

# User manual for the HeadMotion program. Version 2.0

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September 29, 2006

## 1 Introduction

The HeadMotion program is used for computing the movement of the head of the test subjects involved in the torticollis project. The program computes the position and orientation (called *pose*) of the head as well as the velocity and acceleration. The program stores the results in a database, together with information specific for the test subject and the trial.

It is not possible to store the same trial twice in the database. This is enforced by checking the timestamp of each trial. This string, which is present in the tsv data file, gives the date and the time (down to seconds) of when the data was collected. This timestamp must be unique for every trial in the database.

The data in the database can be analyzed by creating groups of trials, and then run analyses, often comparisons, between the groups.

You start the program by double-clicking on the “HeadMotion.bat” icon on the desktop.

## 2 User interface

The graphical user interface contains three tabs: The Process tab, the Search tab and the Analyze tab. The Process tab is used when adding new trials to the database. The Search tab is used to search among the trials in the database. The Analyze tab is used to create groups of the trials in the database, and then run an analysis on the groups.

### 2.1 The Process tab

The tab contains a number of text fields and so-called “combo-boxes”. The combo-boxes store alternatives that can be chosen for each field. See figure 1

Of the three buttons at the bottom, the left (“Process”) is used to add a new trial to the database, the middle (“Correct trial”) is used to edit the

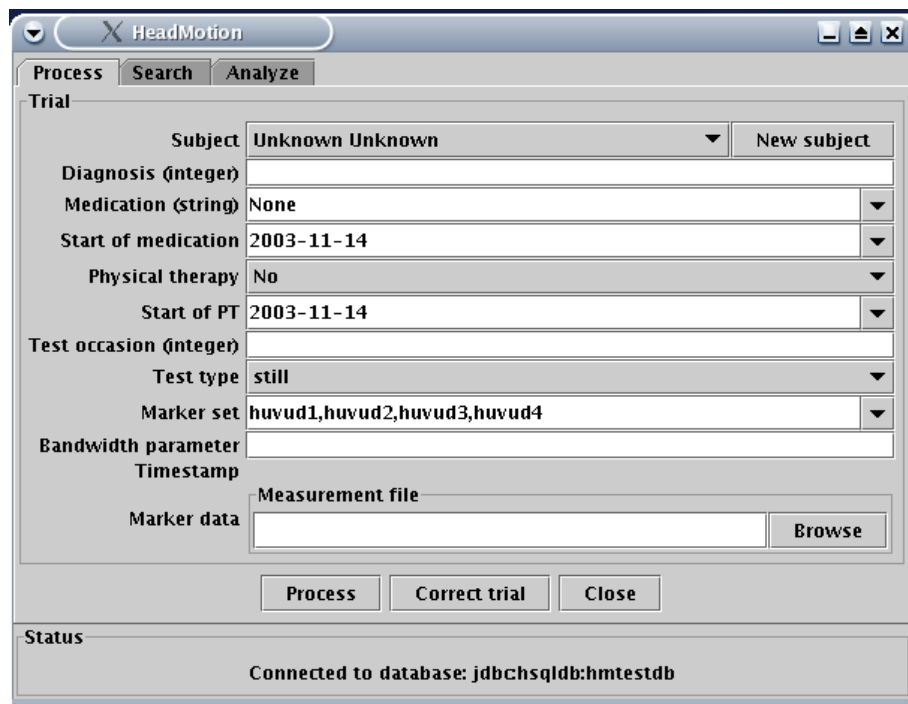


Figure 1: Graphical user interface

information about an existing trial, and the right (“Close”) will close the program.

### 2.1.1 Adding a new trial to the database

To process trials and add them to the database, follow the given steps:

1. Choose the subject. To add a new subject, edit an existing or searching for a subject, press the “Add/Edit subject” button. This launches a dialog. See explanation in the next section.
2. Choose the measurement file (a .tsv file) by clicking the “Browse” button. This will launch a standard file chooser dialog.
3. Set the information about the subject and the trial:

**Diagnosis** This integer represents the diagnosis. 0 would typically indicate a healthy person, and any other number some code that has to be defined.

**Medication** Some standard botolinum toxins are listed.

**Start of medication** Set to empty if no medication is given.

**Physical therapy** Yes or no.

**Start of PT** Set to empty if no PT is prescribed.

**Test occasion** 1 for the first time, 2 for the second, etc.

**Test date** Self-explanatory

**Test type** This list could be expanded as new tests are defined.

**Marker set** The names of the markers on the head. If other names than those suggested are used, then write the names separated by commas.

