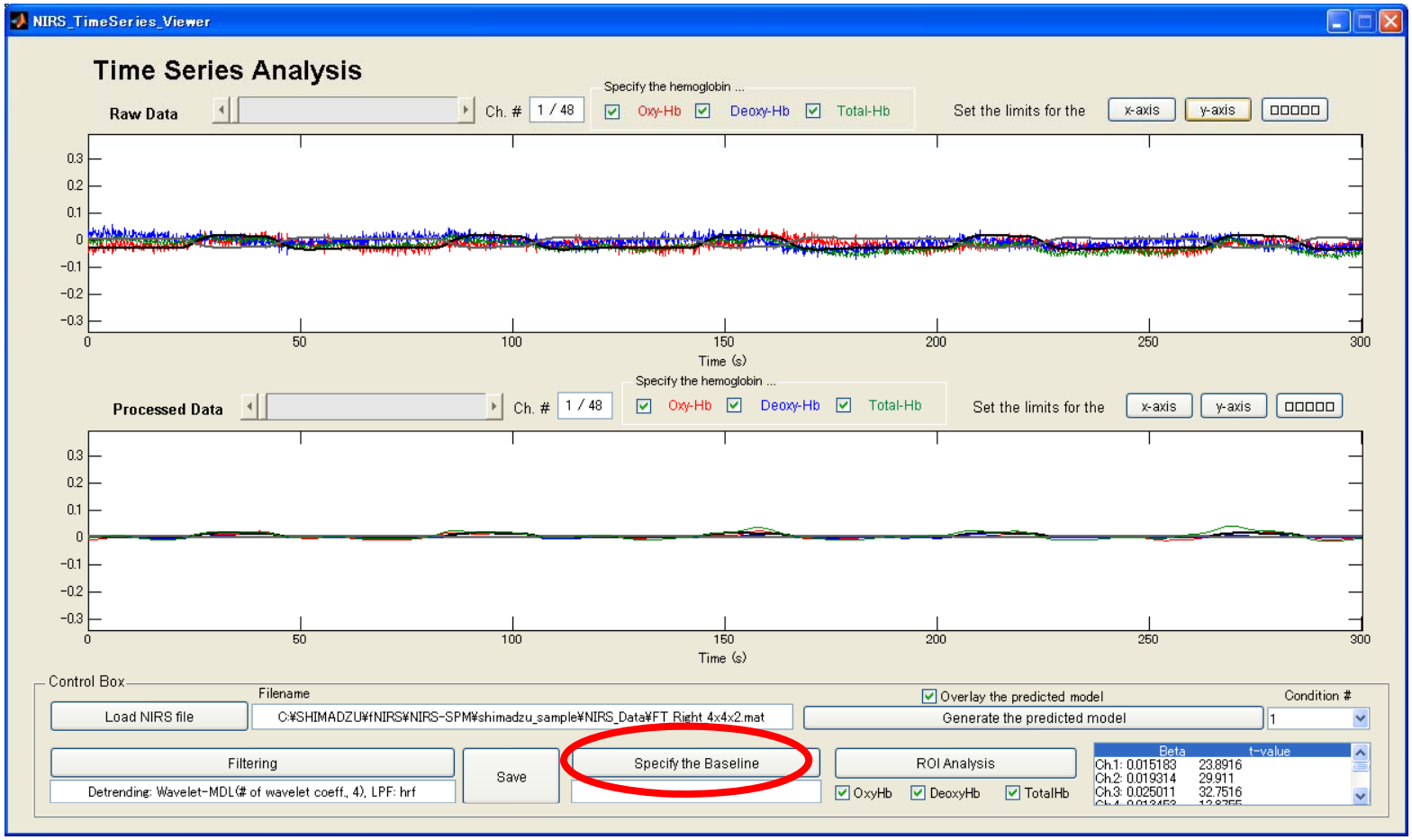
20 80 140 200 260

20

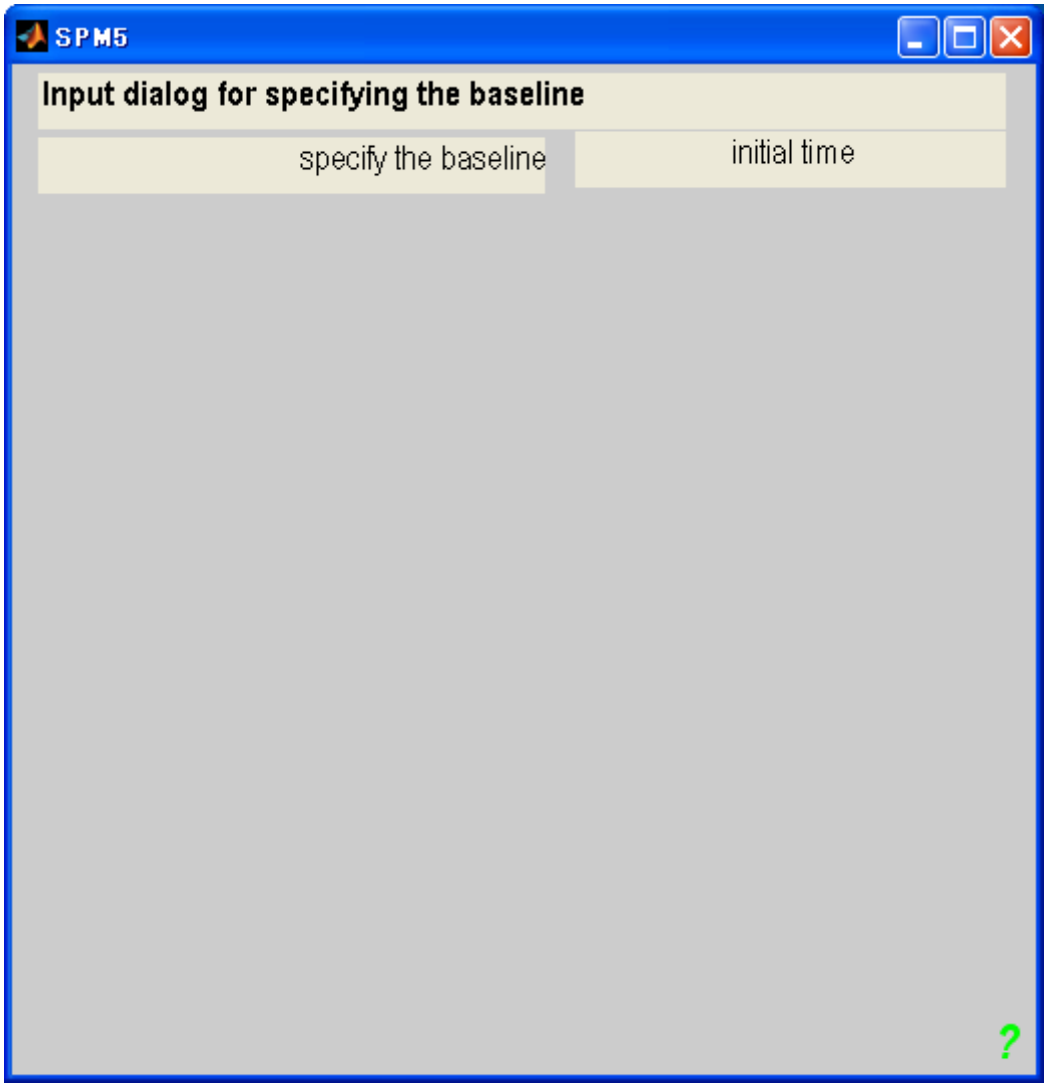

NIRS_TimeSeries_Viewer
Time Series Analysis
Raw Data
Ch. # 1 / 48
Specify the hemoglobin ...
Oxy-Hb
Deoxy-Hb
Total-Hb
Set the limits for the
x-axis
y-axis
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
0
50
100
150
200
250
300
Time (s)
Processed Data
Ch. # 1 / 48
Specify the hemoglobin ...
Oxy-Hb
Deoxy-Hb
Total-Hb
Set the limits for the
x-axis
y-axis
Control Box
Filename
Load NIRS file
C:¥SHIMADZU¥fNIRS¥NIRS-SPM¥shimadzu_sample¥NIRS_Data¥FT_Right_4x4x2.mat
Overlay the predicted model
Generate the predicted model
Condition #
1
Filtering
Save
Specify the Baseline
ROI Analysis
OxyHb
DeoxyHb
TotalHb
Beta
t-value
Ch.1: 0.015183 23.8916
Ch.2: 0.019314 29.911
Ch.3: 0.025011 32.7516

Filtering

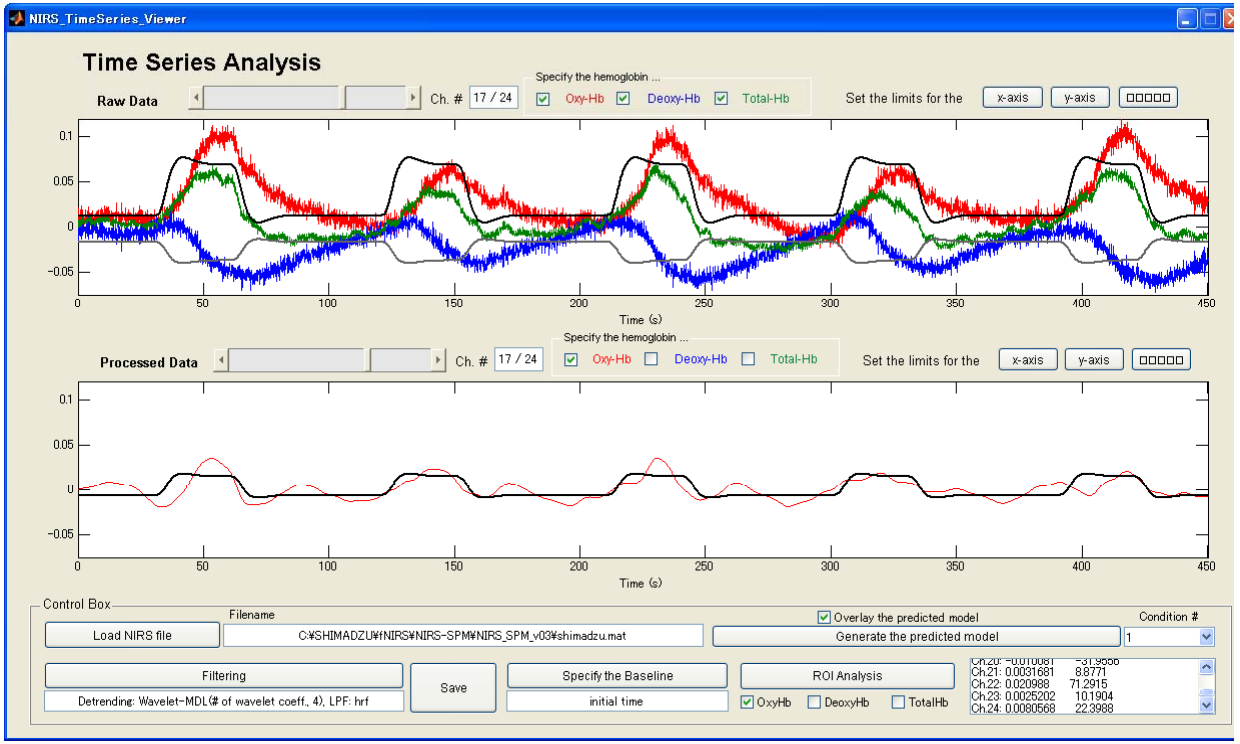

SPM5
Input for the smoothing and detrending process
Low-pass filter?
hrf
Detrending?
Wavelet-MDL
# of wavelet coefficients
4


NIRS_TimeSeries_Viewer
Time Series Analysis
Raw Data
Ch. # 1 / 48
Specify the hemoglobin ...
Oxy-Hb
Deoxy-Hb
Total-Hb
Set the limits for the
x-axis
y-axis
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
0
50
100
150
200
250
300
Time (s)
Processed Data
Ch. # 1 / 48
Specify the hemoglobin ...
Oxy-Hb
Deoxy-Hb
Total-Hb
Set the limits for the
x-axis
y-axis
Time (s)
Control Box
Filename
Load NIRS file
C:¥SHIMADZU¥fNIRS¥NIRS-SPM¥shimadzu_sample¥NIRS_Data¥FT_Right 4x4x2.mat
Overlay the predicted model
Generate the predicted model
Condition #
1
Filtering
Detrending: Wavelet-MDL(# of wavelet coeff., 4), LPF: hrf
Save
Specify the Baseline
ROI Analysis
OxyHb
DeoxyHb
TotalHb
Beta
t-value
Ch.1: 0.015183 23.8916
Ch.2: 0.019314 29.911
Ch.3: 0.025011 32.7516

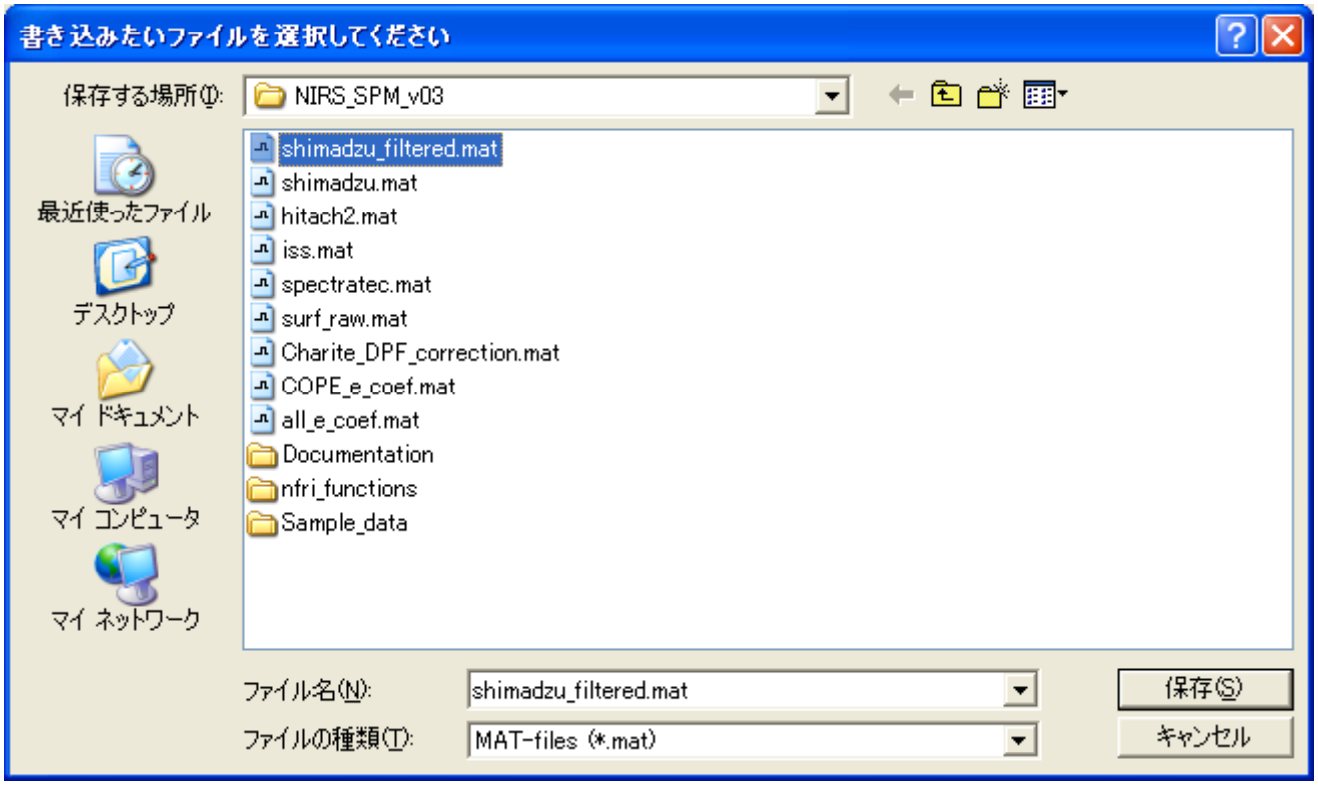
Specify the Baseline



TimeSeries Analysis



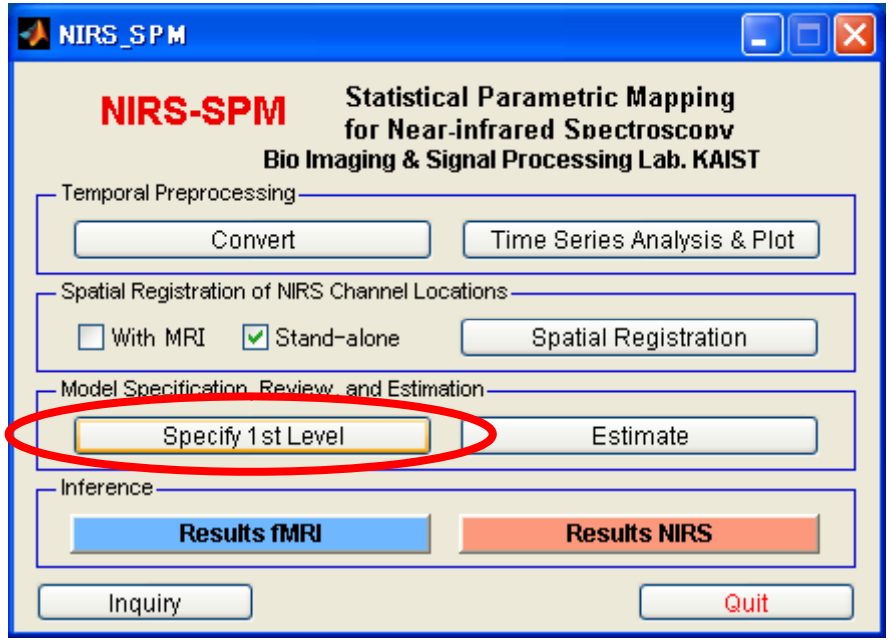
Save



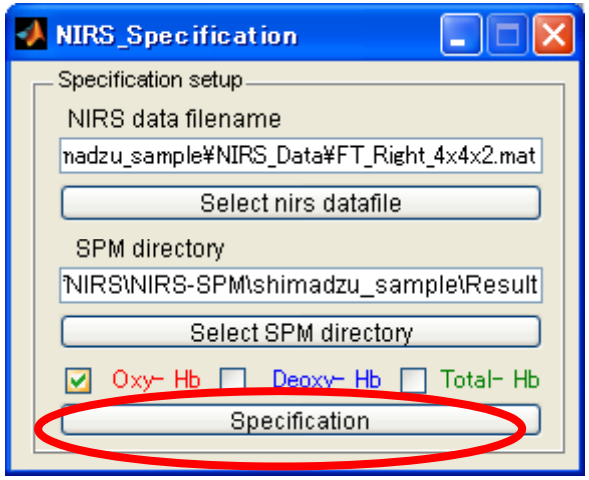
For example….
Shimadzu_Filtered_FT_Right_4x4x2.mat

