Matlab Code

For reading and processing Hitachi ETG-4000 data

A Quick Overview

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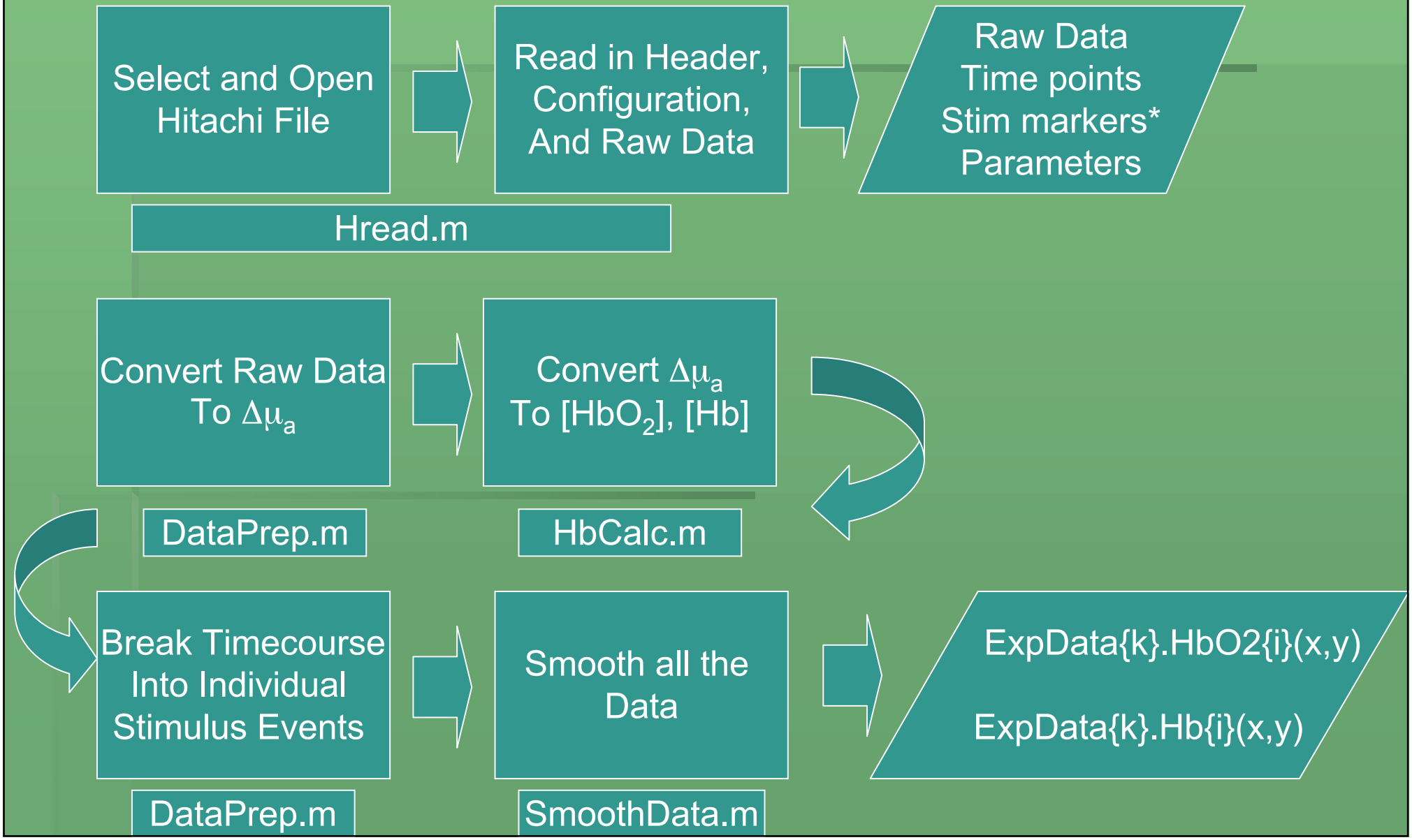
*.m Files