**Bandwidth parameter** This parameter controls the computations. A number greater than 1 will give less smoothing of the results. However, the high frequency noise in the data will start to dominate the calculated velocity and acceleration.

4. Click “Process” to compute the movement and add the results to the database.
5. The results will be presented in a separate plot window. A dialog will also pop-up, and ask you to save to a text file. If you want the results in a text file for importing to excel, then enter a suitable name and click “Save”. Otherwise, just cancel: the data is saved in the database in any case.
6. If you want to print the results directly, there is a print button on the plot window. The quality is not perfect. I will try to improve it later.

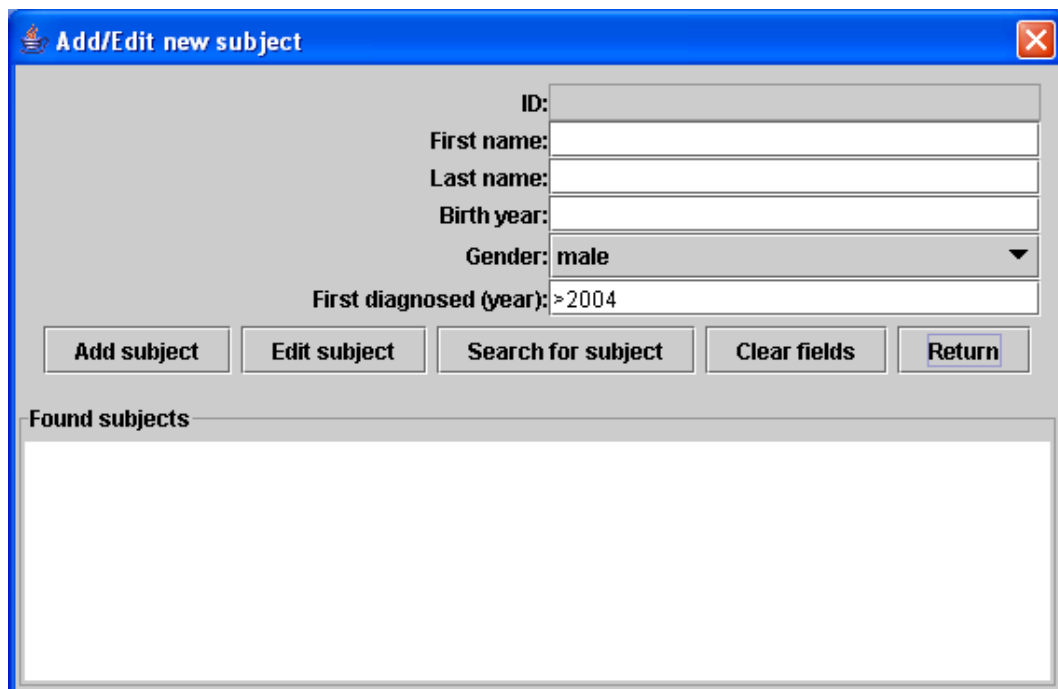
### 2.1.2 Adding, searching and editing subject information

Figure 2 shows the dialog for handling information on the test subjects. To add a new subject to the database, simply fill out the form and press “Add”. To search for a subject, type in search criteria in the fields and press “Search for subject”. Here are some examples of how to set search criteria:

- First or last name: The character “%” can be used as a wild card, so if you write “A%” for first name, you search for all subjects with first name starting with A.
- Birth year: Use  $> 1950$  to search for subjects born after 1950.
- First diagnosed: Use  $< 2004$  to search for subjects diagnosed before 2004.

### 2.1.3 Editing the information for an existing trial

Sometimes the information for a specific trial needs to be changed. An example of this is when artefacts in the data make the trial unfit for further analysis. A trial cannot be deleted from the database, but we can make



A screenshot of a software dialog box titled "Add/Edit new subject". The dialog has a blue title bar with a close button (X) in the top right corner. The main area is light gray and contains several input fields and buttons. The fields are labeled "ID:", "First name:", "Last name:", "Birth year:", "Gender:", and "First diagnosed (year):". The "Gender:" field is a dropdown menu currently showing "male". The "First diagnosed (year):" field contains the text ">2004". Below the fields are five buttons: "Add subject", "Edit subject", "Search for subject", "Clear fields", and "Return". At the bottom of the dialog is a section labeled "Found subjects" followed by a large, empty white rectangular area.