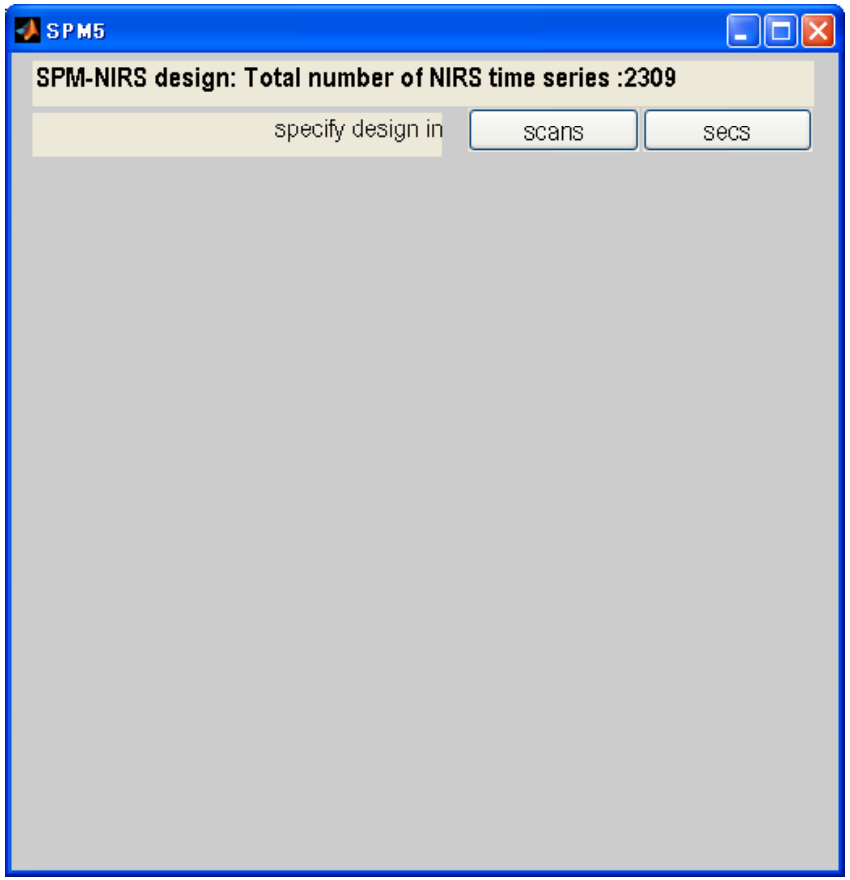
Specify 1st Level

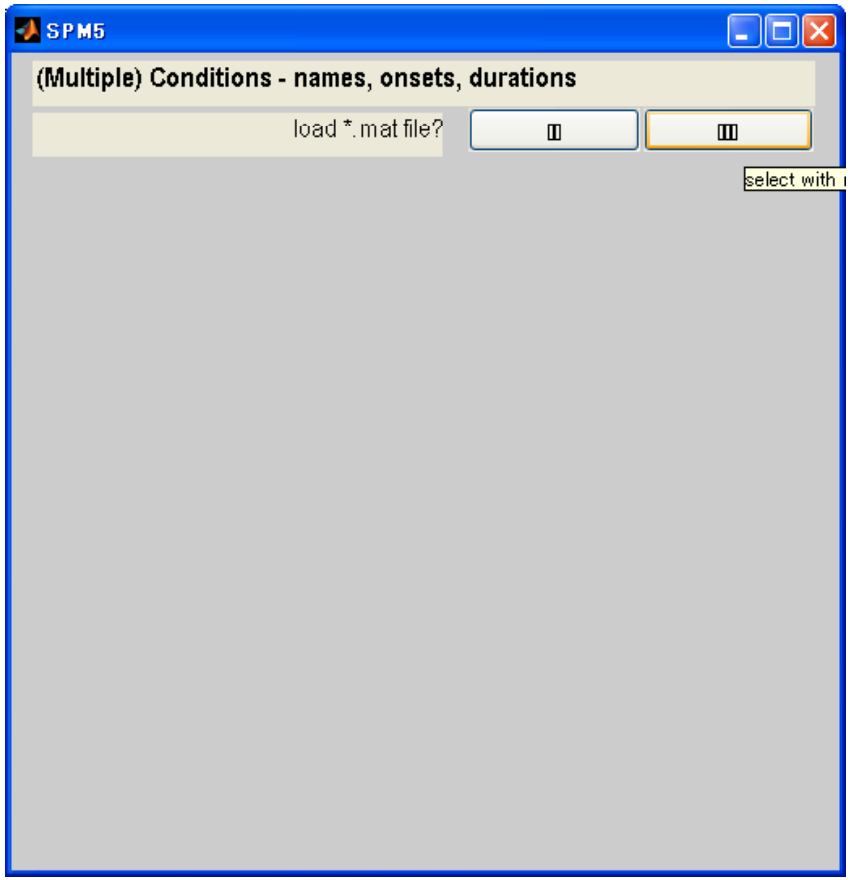
Specify 1st Level

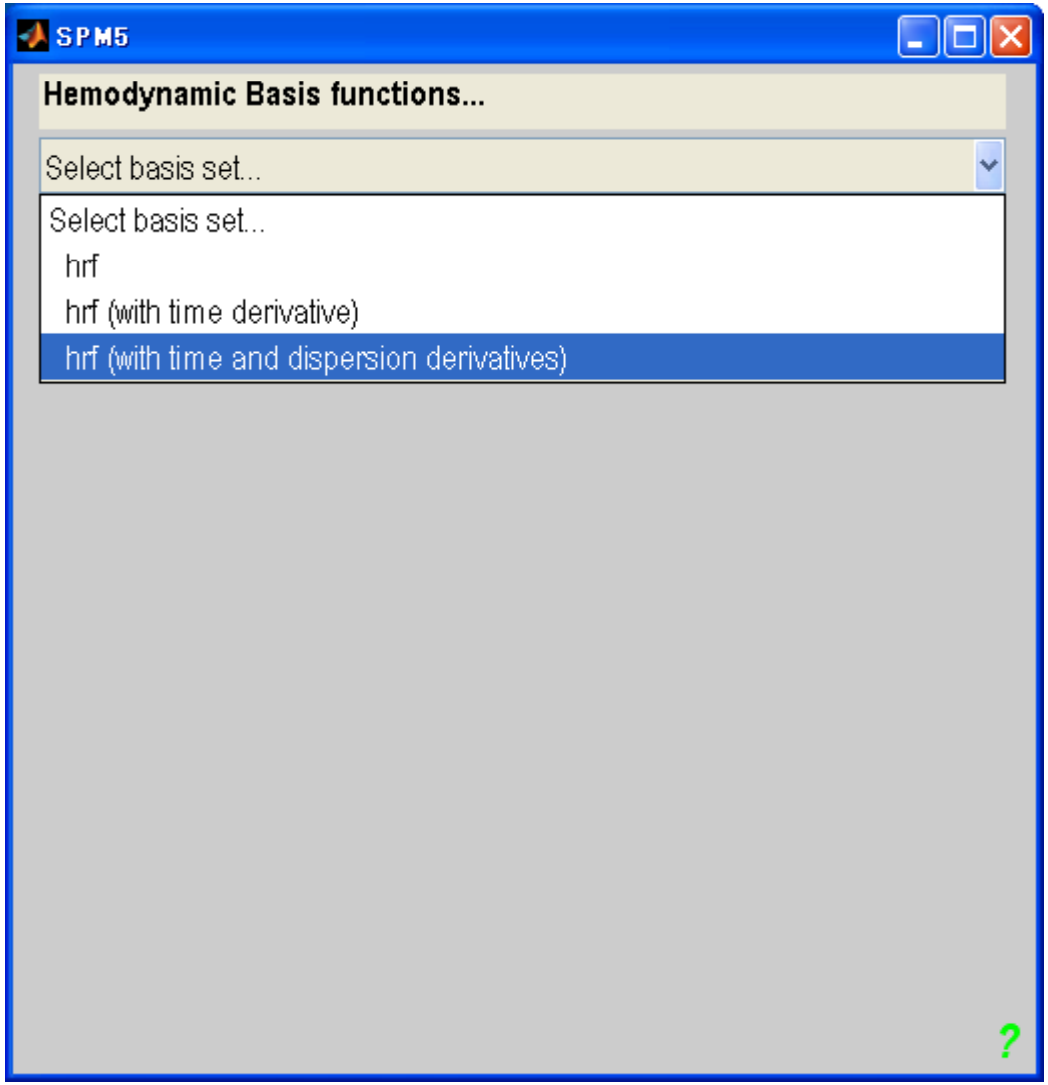


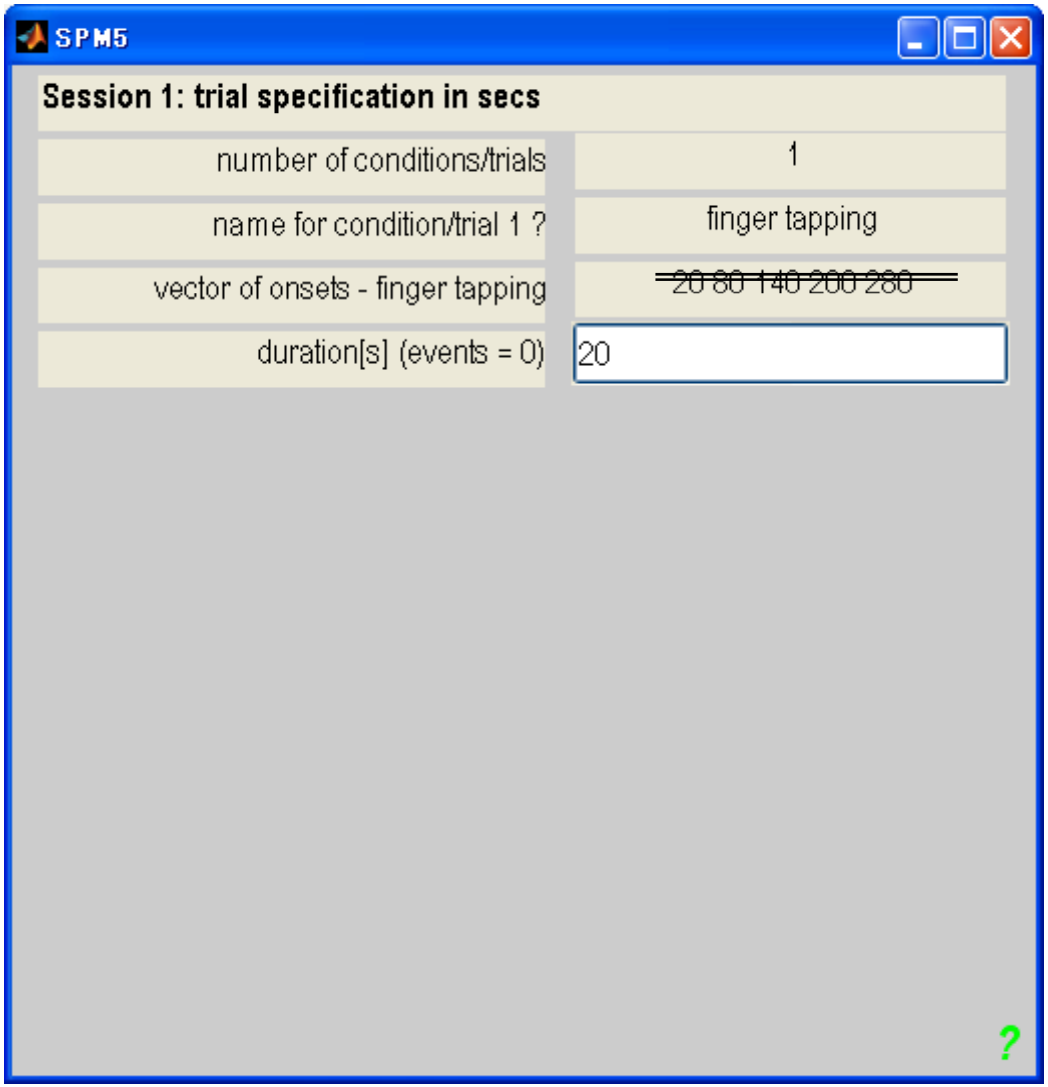
NIRS Specification



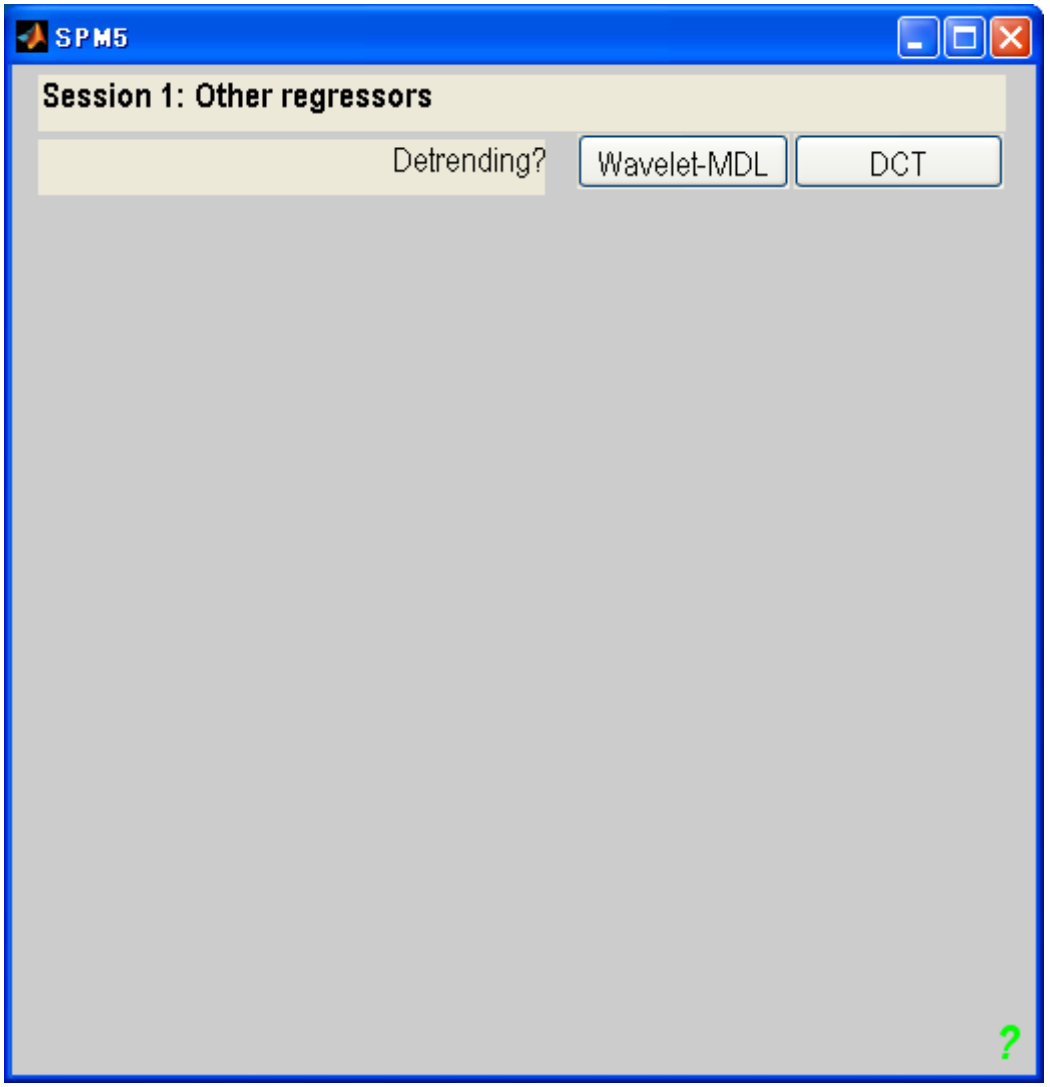

SPM5
SPM-NIRS design: Total number of NIRS time series :2309
specify design in
scans
secs

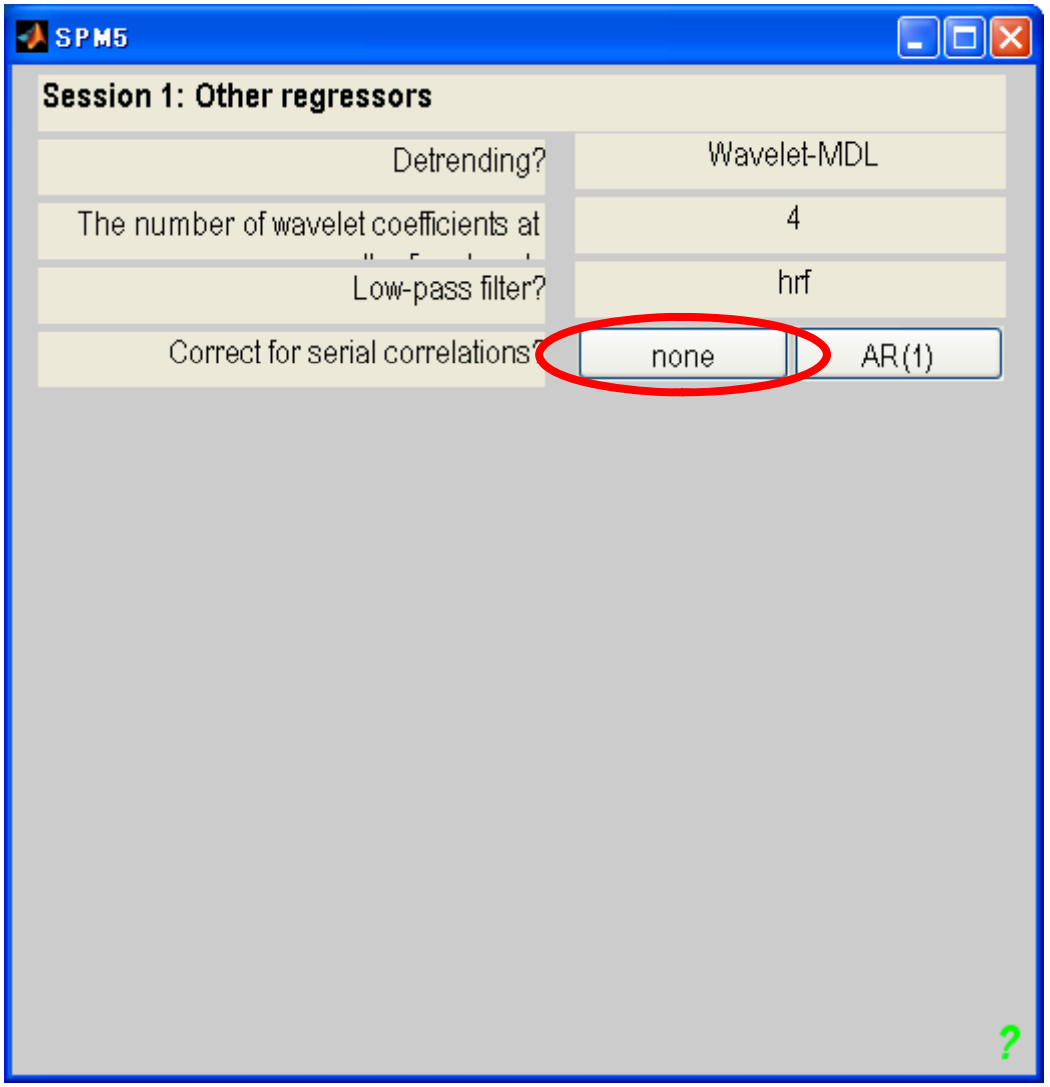

SPM5
(Multiple) Conditions - names, onsets, durations
load *.mat file?
select with

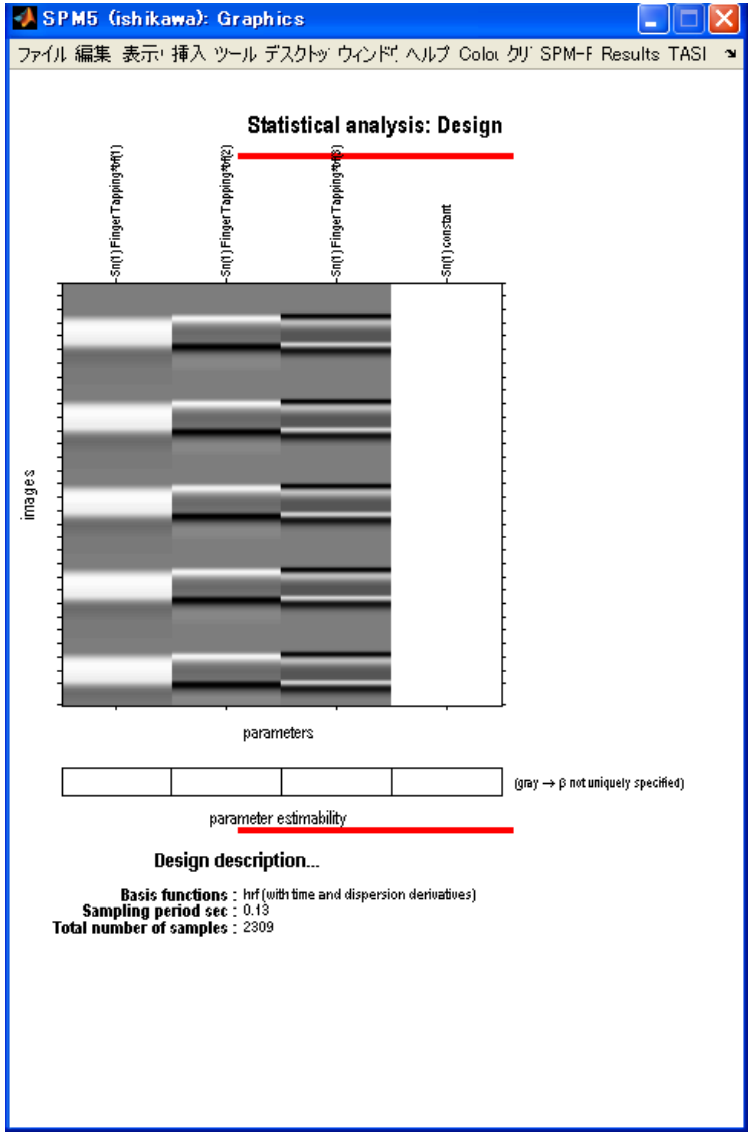

SPM5
Hemodynamic Basis functions...
Select basis set...
Select basis set...
hrf
hrf (with time derivative)
hrf (with time and dispersion derivatives)
?



20 80 140 200 260


SPM5
Session 1: Other regressors
Detrending?
Wavelet-MDL
DCT
?

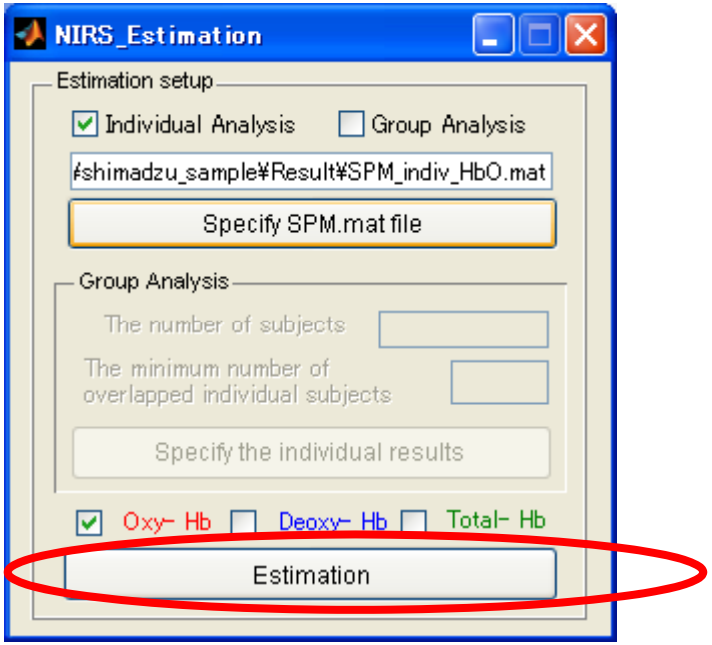

SPM5
Session 1: Other regressors
Detrending?
Wavelet-MDL
The number of wavelet coefficients at
4
Low-pass filter?
hrf
Correct for serial correlations?
none
AR(1)
?