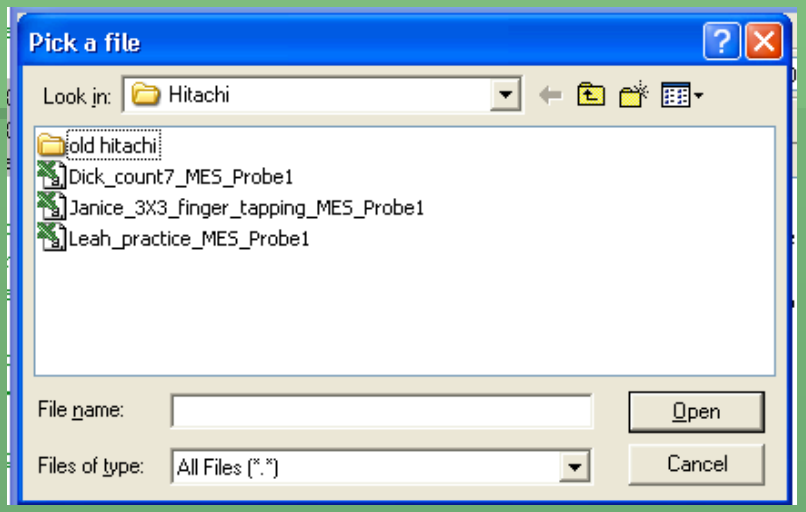
- Dataprep.m
  - Executive function for data reading/processing
- Hread.m
  - Reads and parses Hitachi data
  - Also calls:
    - Probe3x3config.m
    - Probe3x5config.m
    - Probe4x4config.m
- Smoothdata.m
  - Smooths data in two ways:
    - FFT filter
    - Savitsky-Golay filter
- HbCalc.m
  - Converts Data from μ_a to Oxy-Deoxy concentration changes
  - Also calls:
    - LoadHb.m

Block Diagram of Code



Reading in Data (Hread.m)

- Opens a Dialog Box, select a file…
- Scans Header for:
  - PreScan
  - Probe Config
  - Wavelengths for each channel
  - Data rate
  - Stim types and lengths
    - rests are not in header! They are extracted from the raw data markers instead
- Raw Data and Time point array are parsed



where j=stimulus type, x=measurment data, y=channel

Data(j).lam1wavelen(y)	specific wavelength ~698
Data(j).lam1intensity=measurements(x,y)	detected values @~698
Data(j).lam2wavelen=lambdas(y)	specific wavelength ~824
Data(j).lam2intensity=measurements(x,y)	detected values @~824

timepoints(x) time value per data point

ActiveStim(i).name	stim type 1=A 2=B etc...
ActiveStim(i).onTime	Stim time in seconds
ActiveStim(i).offTime	Rest time in seconds

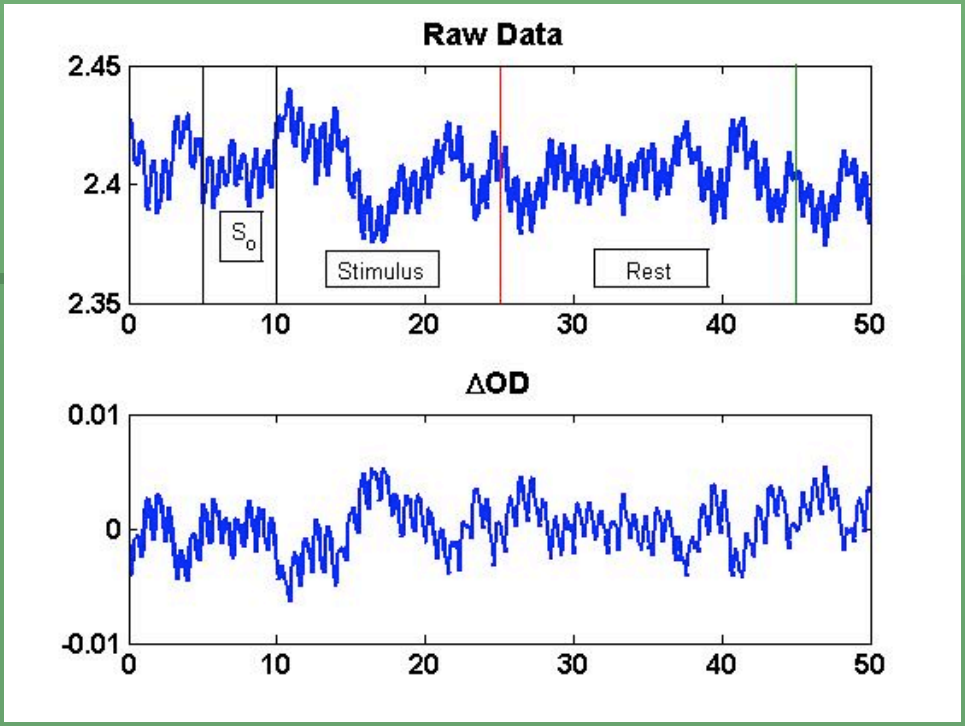
Parameters.TotalTime	Time of entire acquisition (sec)
Parameters.PreScanTime	Time of prescan
Parameters.WaitTime	Time of wait prior to first stim
Parameters.StimRepeats	Number of epochs
Parameters.NumActiveStims	Number of different stimuli