**Add/Edit new subject**

ID:

First name:

Last name:

Birth year:

Gender: male ▼

First diagnosed (year): >2004

**Found subjects**

Figure 2: Dialog for handling the subject information

sure that it will not show up when we define groups from the trials (see the section on the Analyze tab).

To open a specific trial to edit, you first need to find it by using the Search tab (see section below). You can see that a trial is ready to be edited by checking that the Timestamp field has a value. Change the information for the trial, and then click on “Correct trial” to save the changes to the database. To continue with the example above, change Test occasion to a negative number. It will then be easy to avoid the trial when defining groups. It is a good idea in this case to set the Test occasion to  $-2$  if the number was 2, and so on, in order to remember what it originally was.

## 2.2 The Search tab

The Search tab is used for searching among the trials in the database. Figure 3 shows the interface. In the displayed example, the database has been searched for healthy subjects (Diagnosis set to “=0”), trials from the first test day (Test occasion set to “=1”) and trials with the head kept still (Test type set to “still”).

A trial may be edited by selecting it in the list, and then click the “Edit trial” button. The information about the trial will then be presented in the Process tab.

## 2.3 The Analyze tab

The tab consists of a list of groups, with buttons that will add a new group, edit an existing one, or delete selected groups. See Figure 4. The tab also contains a drop down list with different types of analyses that can be run on the groups. The left of the two buttons on the bottom will start the analysis. The right button will close the program.

### 2.3.1 Adding or editing a group

Upon clicking the New button, a dialog pops up (Figure 6). Enter a descriptive name for the group and click OK.

A new window pops up, in which you define the trials that should go in the group. Clicking Edit in the Analyze tab will bring you directly to this window. Figure ?? shows the interface for a case when the group already contains a set of trials. Note that the name of the group appears on the window’s title bar. The interface works very much like the Search tab. The upper left frame, titled “Search trial” is used to define search criteria. If all fields (Diagnosis, Medication, Physical therapy, Test occasion and Test type) are left with no values set or chosen, then a search will return all the trials in the database. If, for instance, Test type is set to “still”, then a search will return all trials with the test subject keeping the head still. If,

HeadMotion

Process Search Analyze

Search trials

Subject: Subject: 14 Ture Tureson male Add/search subject

Diagnosis (integer)

Medication (string)

Physical therapy

Test occasion (integer)