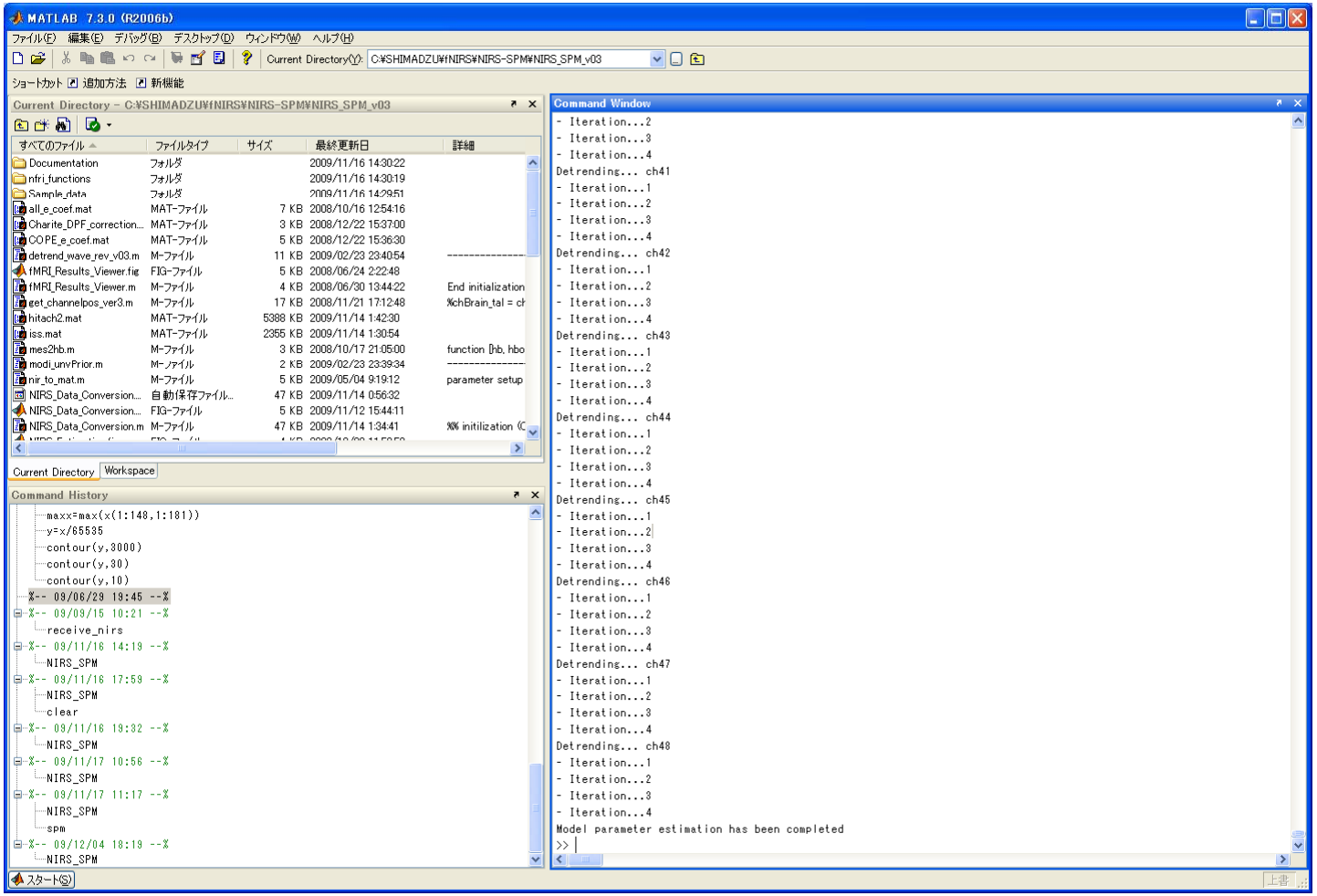


Created SPM_indiv_HbO.mat

Estimate

Estimate

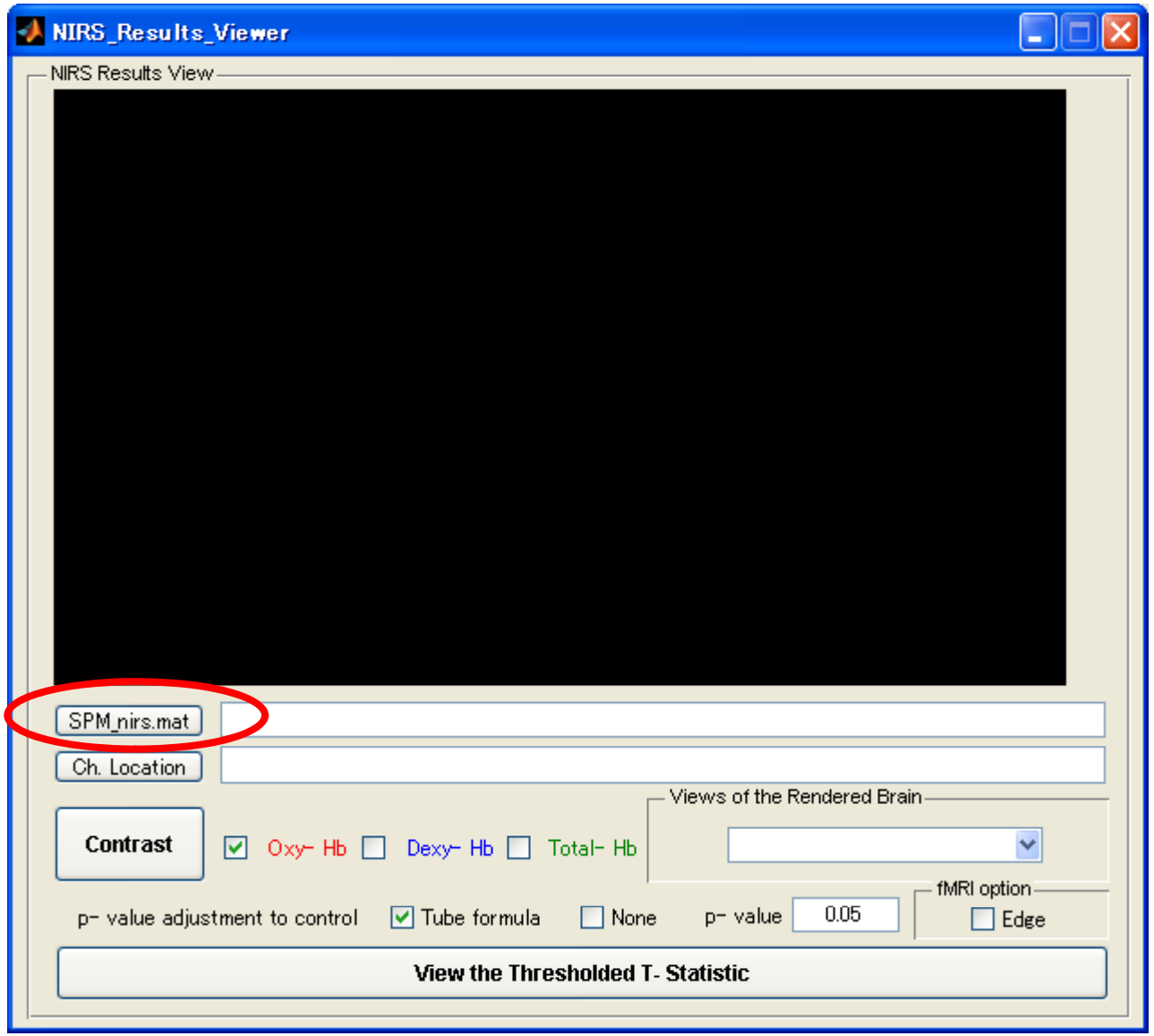

NIRS_Estimation
Estimation setup
Individual Analysis
Group Analysis
¥shimadzu_sample¥Result¥SPM_indiv_HbO.mat
Specify SPM.mat file
Group Analysis
The number of subjects
The minimum number of overlapped individual subjects
Specify the individual results
Oxy- Hb
Deoxy- Hb
Total- Hb
Estimation