Convert Raw Data to $\Delta\mu_a$

- From Beer's Law: $\frac{S}{S_o} = e^{-\Delta\mu_a^{\lambda}\langle L\rangle}$

$$\Delta\mu_a^{\lambda} = \frac{-\log\left(\frac{S}{S_o}\right)}{\langle L\rangle}$$

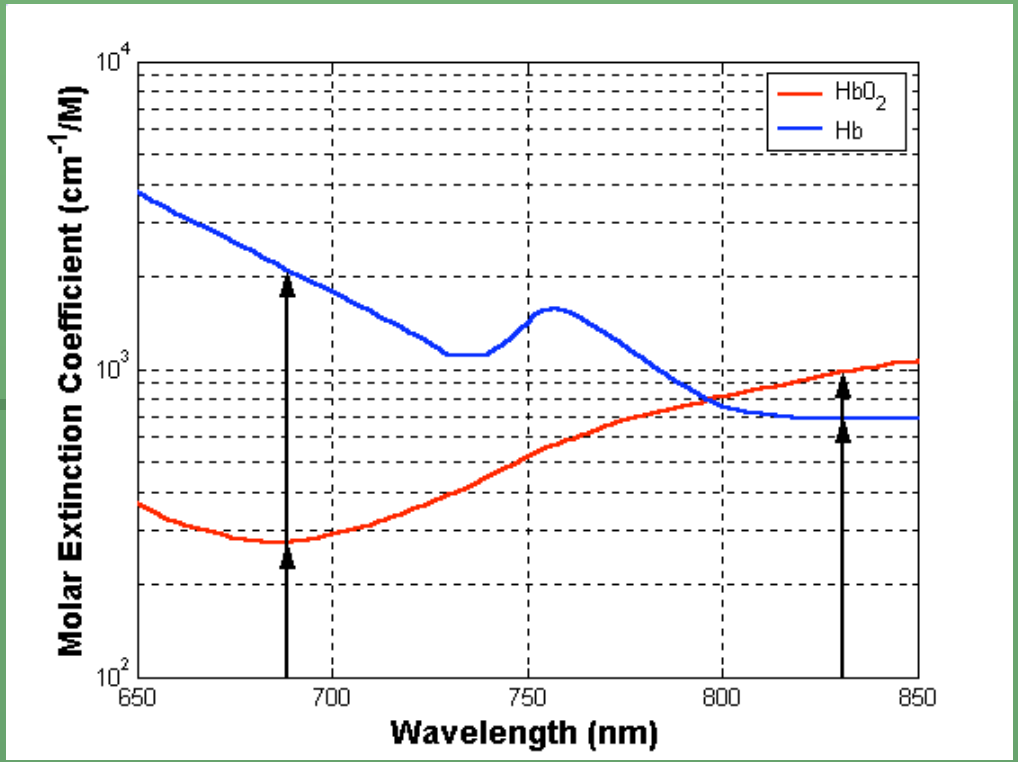
- In DataPrep,
  - S is the timecourse
  - S_o is the average value of the raw data from the end of the prescan time to the end of the initial wait period
  - **Assumption**: <L> = 5 for Source-Detector Separation of 3cm



Convert $\Delta\mu_a$ to HbO_2 and Hb

$$\begin{pmatrix} \Delta\mu_a^{690nm} \\ \Delta\mu_a^{830nm} \end{pmatrix} = \begin{pmatrix} \varepsilon_{HbO_2}^{690nm} & \varepsilon_{Hb}^{690nm} \\ \varepsilon_{HbO_2}^{830nm} & \varepsilon_{Hb}^{830nm} \end{pmatrix} \begin{pmatrix} \Delta[HbO_2] \\ \Delta[Hb] \end{pmatrix}$$

- HbCalc.m
  - Input
    - $\Delta\mu_a$ timecourse
    - Specific wavelength
  - LoadHb.m finds the wavelength specific absorptivities, ε, for oxy and deoxy from a look-up table.
  - Concentrations are calculated by taking the inverse of the absorptivity matrix.



Smoothing

- Two methods of smoothing, performed on each epoch
  - FFT filtering
    - 1) removes baseline frequencies of each epoch
    - 2) removes high frequency spikes (artifacts) based on a threshold
  - Savitisky-Golay
    - Smoothes data in mid frequency range
      - 2 parameters
        - Window size
        - Order of filter

Final Output

- ExpData{k}.HbO2{i}(x,y)
  ExpData{k}.Hb{i}(x,y)
  where k=stim type, i=channel, x=epoch #, y=data points
- In light of the new type of stimulus
  - Data ought to be kept as an entire time course?
- Other changes:
  - Output timepoints?
  - Other smoothing/signal processing tools?
- Analysis tools?