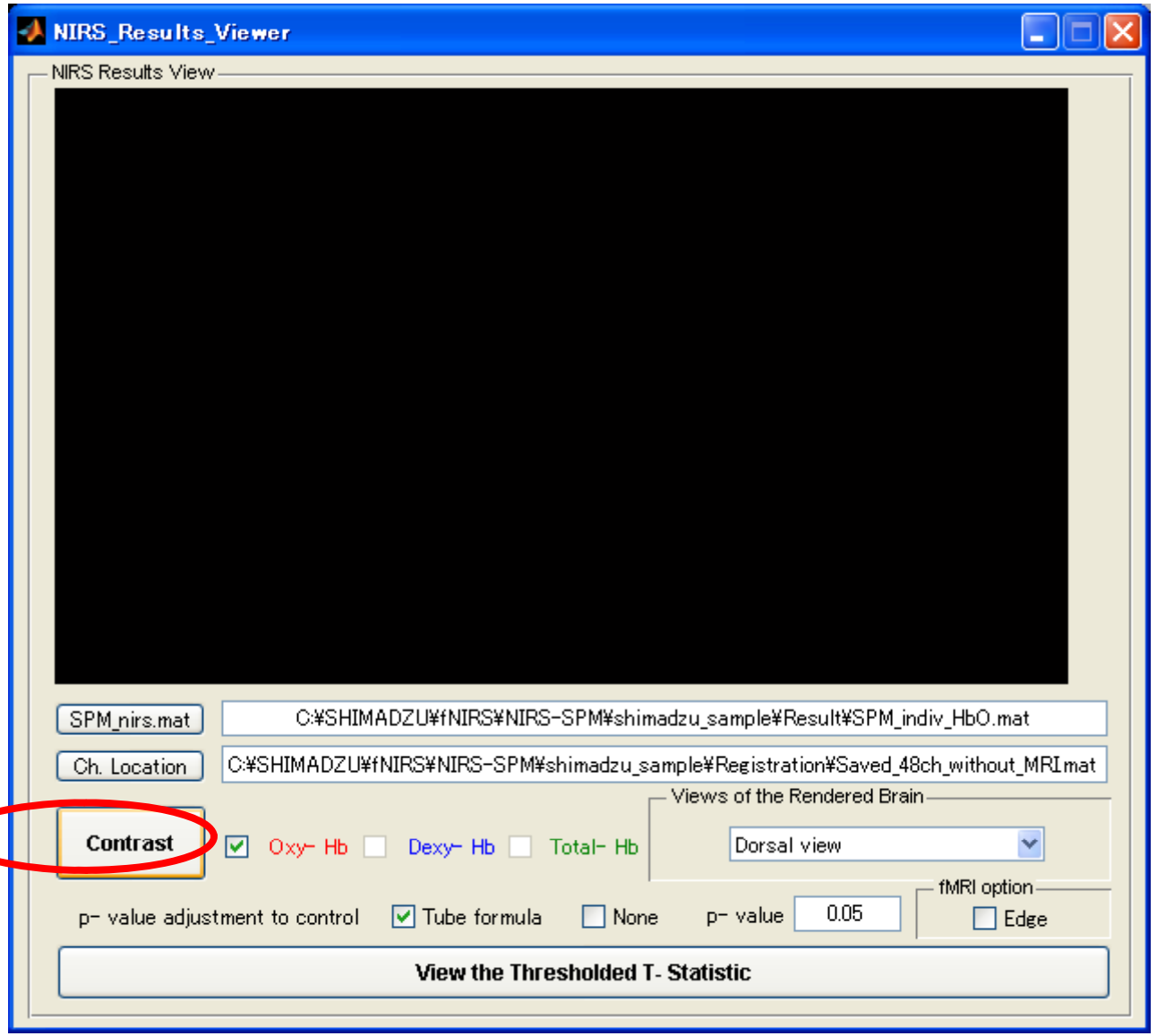


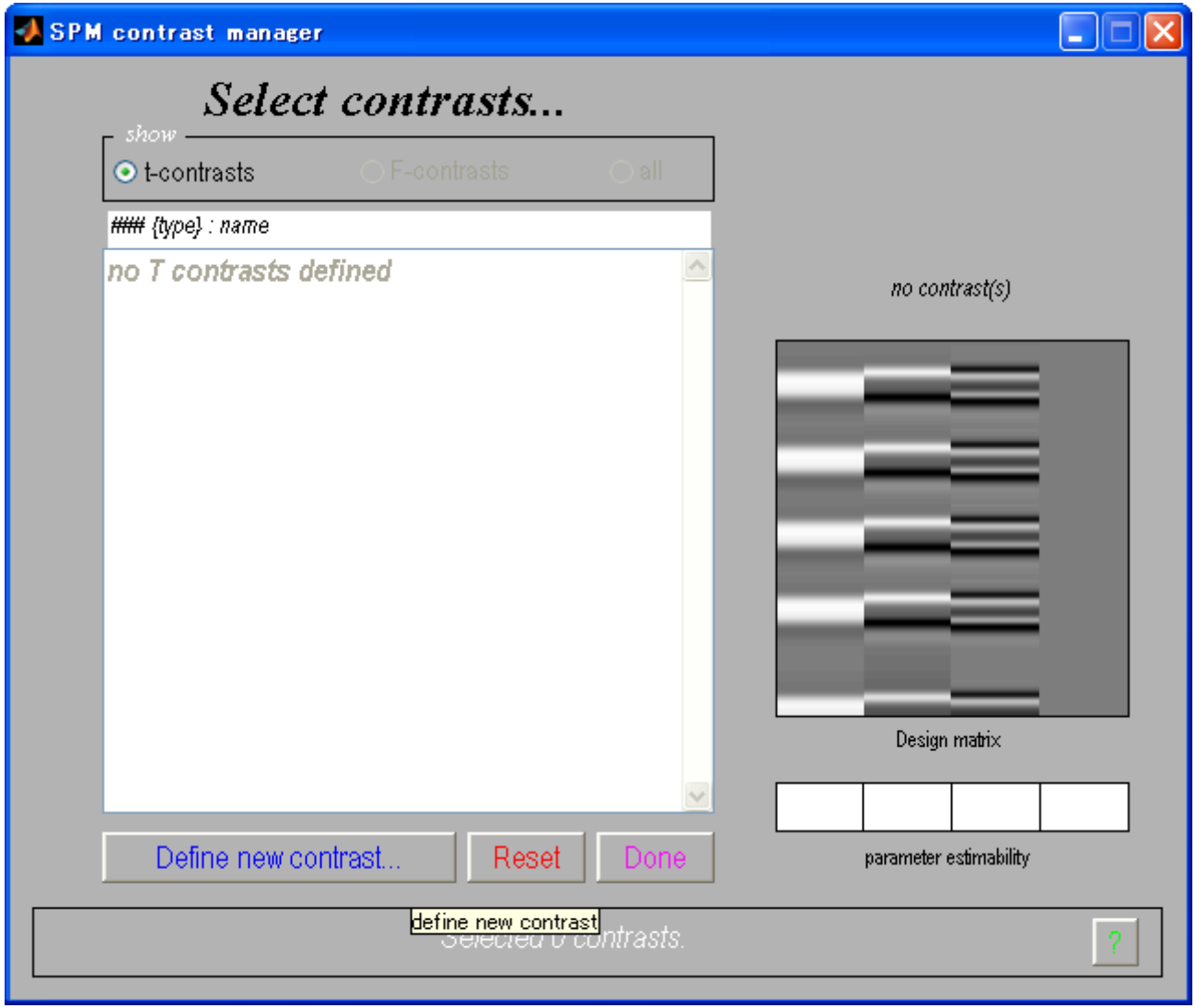
Updated SPM_indiv_HbO.mat

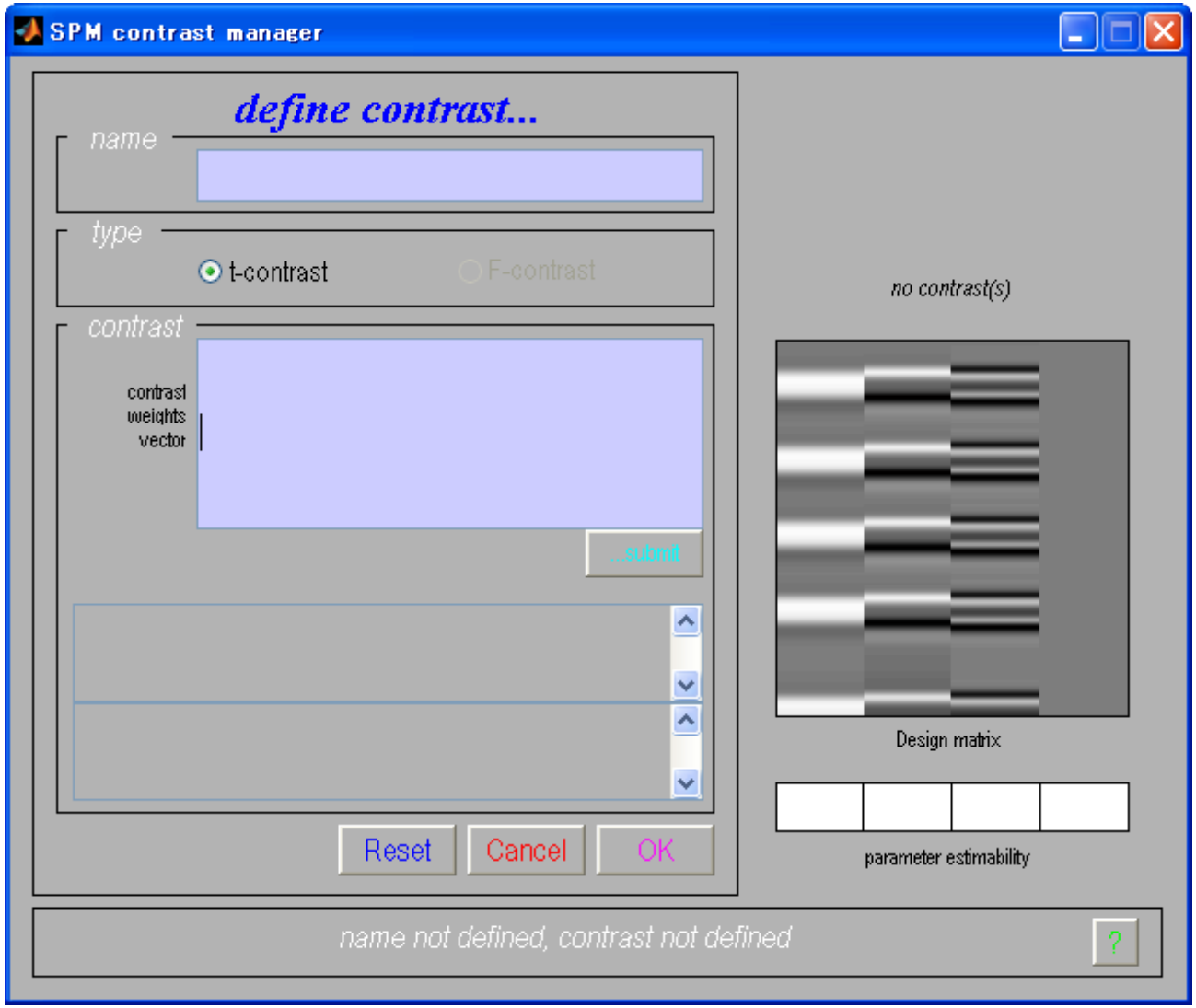
Results NIRS

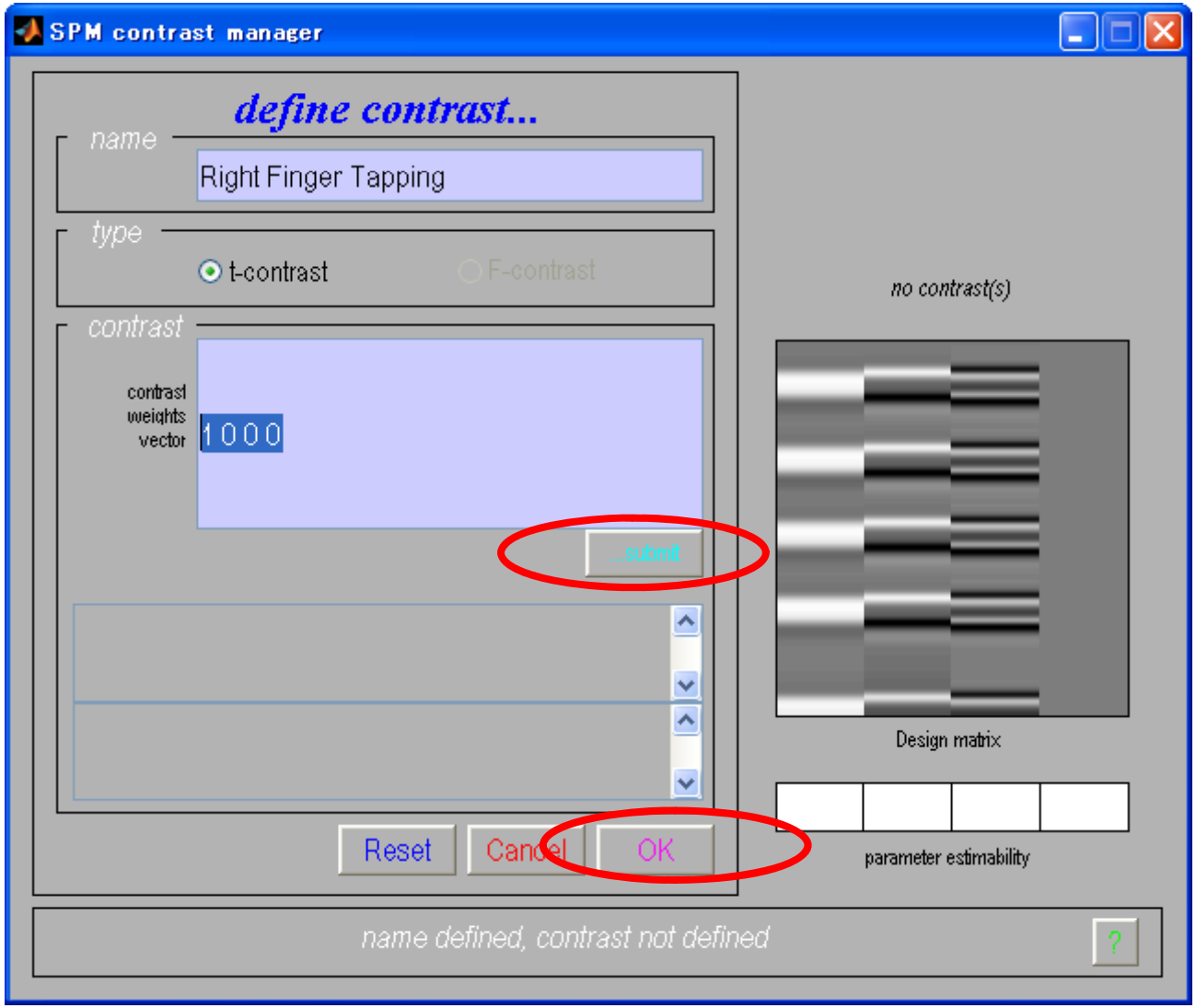
Results NIRS

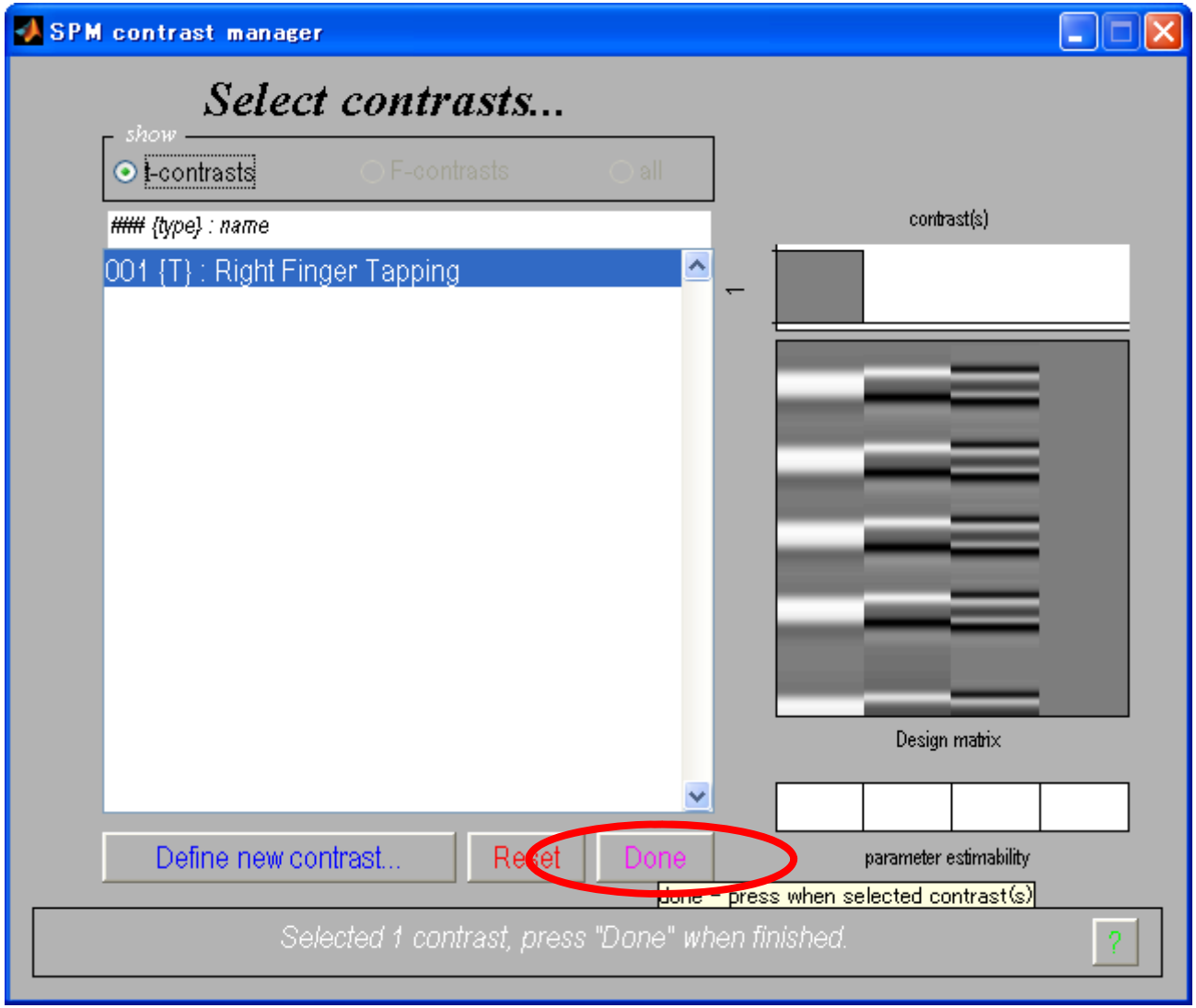


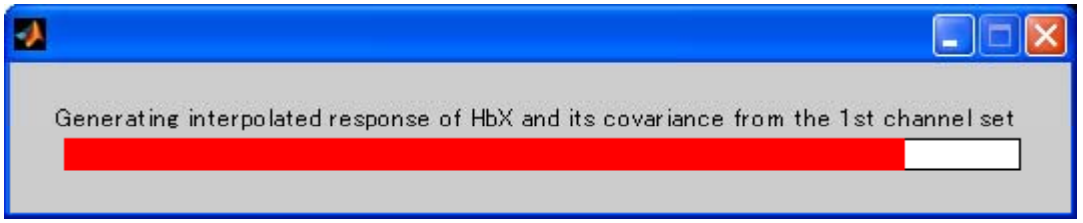

NIRS_Results_Viewer
NIRS Results View
SPM_nirs.mat
C:¥SHIMADZU¥fNIRS¥NIRS-SPM¥shimadzu_sample¥Result¥SPM_indiv_HbO.mat
Ch. Location
C:¥SHIMADZU¥fNIRS¥NIRS-SPM¥shimadzu_sample¥Registration¥Saved_48ch_without_MRI.mat
Contrast
Oxy- Hb
Dexy- Hb
Total- Hb
Views of the Rendered Brain
Dorsal view
fMRI option
Edge
p- value adjustment to control
Tube formula
None
p- value
0.05
View the Thresholded T- Statistic


SPM contrast manager
Select contrasts...
show
t-contrasts
F-contrasts
all
{type} : name
no T contrasts defined
no contrast(s)
Design matrix
parameter estimability
Define new contrast...
Reset
Done
define new contrast
?

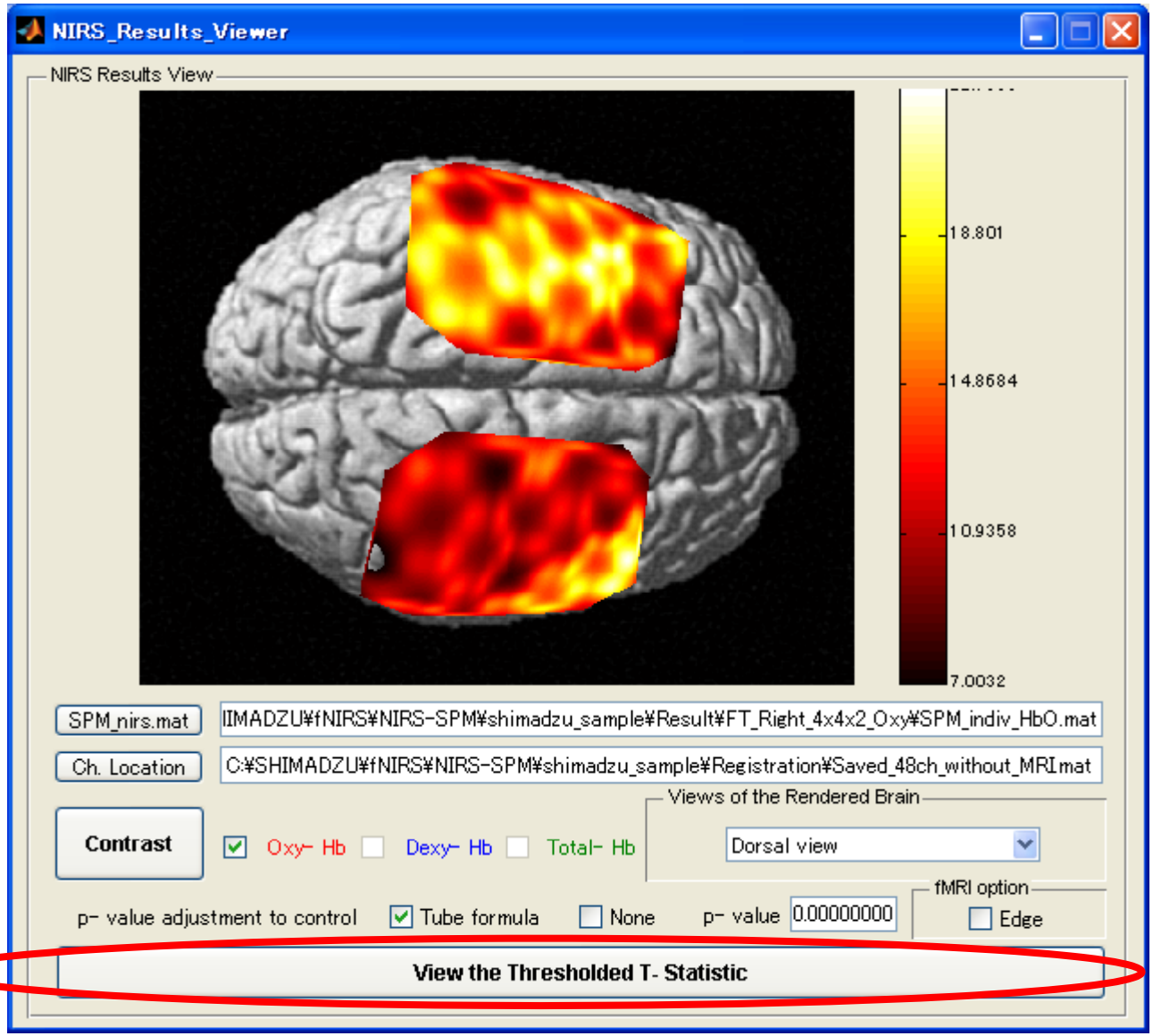

SPM contrast manager
define contrast...
name
type
t-contrast
F-contrast
contrast
contrast weights vector
...submit
Reset
Cancel
OK
no contrast(s)
Design matrix
parameter estimability
name not defined, contrast not defined
?


SPM contrast manager
define contrast...
name
Right Finger Tapping
type
t-contrast
F-contrast
contrast
contrast weights vector
1 0 0 0
...submit
Reset
Cancel
OK
no contrast(s)
Design matrix
parameter estimability
name defined, contrast not defined
?

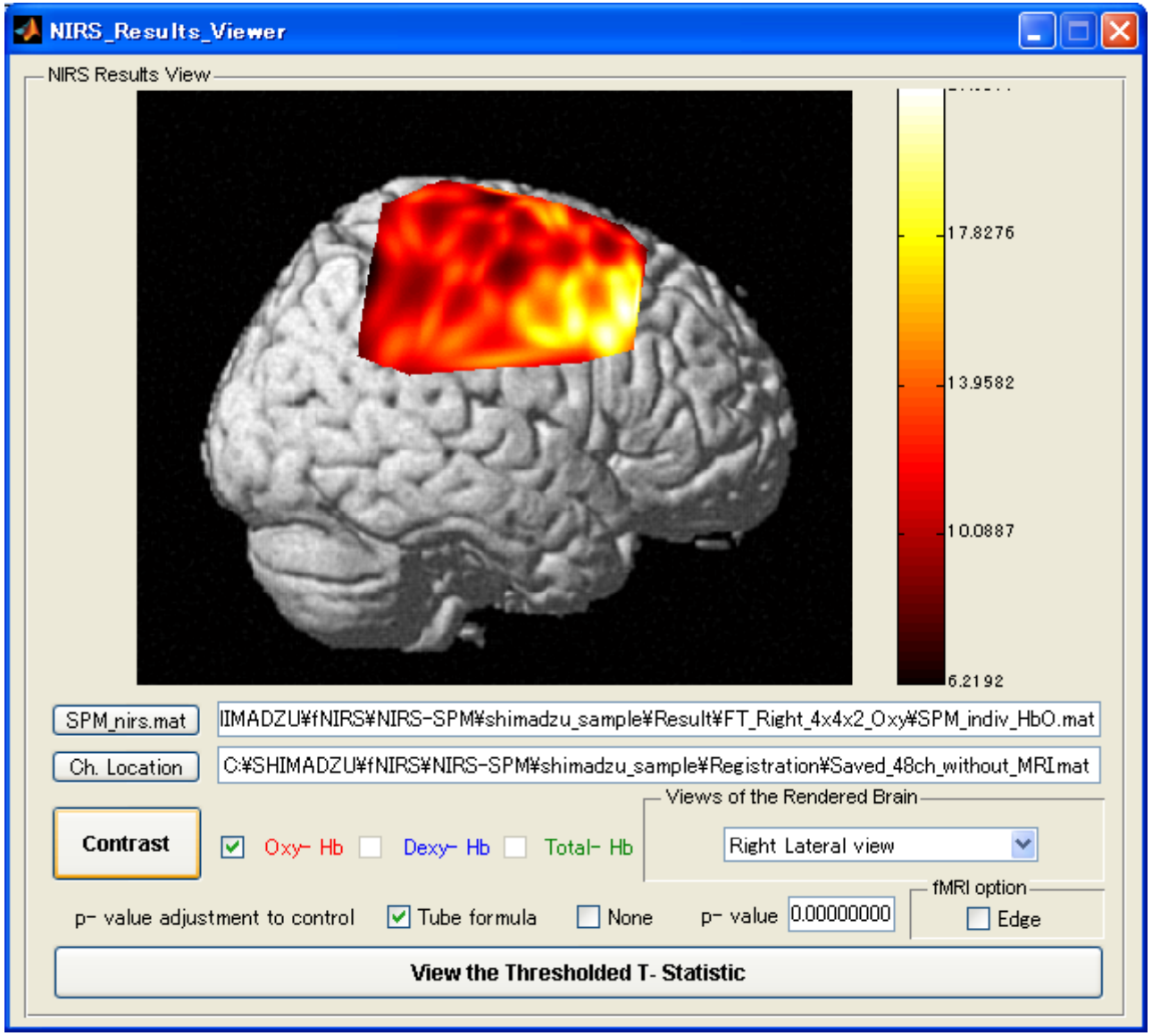

SPM contrast manager
Select contrasts...
show
t-contrasts
F-contrasts
all
{type} : name
001 {T} : Right Finger Tapping
contrast(s)
Design matrix
parameter estimability
Define new contrast...
Reset
Done
Done - press when selected contrast(s)
Selected 1 contrast, press "Done" when finished.
?


Generating interpolated response of HbX and its covariance from the 1st channel set

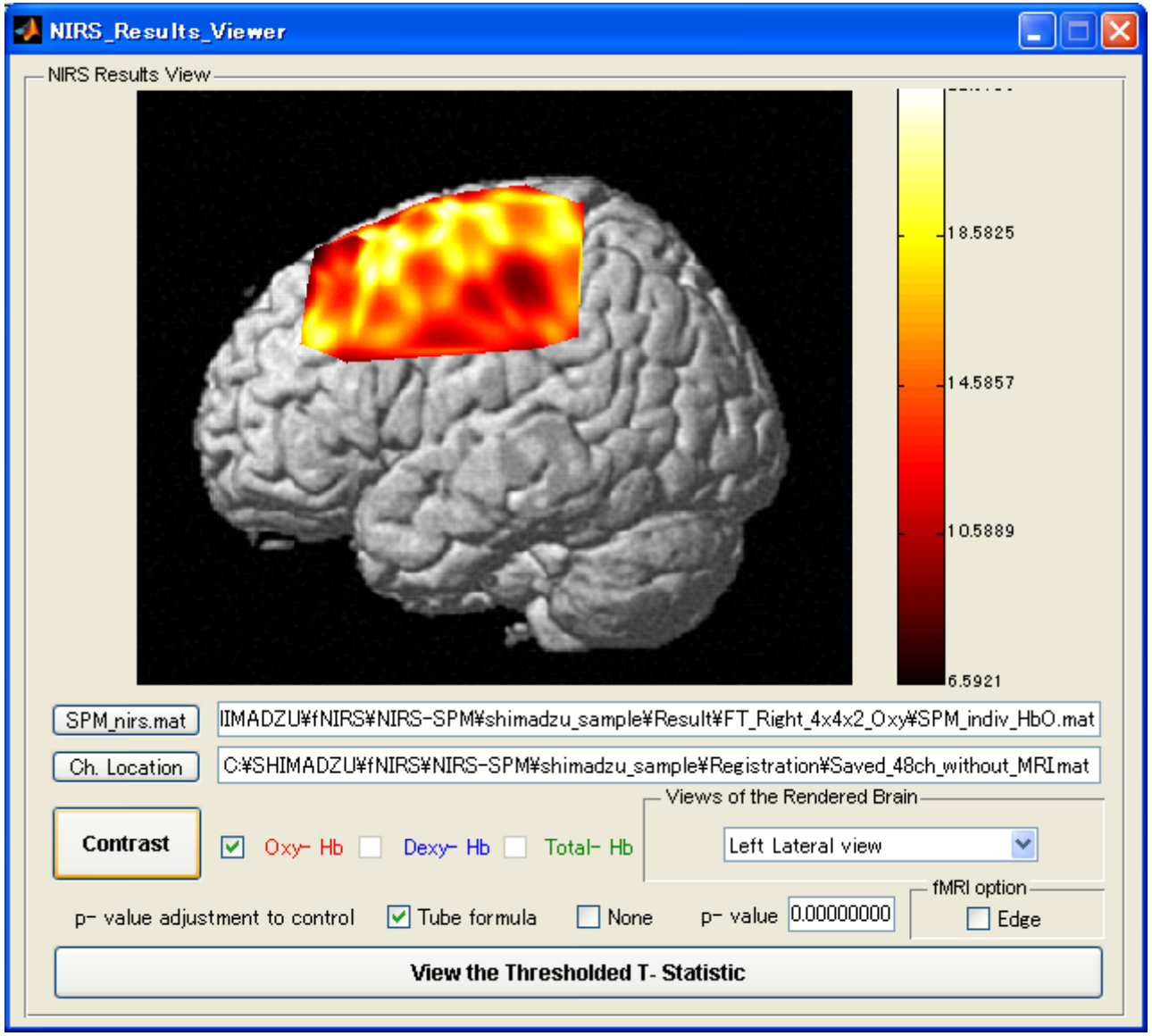

Generating interpolated response of HbX and its covariance from the 2nd channel set



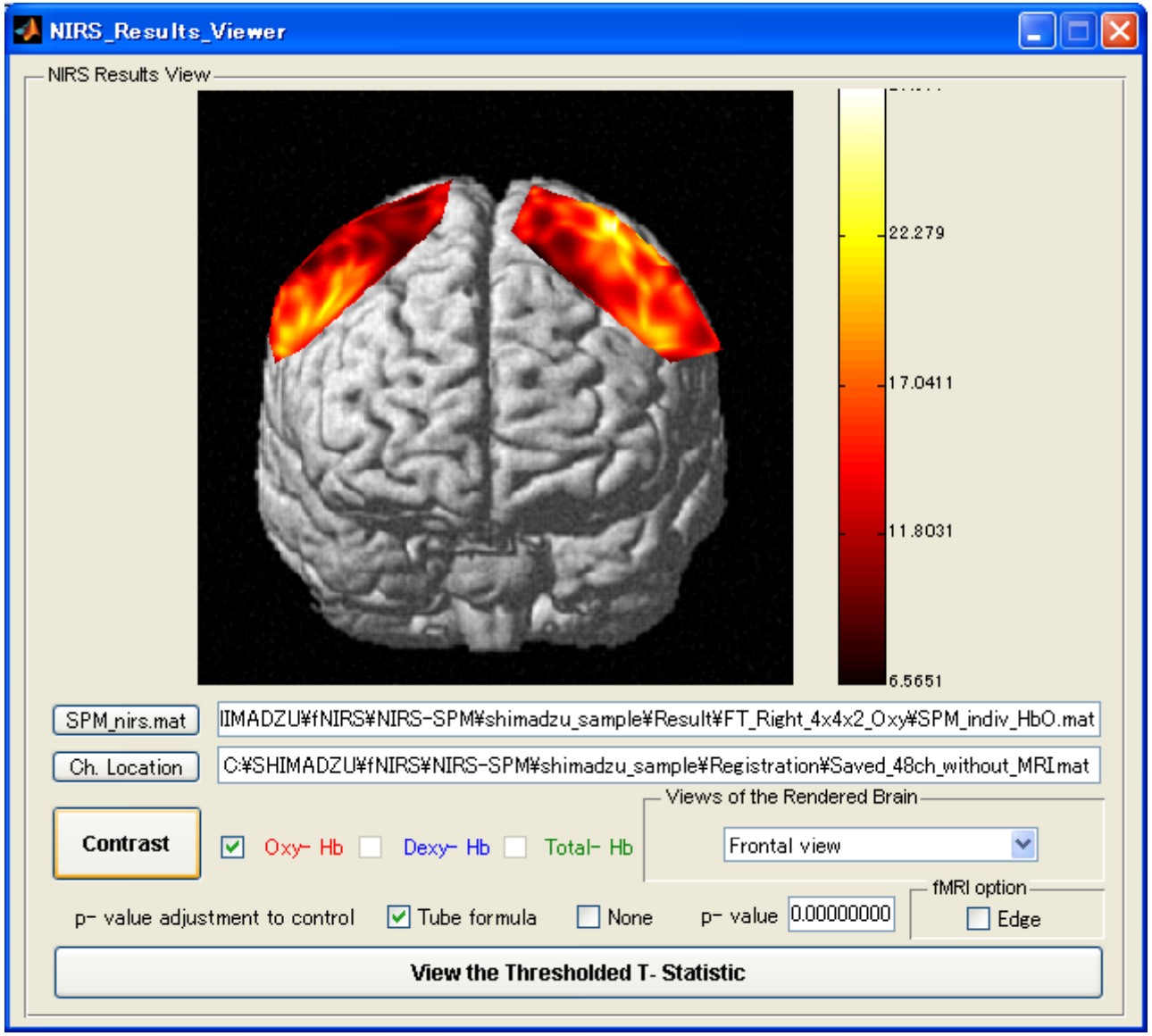
Created cinterp_SPM_nirs_HbO1_dorsal.mat



Created cinterp_SPM_nirs_HbO1_right.mat

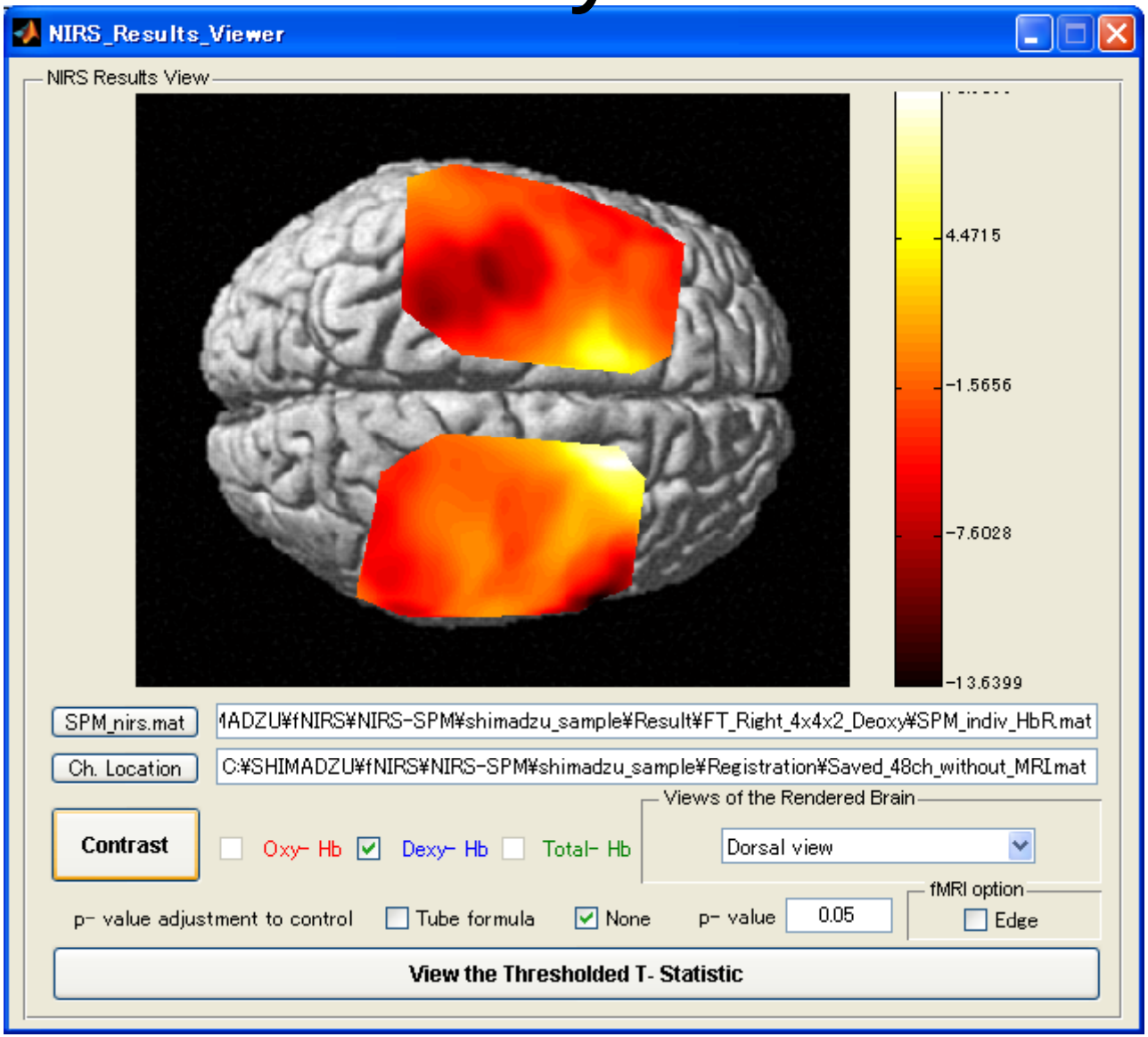


Created cinterp_SPM_nirs_HbO1_left.mat

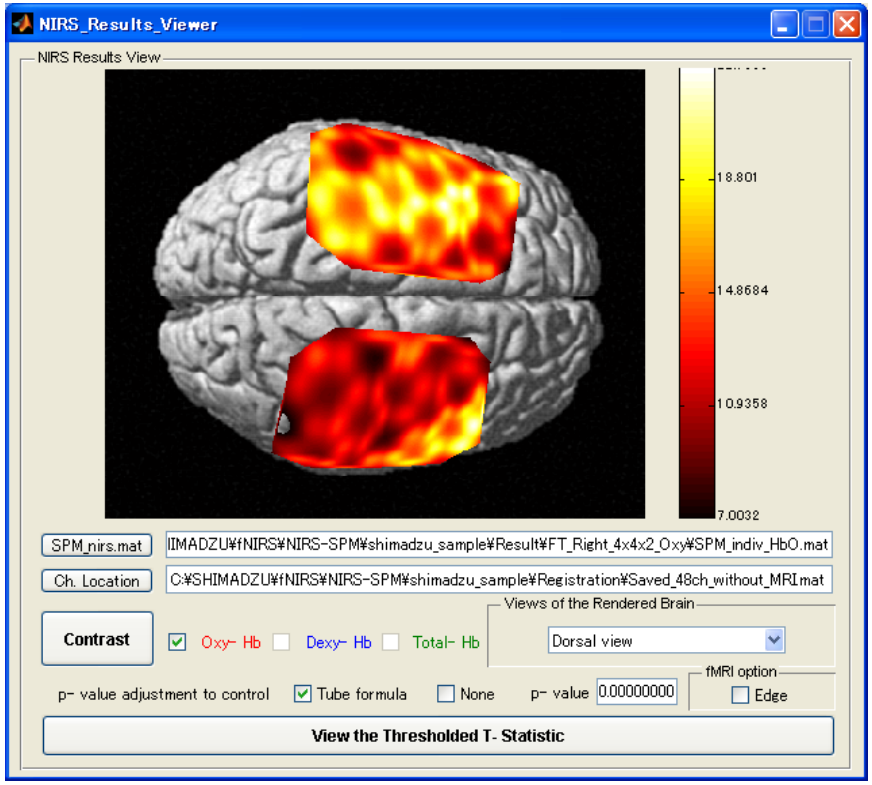


Created cinterp_SPM_nirs_HbO1_frontal.mat

Deoxy-Hb

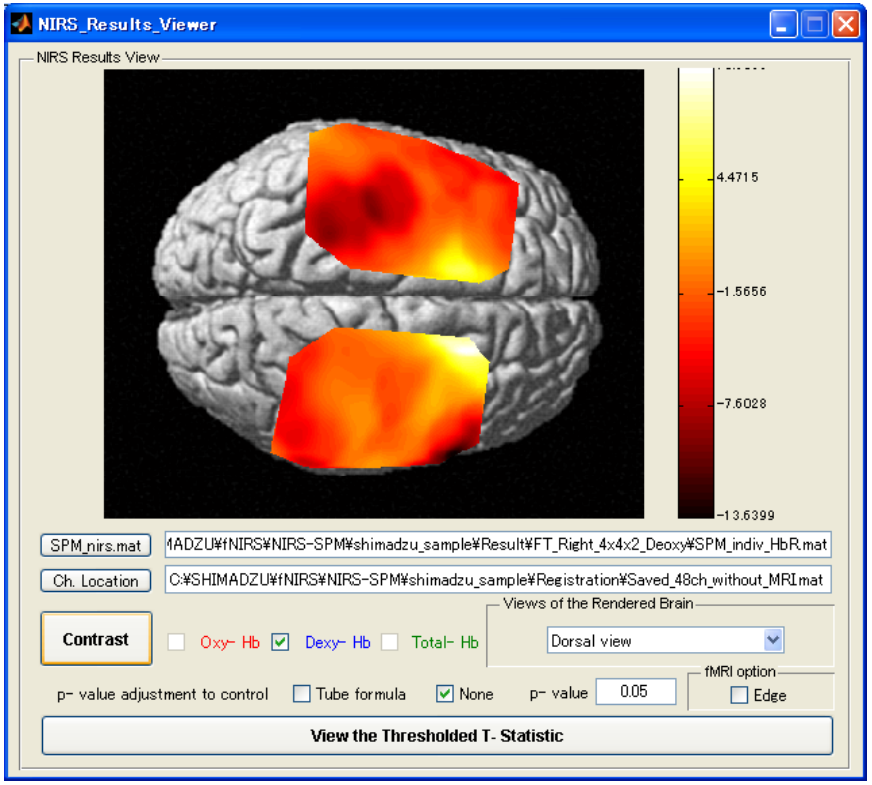

NIRS_Results_Viewer
NIRS Results View
4.4715
-1.5656
-7.6028
-13.6399
SPM_nirs.mat
MADZU¥fNIRS¥NIRS-SPM¥shimadzu_sample¥Result¥FT_Right_4x4x2_Deoxy¥SPM_indiv_HbR.mat
Ch. Location
C:¥SHIMADZU¥fNIRS¥NIRS-SPM¥shimadzu_sample¥Registration¥Saved_48ch_without_MRI.mat
Views of the Rendered Brain
Contrast
Oxy- Hb
Dexy- Hb
Total- Hb
Dorsal view
fMRI option
p- value adjustment to control
Tube formula
None
p- value
0.05
Edge
View the Thresholded T- Statistic

T-map of right finger tapping



OxyHb

High t value was indicated in primary motor cortex of left side.



DeoxyHb

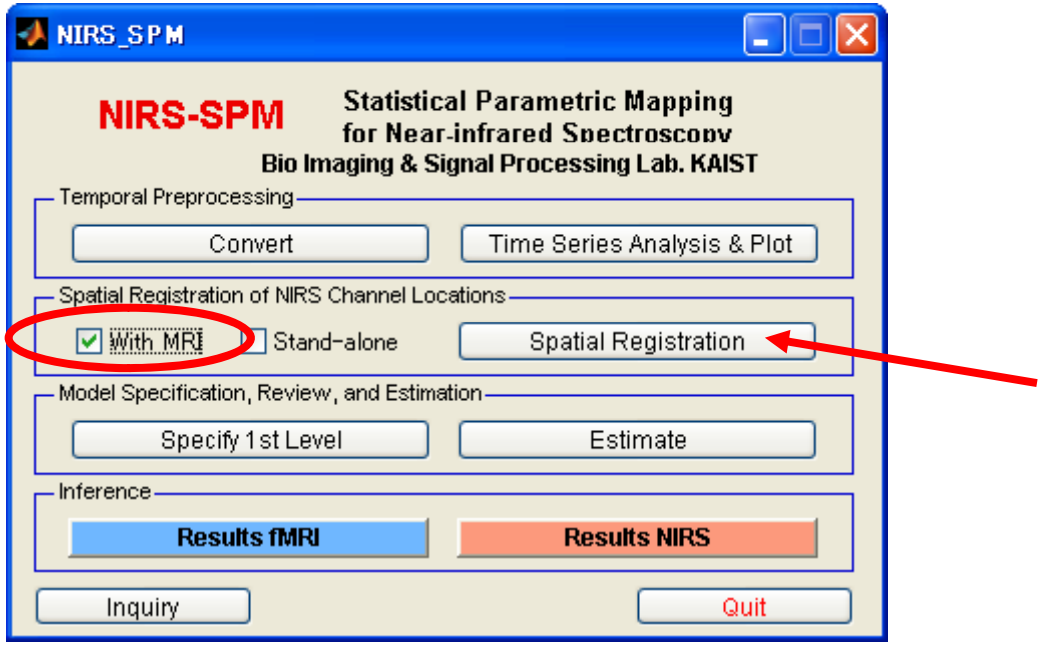
The t value of the minus was indicated in primary motor cortex of left side.

The result showed that increased OxyHb and decreaed DeoxyHb was found at tapping

Appendix

Spatial Registration

Spatial Registration (with MRI)

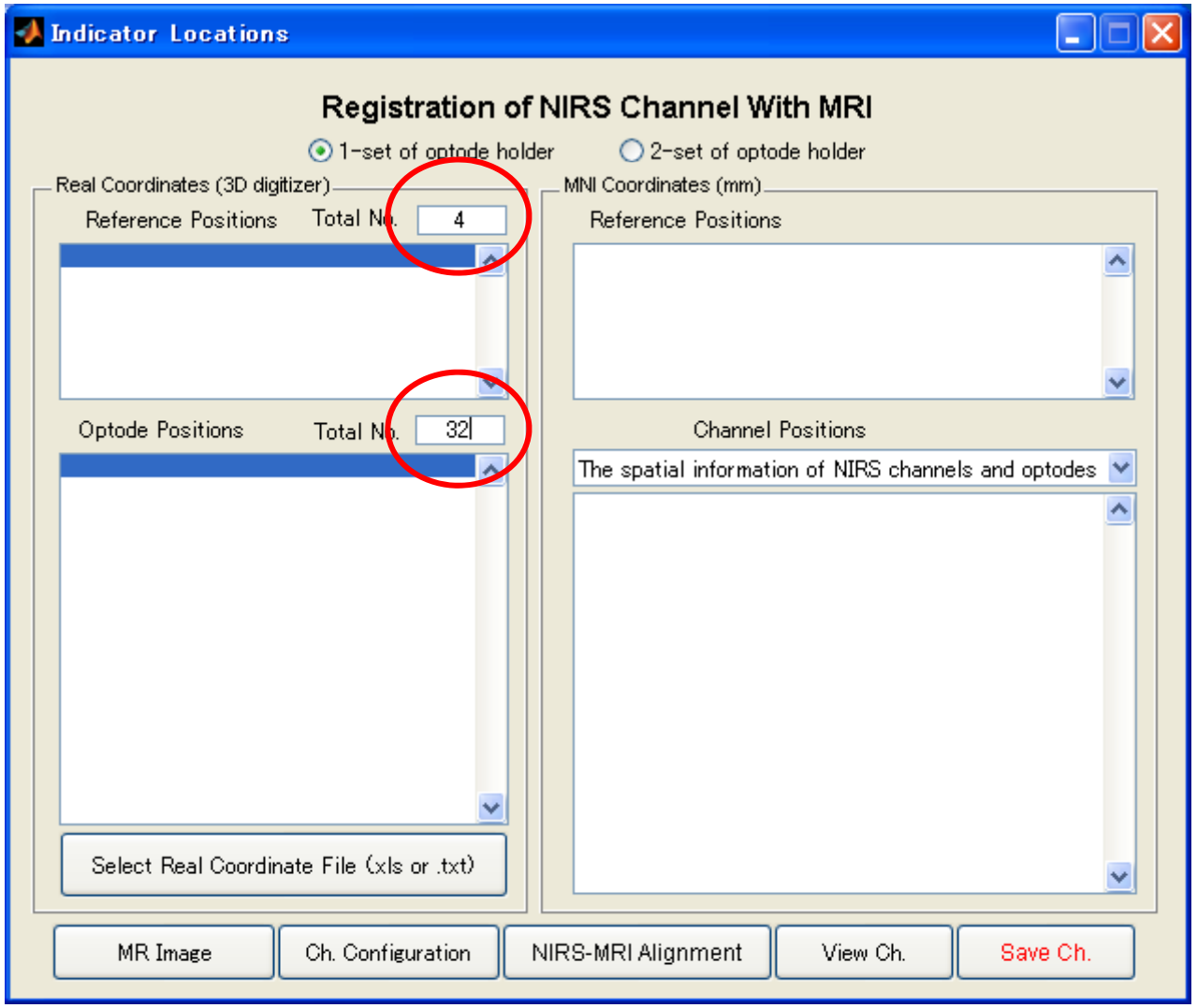


Preparation

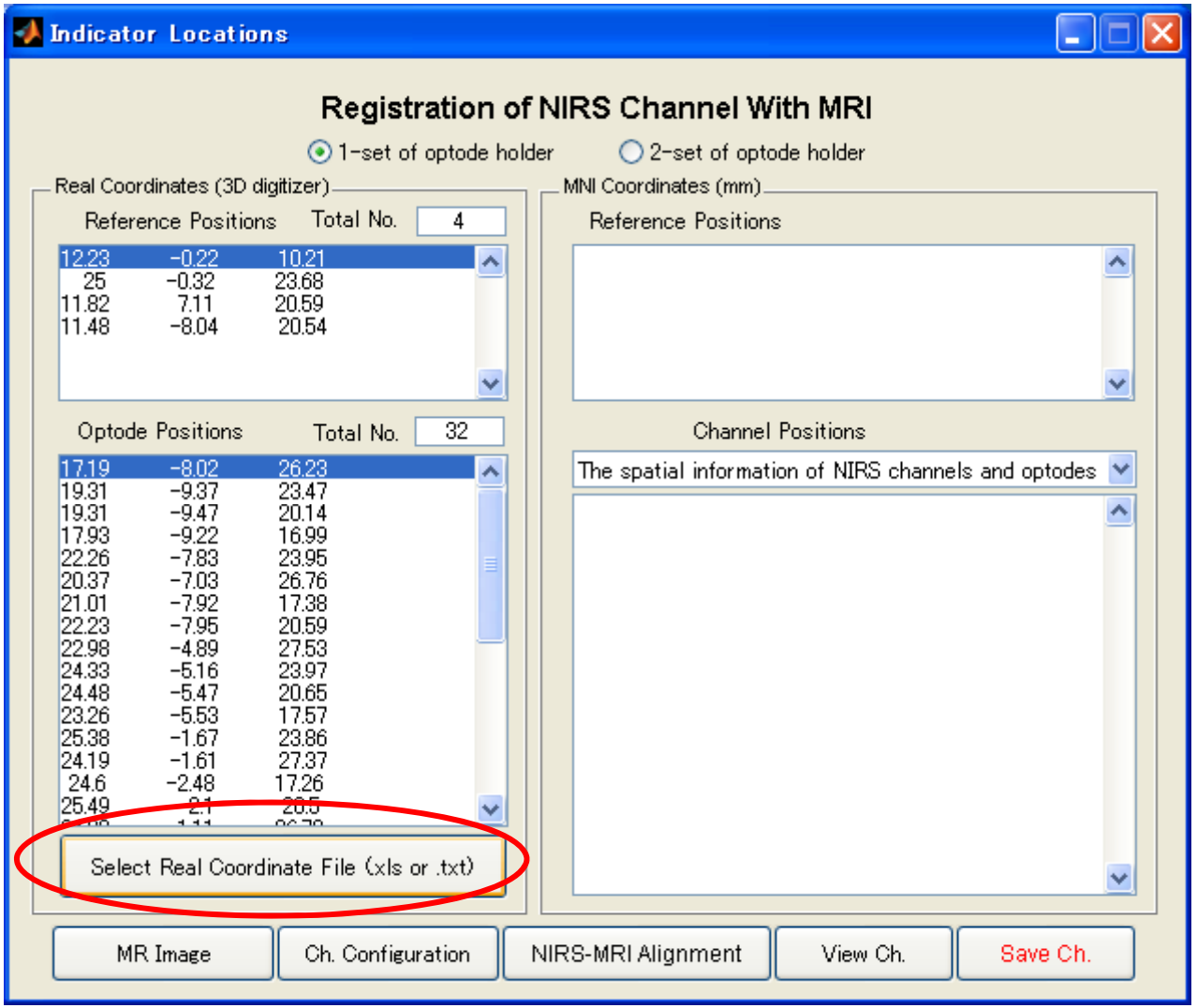
- MRI image
  - T1W
  - Normalized T1W
  - Gray Matter and White Matter images
- File for Coefficient
  - Mat file for conversion
- Location data of 4 Reference points and Probes
  - Measured using Fastrak
- Registration File
- Ch. Config File

Type	Folder name	File name
T1W	WithMRI	mri.nii
Normalized T1W	WithMRI	wmri.nii
Gray Matter	WithMRI	c1mri.nii
White Matter	WithMRI	c2mri.nii
Mat file for conversion	WithMRI	mri_sn.mat
Location data	Registration	Shimadzu_Real_4x4x2_FingerTapping.txt
Ch. Config file	Ch_Config	Shimadzu_4x4x2_48ch.txt
Saved file	Registration	Shimadzu_Saved_48ch_with_MRI

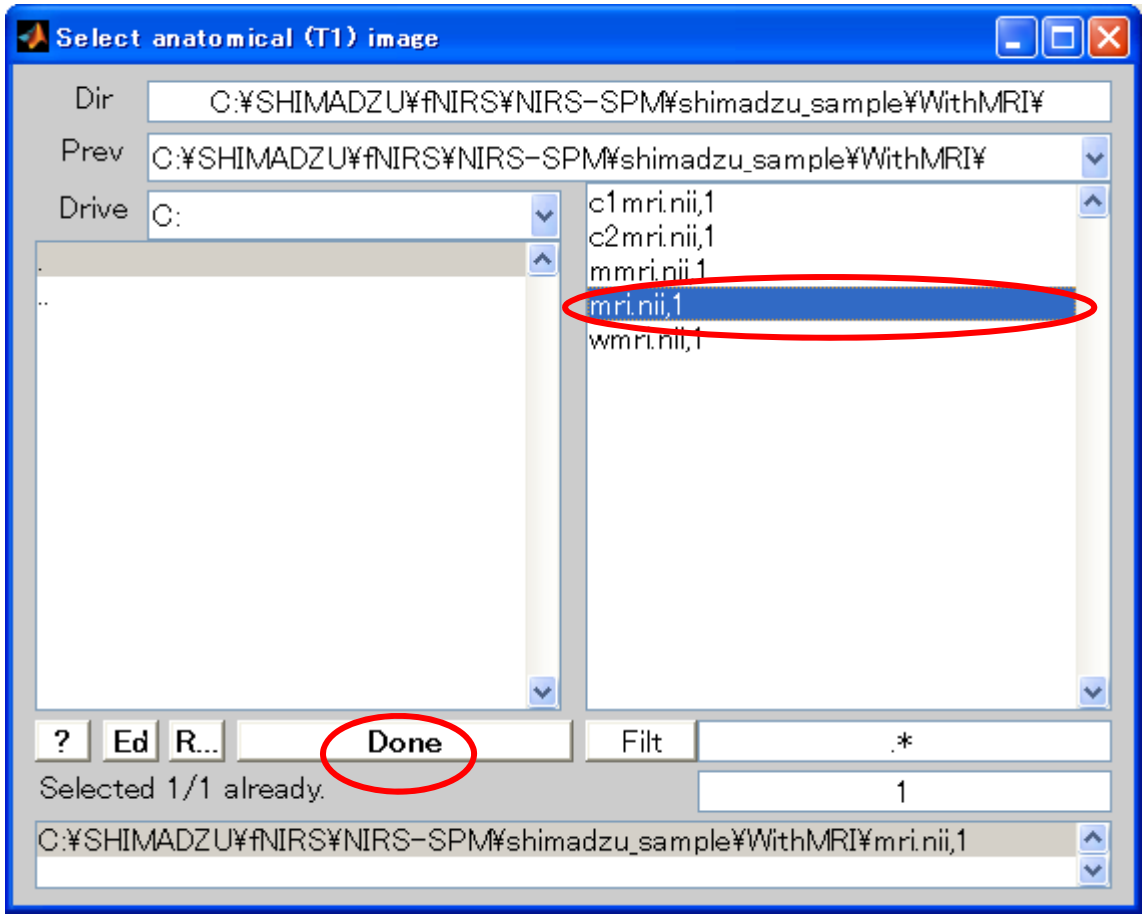
Set Reference Points and Optode



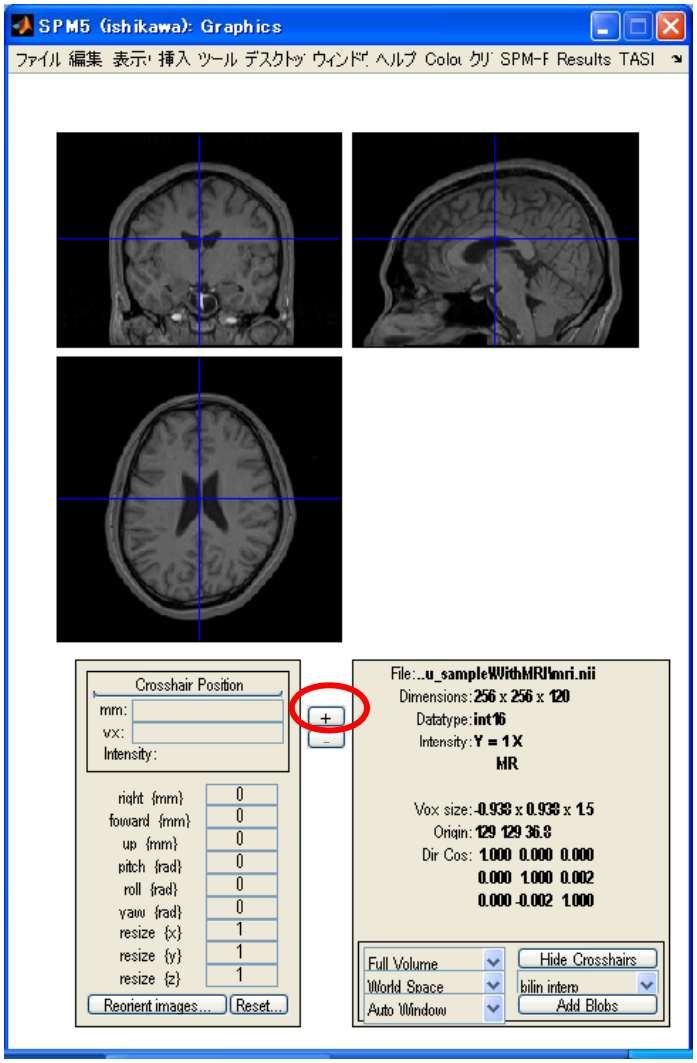
Select Real Coordinate File



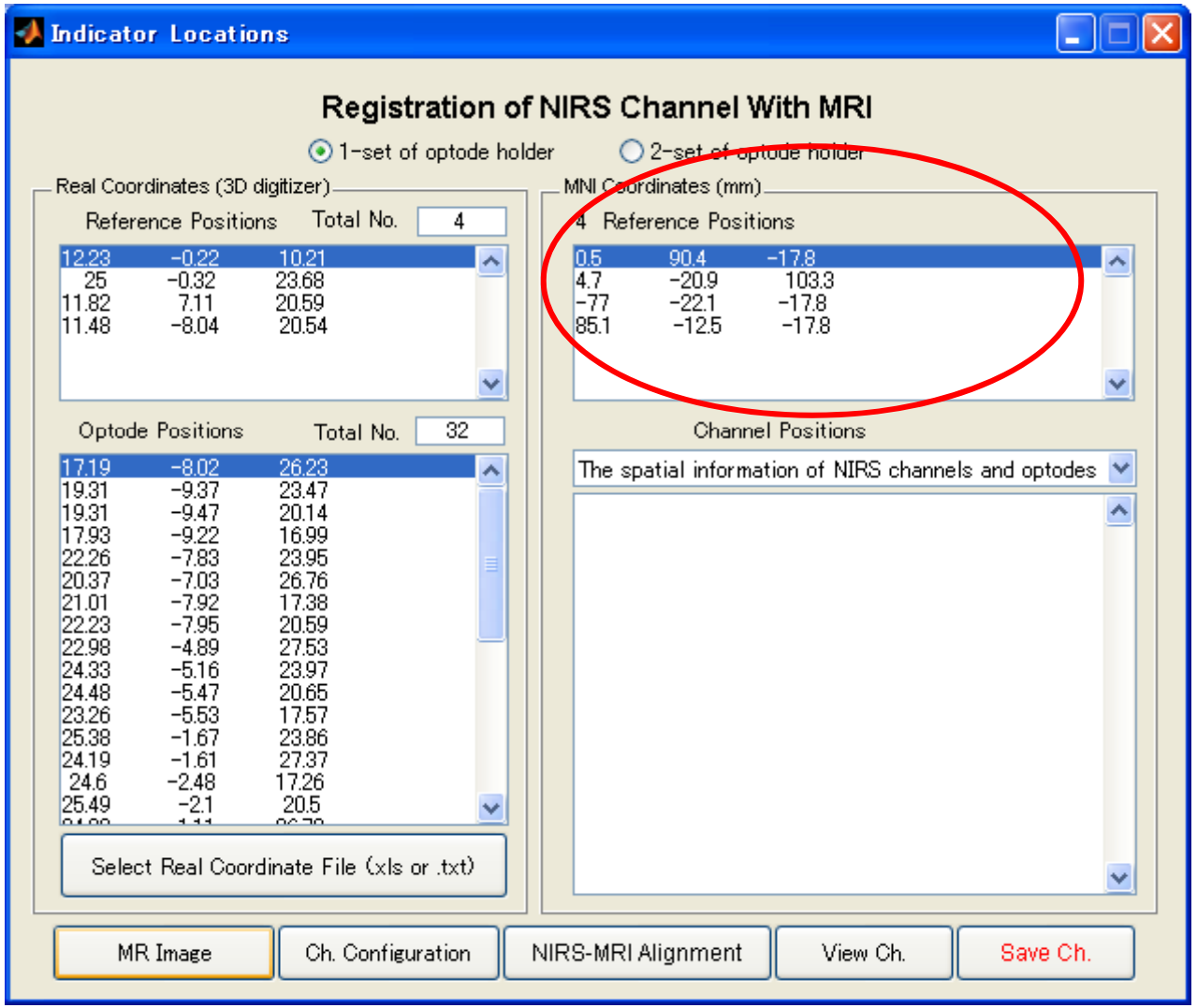
MR Image （Select T1 and Normalized image)



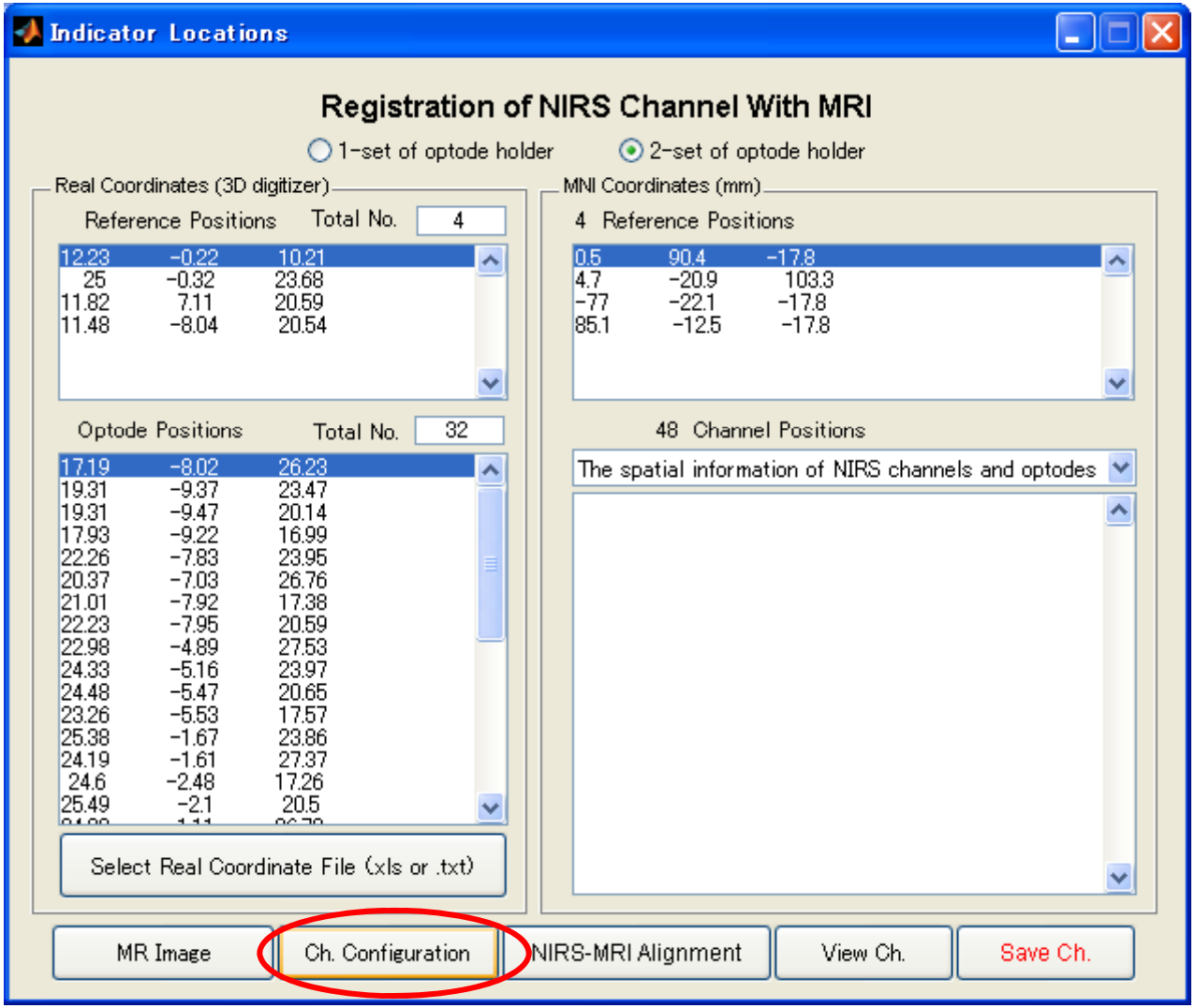
Set Reference Points



NZ
+
CZ
+
AL
+
AR

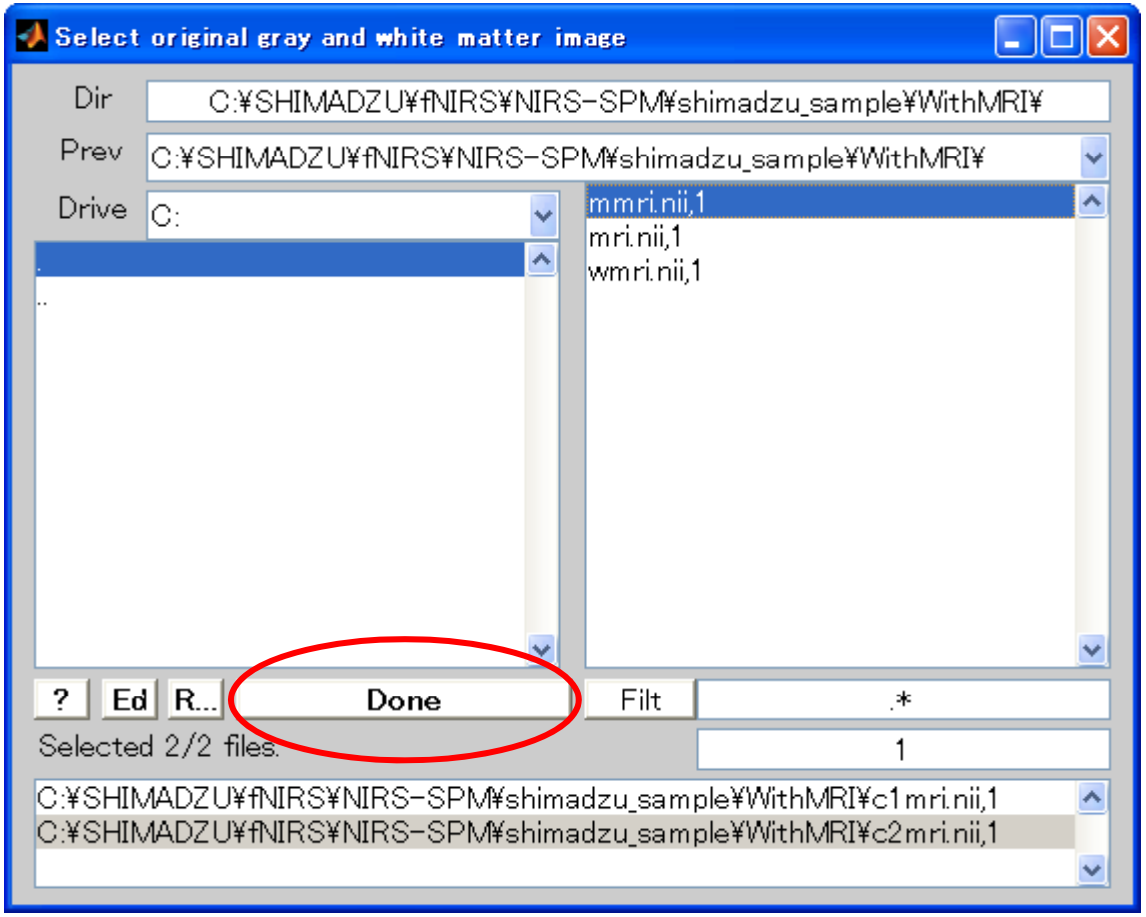

Indicator Locations
Registration of NIRS Channel With MRI
1-set of optode holder
2-set of optode holder
Real Coordinates (3D digitizer)
Reference Positions
Total No.
4
12.23 -0.22 10.21
25 -0.32 23.68
11.82 7.11 20.59
11.48 -8.04 20.54
Optode Positions
Total No.
32
17.19 -8.02 26.23
19.31 -9.37 23.47
19.31 -9.47 20.14
17.93 -9.22 16.99
22.26 -7.83 23.95
20.37 -7.03 26.76
21.01 -7.92 17.38
22.23 -7.95 20.59
22.98 -4.89 27.53
24.33 -5.16 23.97
24.48 -5.47 20.65
23.26 -5.53 17.57
25.38 -1.67 23.86
24.19 -1.61 27.37
24.6 -2.48 17.26
25.49 -2.1 20.5
Select Real Coordinate File (xls or .txt)
MNI Coordinates (mm)
4 Reference Positions
0.5 90.4 -17.8
4.7 -20.9 103.3
-77 -22.1 -17.8
85.1 -12.5 -17.8
Channel Positions
The spatial information of NIRS channels and optodes
MR Image
Ch. Configuration
NIRS-MRI Alignment
View Ch.
Save Ch.

Set Ch.Config File

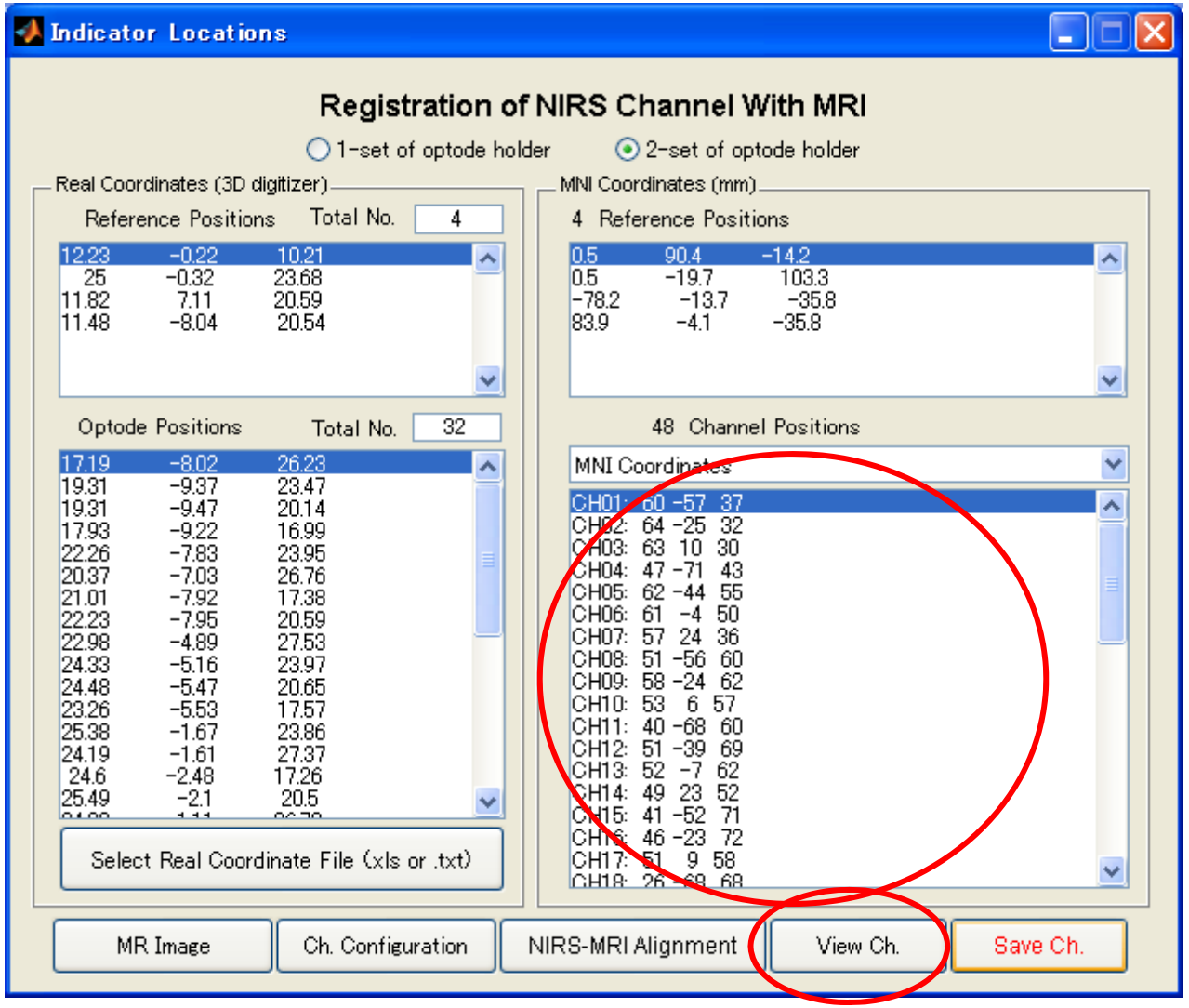


NIRS-MRI Alignment

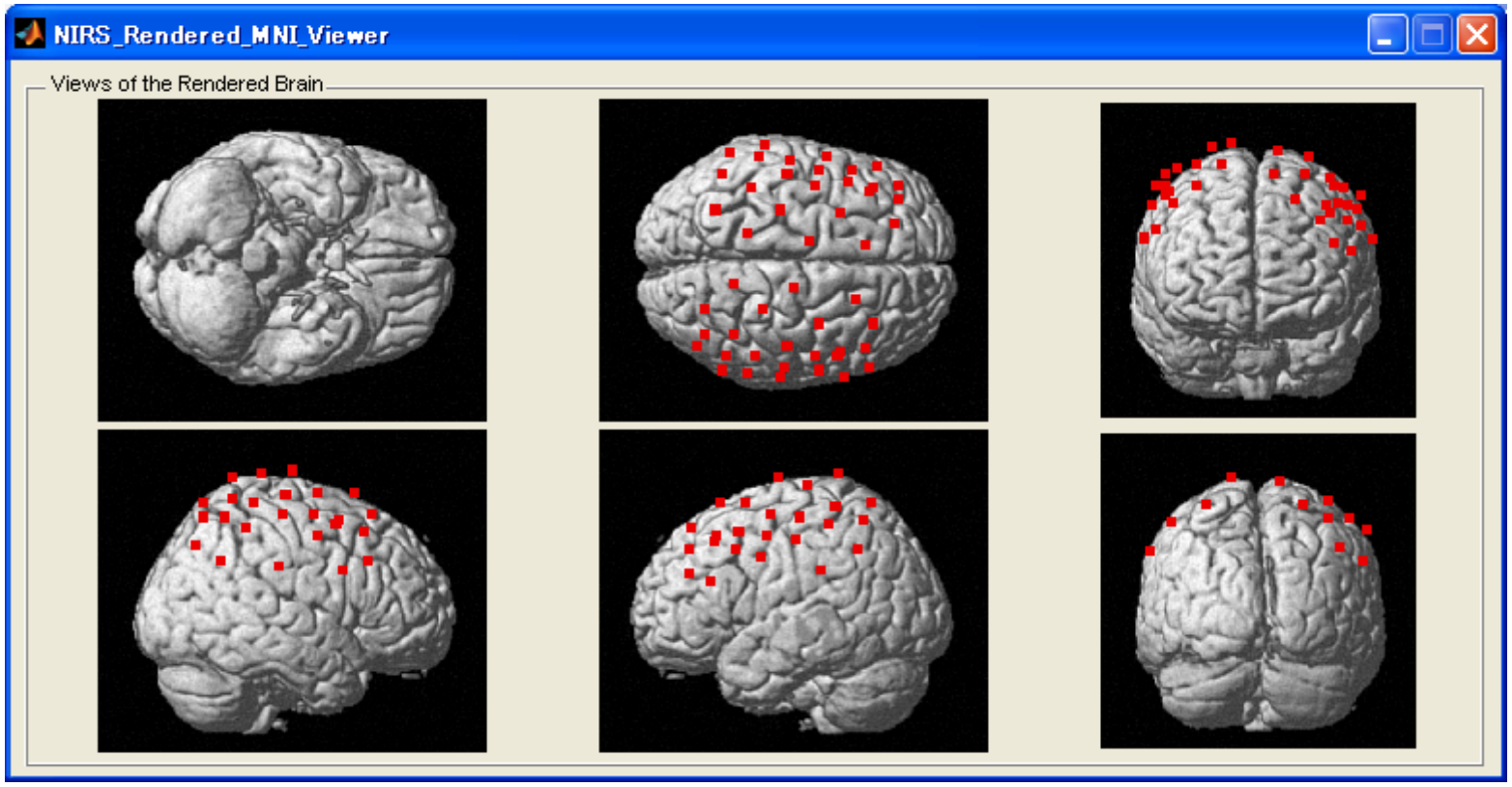
Select parameter file and then Gray matter and White matter file



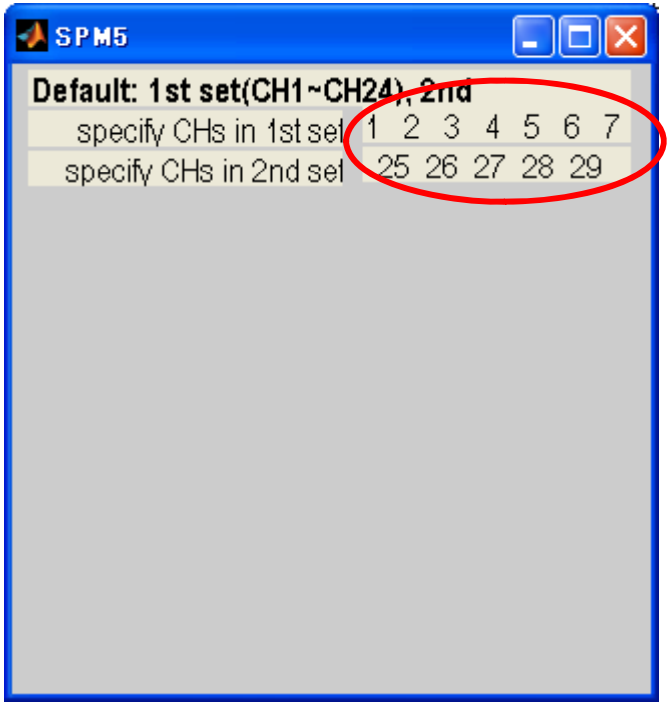
MNI Coordinates



View Ch.

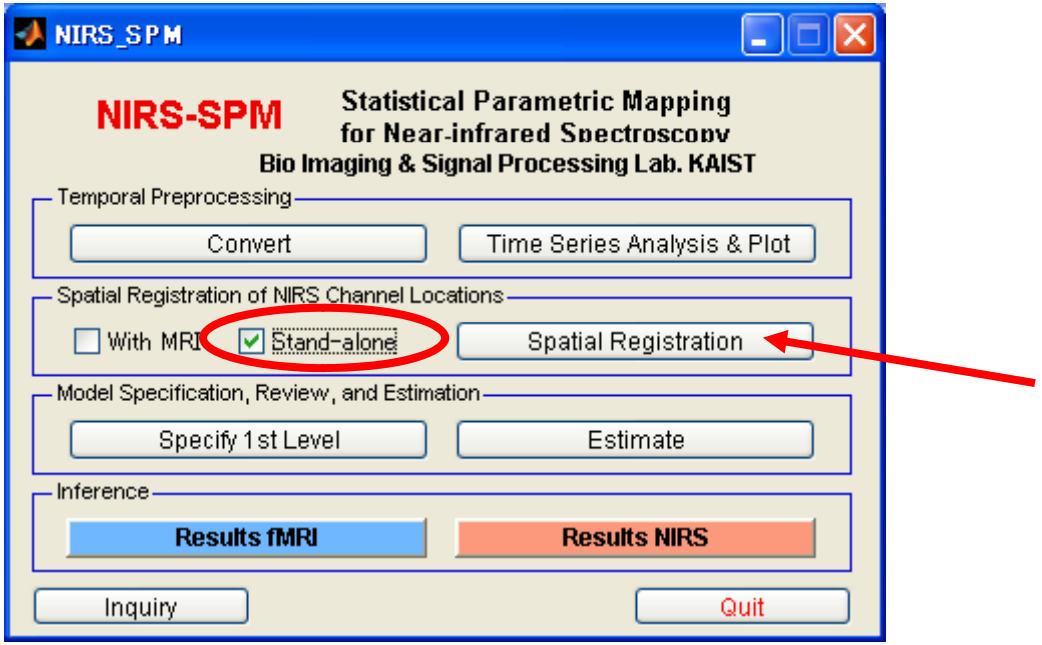


Save Ch.



Shimadzu_Saved_48ch_with_MRI.mat

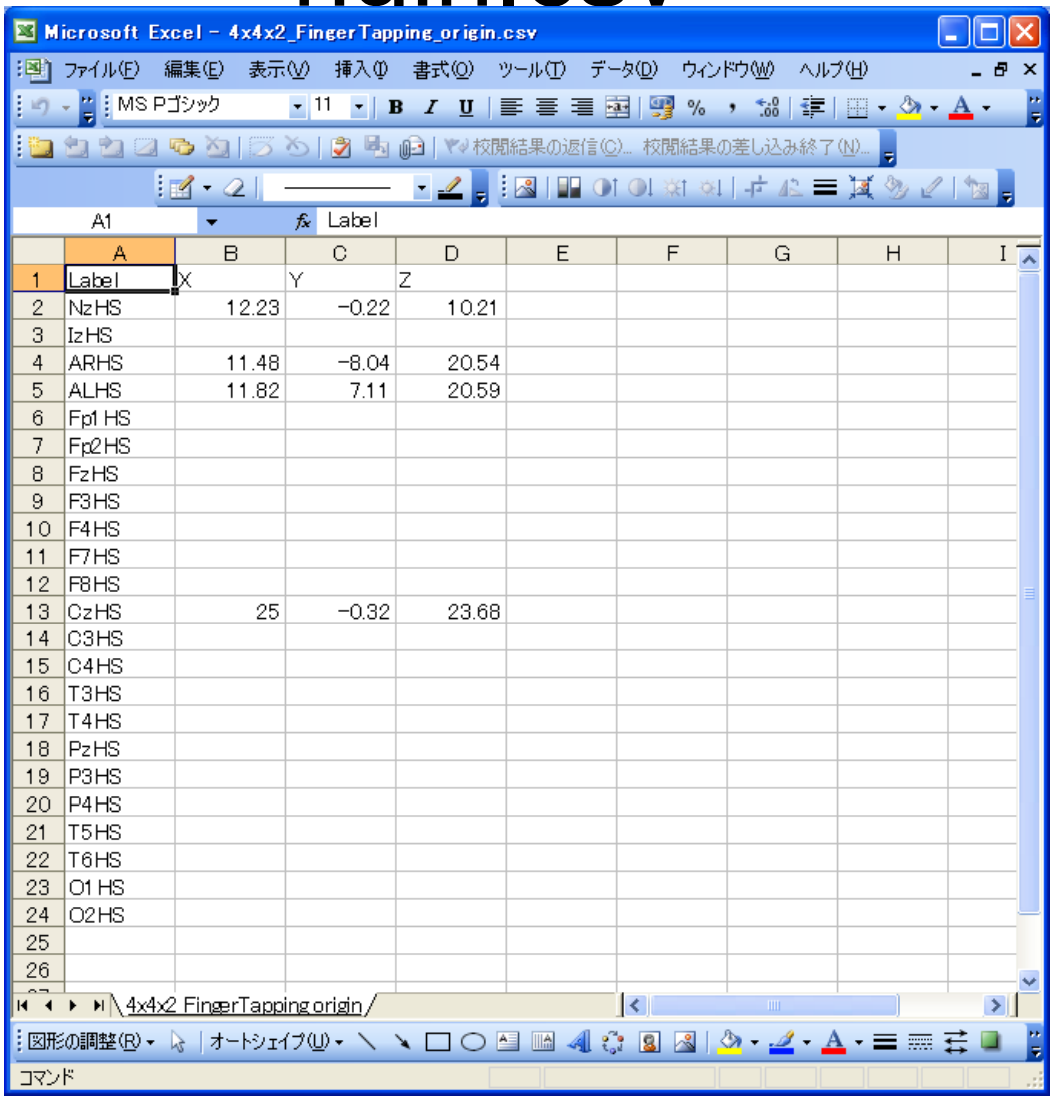
Spatial Registration(without MRI)



Preperation

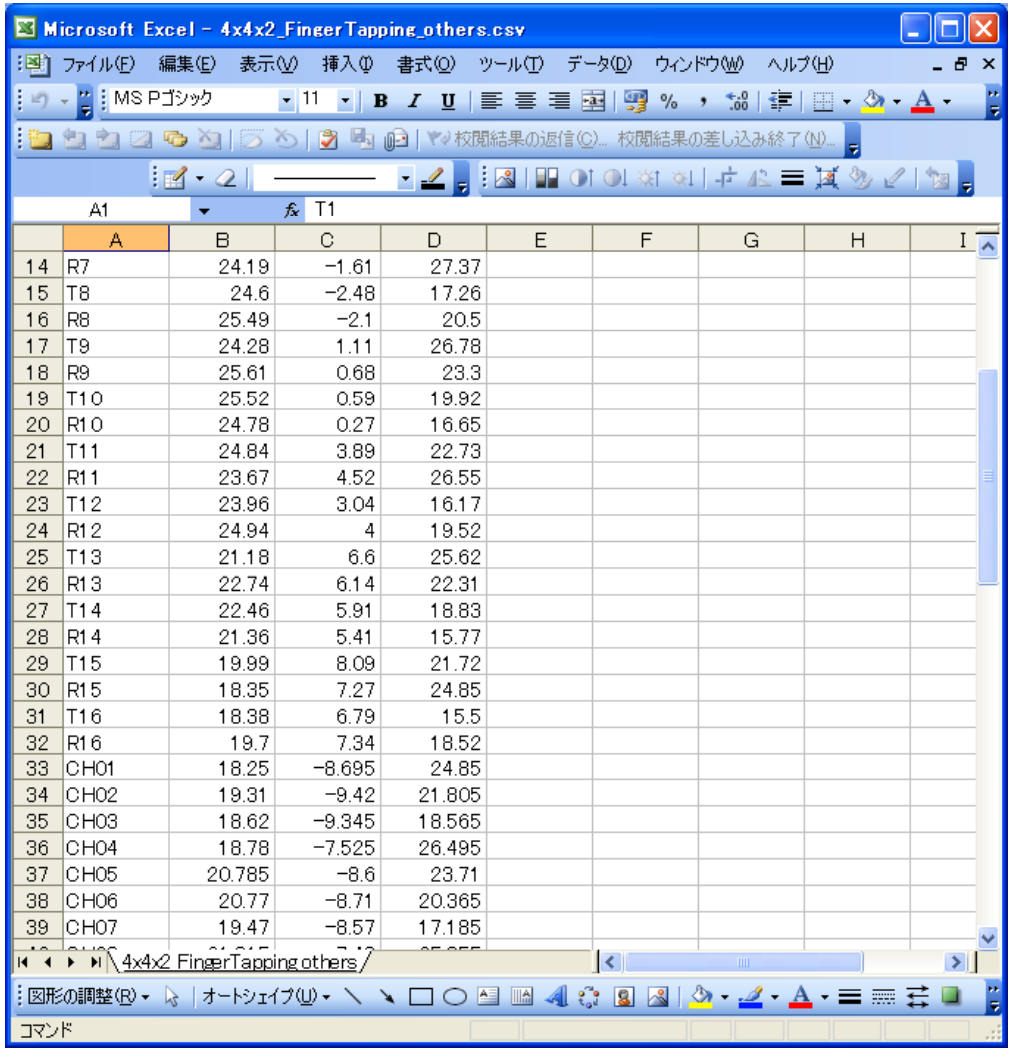
- Location data of Reference point
  - Shimadzu_4x4x2_FingerTapping_origin.csv
- Location data of Probe and Channel
  - Shimadzu_4x4x2_FingerTapping_others.csv

Shimadzu_4x4x2_FingerTapping_origin.csv



	A	B	C	D	E	F	G	H	I
1	Label	X	Y	Z					
2	NzHS	12.23	−0.22	10.21					
3	IzHS								
4	ARHS	11.48	−8.04	20.54					
5	ALHS	11.82	7.11	20.59					
6	Fp1 HS								
7	Fp2 HS								
8	FzHS								
9	F3HS								
10	F4HS								
11	F7HS								
12	F8HS								
13	CzHS	25	−0.32	23.68					
14	C3HS								
15	C4HS								
16	T3HS								
17	T4HS								
18	PzHS								
19	P3HS								
20	P4HS								
21	T5HS								
22	T6HS								
23	O1 HS								
24	O2HS								
25									
26									

Shimadzu_4x4x2_FingerTapping_others.csv

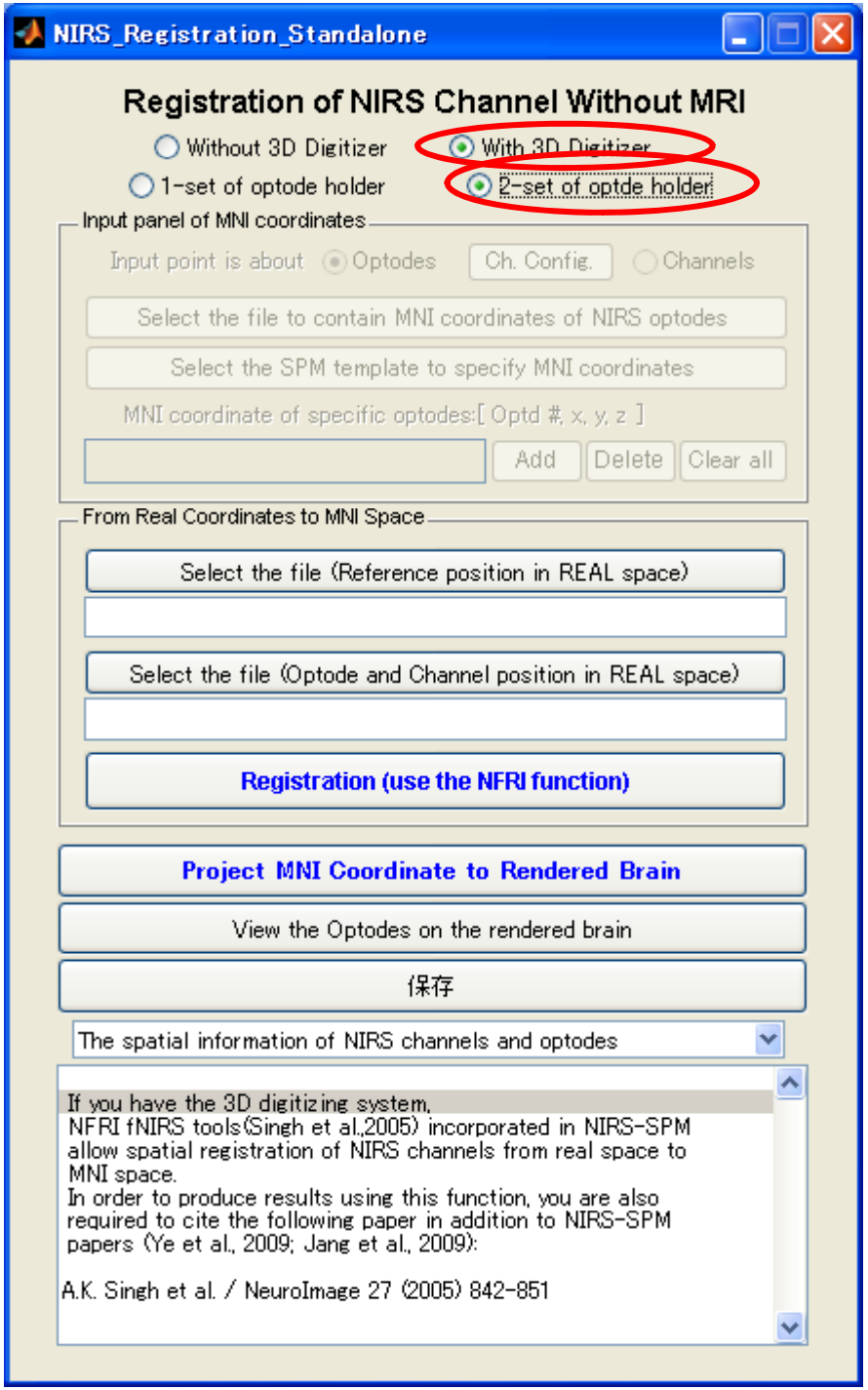


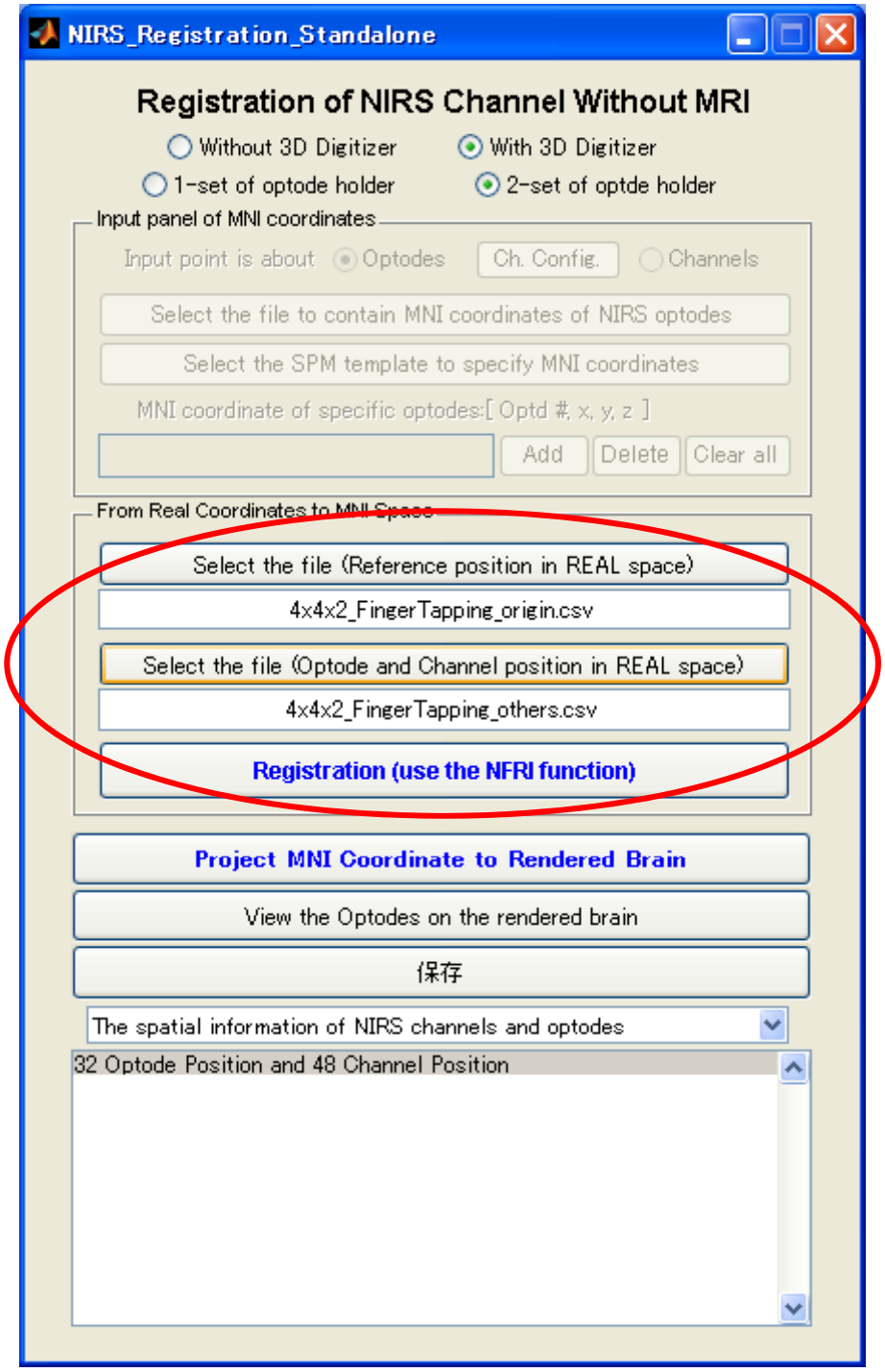
	A	B	C	D
14	R7	24.19	-1.61	27.37
15	T8	24.6	-2.48	17.26
16	R8	25.49	-2.1	20.5
17	T9	24.28	1.11	26.78
18	R9	25.61	0.68	23.3
19	T10	25.52	0.59	19.92
20	R10	24.78	0.27	16.65
21	T11	24.84	3.89	22.73
22	R11	23.67	4.52	26.55
23	T12	23.96	3.04	16.17
24	R12	24.94	4	19.52
25	T13	21.18	6.6	25.62
26	R13	22.74	6.14	22.31
27	T14	22.46	5.91	18.83
28	R14	21.36	5.41	15.77
29	T15	19.99	8.09	21.72
30	R15	18.35	7.27	24.85
31	T16	18.38	6.79	15.5
32	R16	19.7	7.34	18.52
33	CH01	18.25	-8.695	24.85
34	CH02	19.31	-9.42	21.805
35	CH03	18.62	-9.345	18.565
36	CH04	18.78	-7.525	26.495
37	CH05	20.785	-8.6	23.71
38	CH06	20.77	-8.71	20.365
39	CH07	19.47	-8.57	17.185

T**, X, Y, Z
R**, X, Y, Z
CH**, X, Y, Z

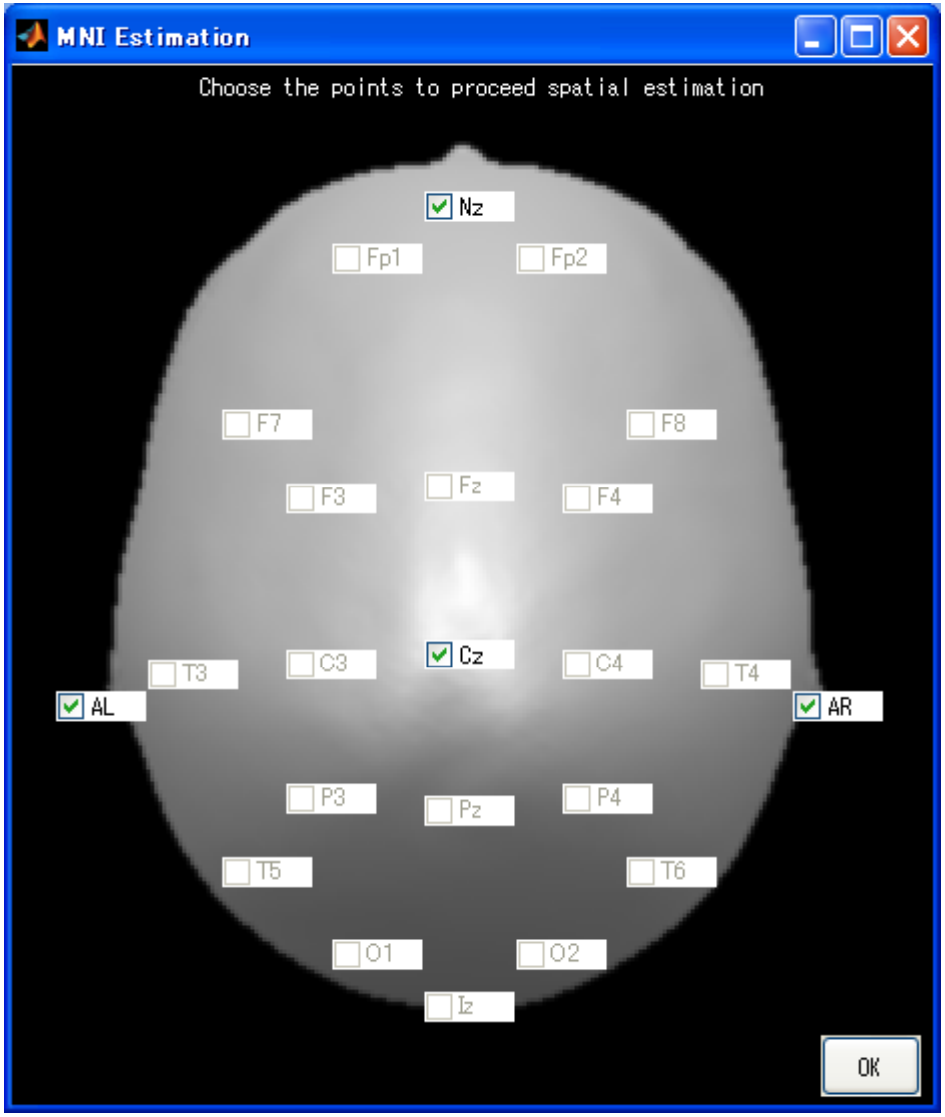
CH is center point of logical target T,R

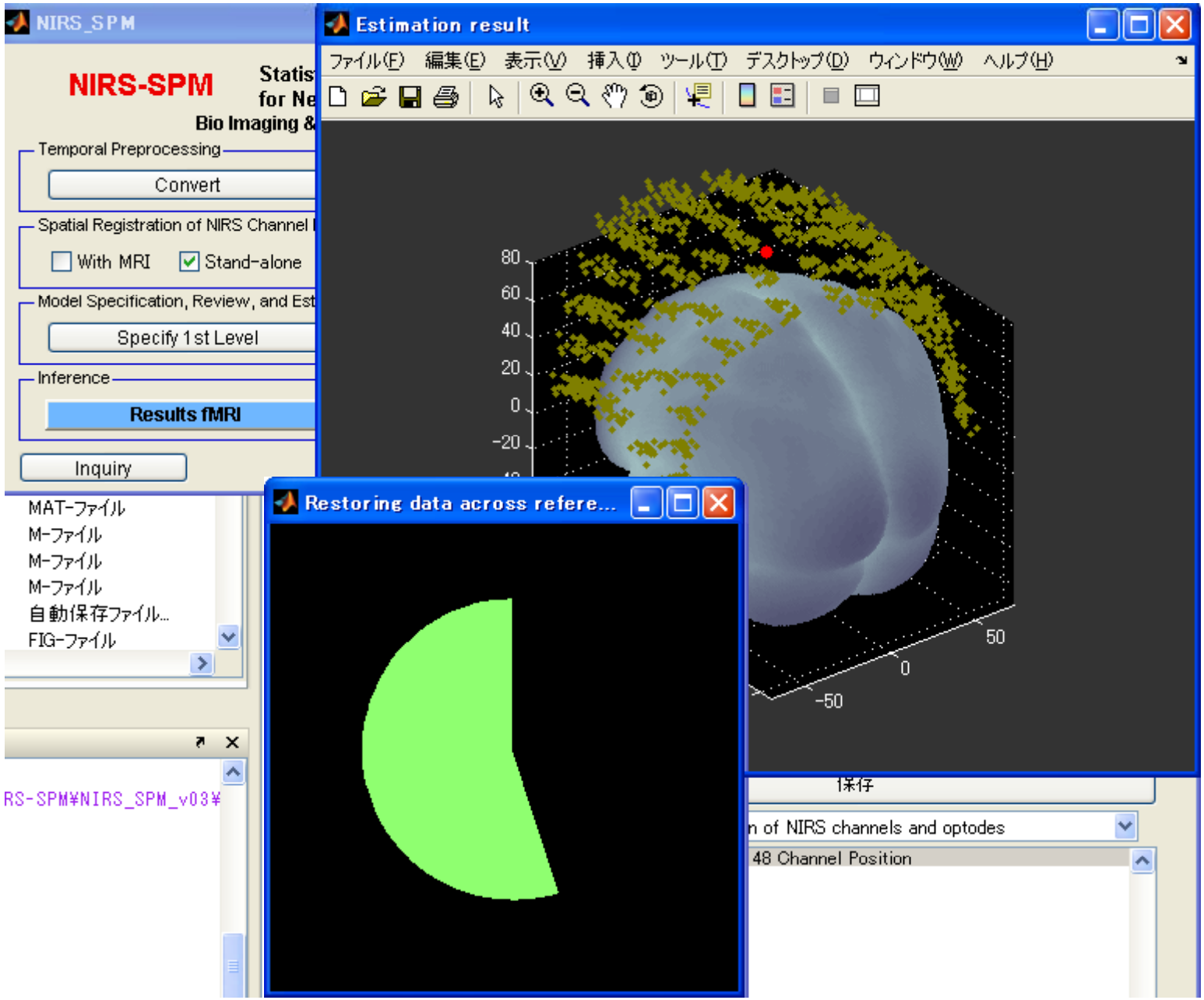
NIRS_Registration_Standalone



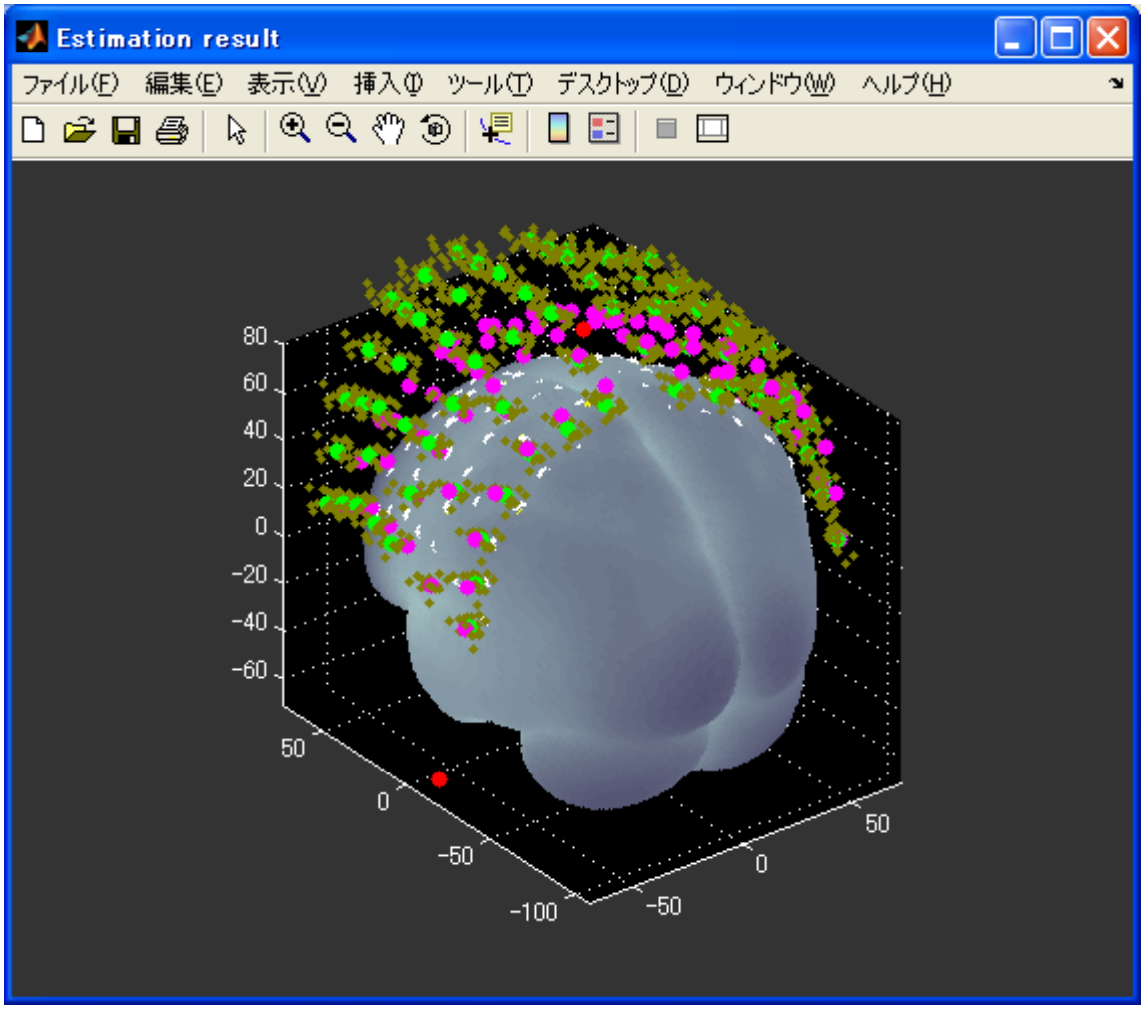

NIRS_Registration_Standalone
Registration of NIRS Channel Without MRI
Without 3D Digitizer
With 3D Digitizer
1-set of optode holder
2-set of optde holder
Input panel of MNI coordinates
Input point is about
Optodes
Ch. Config.
Channels
Select the file to contain MNI coordinates of NIRS optodes
Select the SPM template to specify MNI coordinates
MNI coordinate of specific optodes:[Optd #, x, y, z]
Add
Delete
Clear all
From Real Coordinates to MNI Space
Select the file (Reference position in REAL space)
4x4x2_FingerTapping_origin.csv
Select the file (Optode and Channel position in REAL space)
4x4x2_FingerTapping_others.csv
Registration (use the NFRI function)
Project MNI Coordinate to Rendered Brain
View the Optodes on the rendered brain
保存
The spatial information of NIRS channels and optodes
32 Optode Position and 48 Channel Position

MNI Estimation

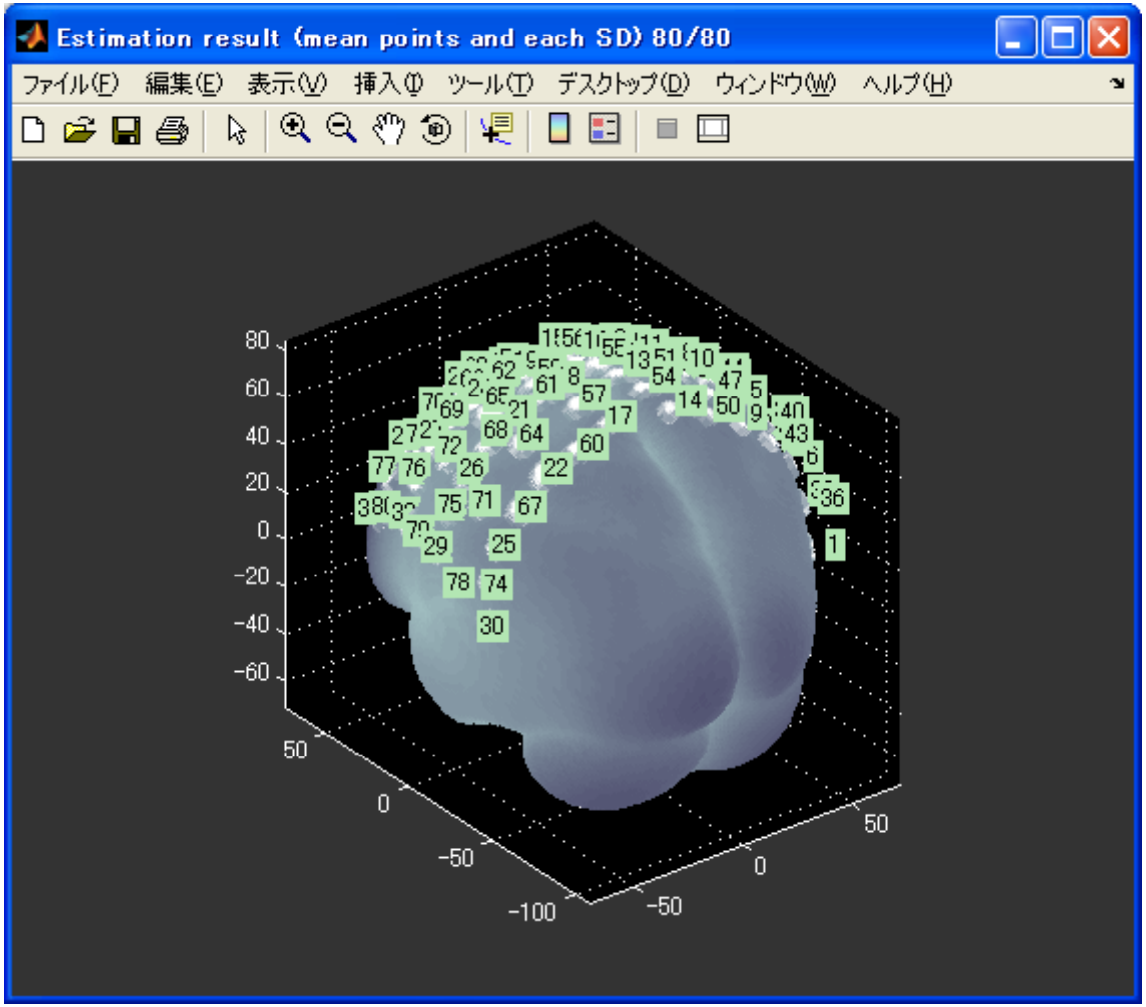



NIRS_SPM
NIRS-SPM
Statis
for Ne
Bio Imaging &
Temporal Preprocessing
Convert
Spatial Registration of NIRS Channel
With MRI
Stand-alone
Model Specification, Review, and Est
Specify 1st Level
Inference
Results fMRI
Inquiry
MAT-ファイル
M-ファイル
M-ファイル
M-ファイル
自動保存ファイル...
FIG-ファイル
RS-SPM¥NIRS_SPM_v03¥
Estimation result
ファイル(F) 編集(E) 表示(V) 挿入(I) ツール(T) デスクトップ(D) ウィンドウ(W) ヘルプ(H)
80
60
40
20
0
-20
50
0
-50
Restoring data across refere...
保存
n of NIRS channels and optodes
48 Channel Position

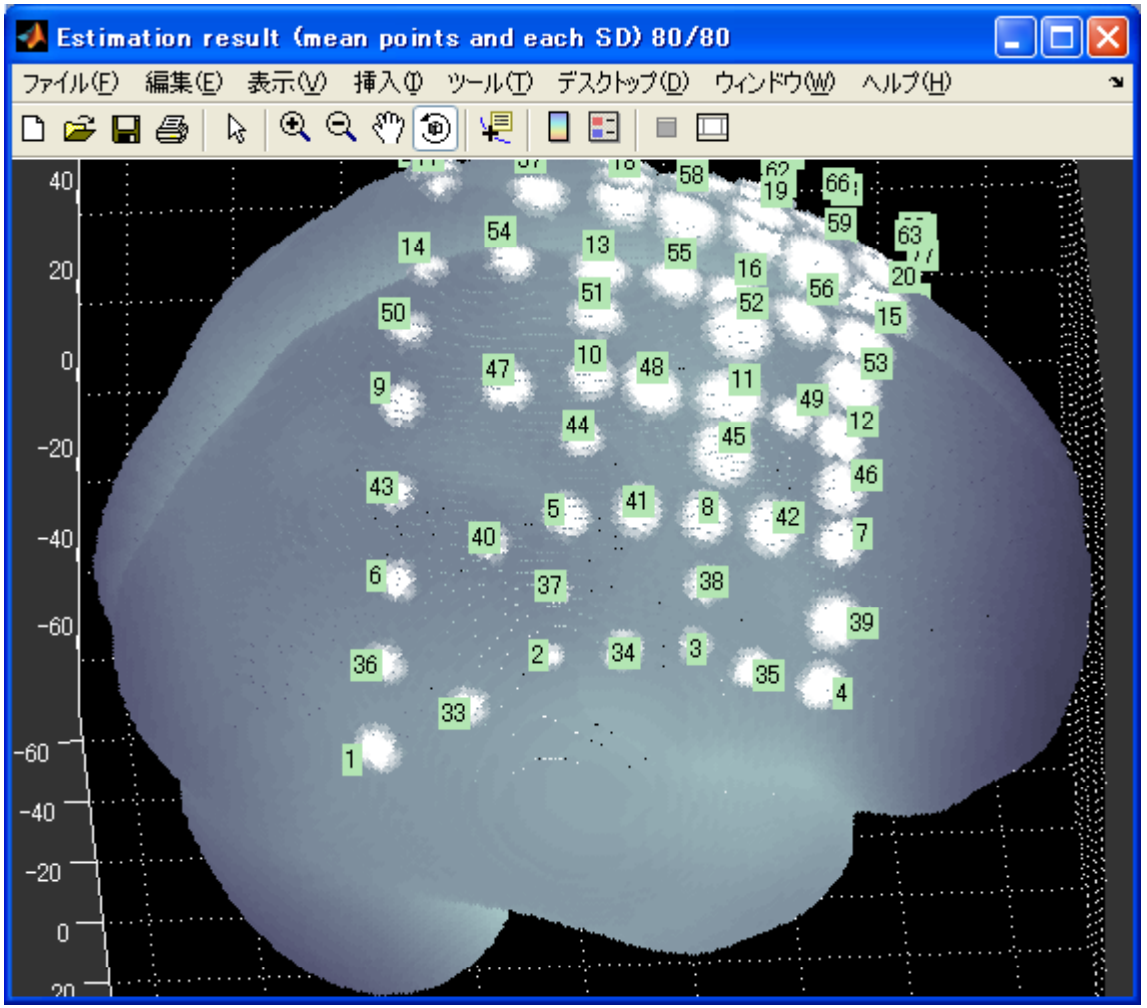
Estimation result



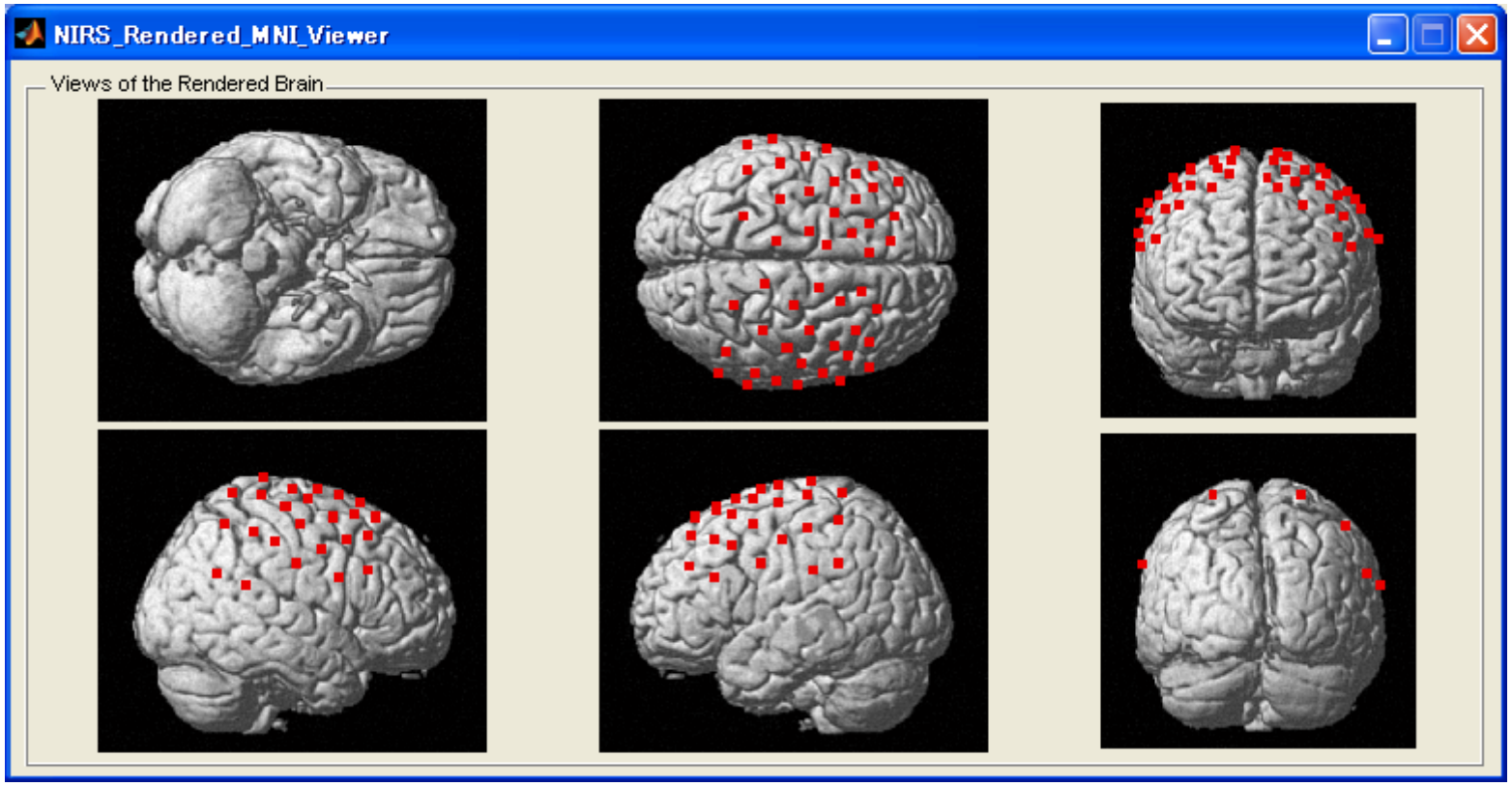
Estimation result



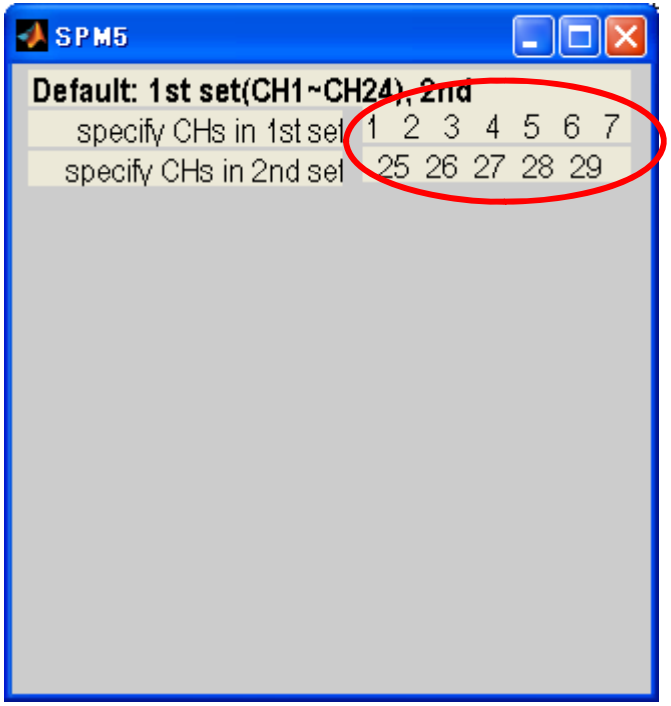
Zoomed


Estimation result (mean points and each SD) 80/80
ファイル(F) 編集(E) 表示(V) 挿入(I) ツール(T) デスクトップ(D) ウィンドウ(W) ヘルプ(H)
40
20
0
-20
-40
-60
-60
-40
-20
0
20
58
19
66
59
63
20
14
54
13
55
16
56
51
52
50
15
10
48
53
47
11
9
49
12
44
45
46
43
5
41
8
42
7
40
6
37
38
39
36
2
34
3
35
4
33
1

Project….



Save Ch.



Shimadzu_Saved_48ch_without_MRI.mat