Test type

Timestamp from: 1900-01-01 to: 2010-12-31

Search for trials

Found trials

Edit trial Delete trials Close

Status

Connected to database: jdbc:hsqldb:hmtestdb

Figure 3: The Search tab

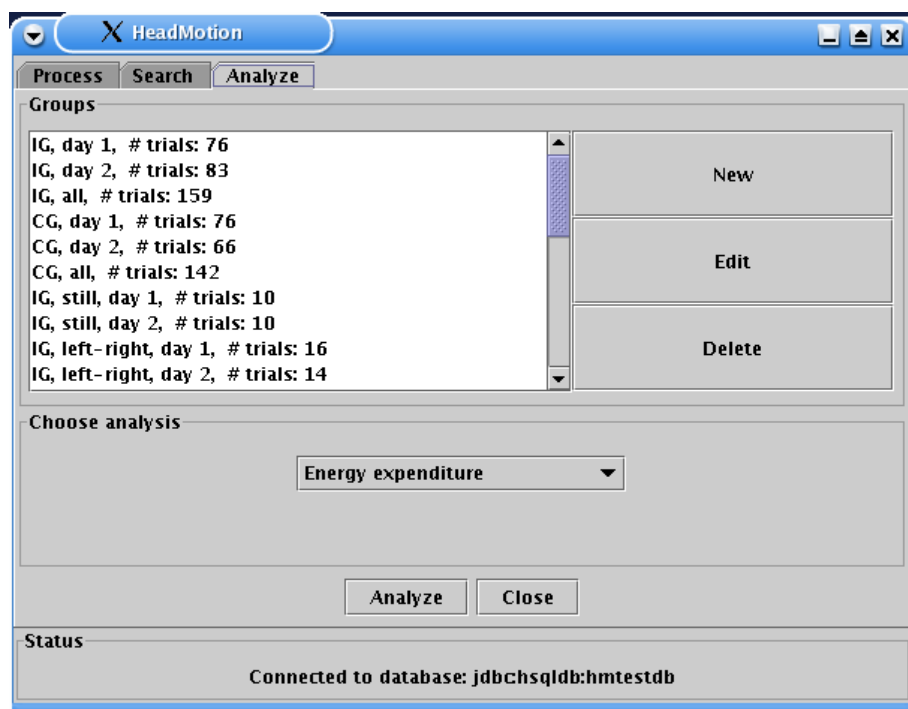


Figure 4: The Analyze tab

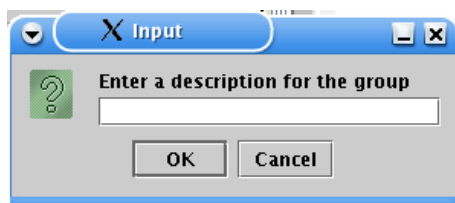


Figure 5: The new group dialog

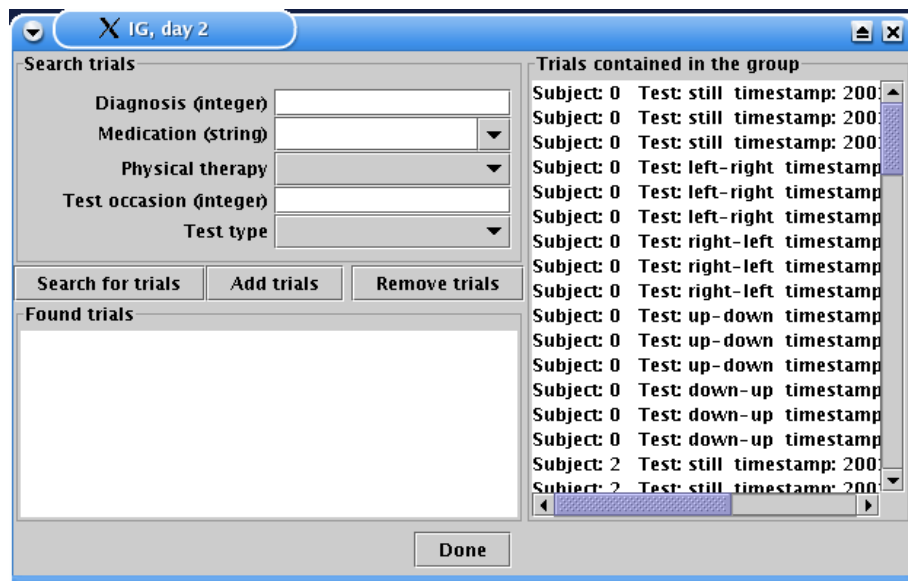


Figure 6: The interface for defining the trials that go into a group

furtheron, Diagnosis is set to “0”, then a search will return all patient trials with the head still.

The Diagnosis and Test occasion fields work in the same way. Define a criterion by writing either of “=”, “|” or “<”, followed by an integer. Remember that healthy control subjects have diagnosis 0. Writing “=0” in the Diagnosis field will give trials for control subjects only.

The trials that are found in a search will appear in the list on the lower left of the interface, titled “Found trials”. To add trials from this group to the group you have to first select them, and then click the “Add trials” button. The selected trials will appear on the list to the right. Trials that are already there will not be added, so there are no risk of duplicating trials in the group.

To remove trials from the group, select the trials in the right side list, and then click the Remove trials button.

Click Done when you are satisfied with the contents of your group. If the group is empty (no trials on the right side list), then it is discarded.

### 2.3.2 Running an analysis

The two most important analyses in the current version (1.0), are “Energy expenditure” and “Energy expenditure test-retest”. To run either of the analyses, choose two groups from the list, pick the analysis and click “Analyze”. Depending on the size of the groups, the analysis may take quite some time (several minutes).

The analyses:



**Energy expenditure** Comparison of the Energy Expenditure Index between two independent groups using the Wilcoxon two sample test. The EEI is computed for each trial in the groups. Before running the Wilcoxon test, each group is *consolidated*. By this is meant that all the trials in the group that is from the same test subject and the same test type are averaged. The hypothesis test is performed on the averages. The result from the test is presented in a dialog (Figure 7) and the EEI valuse are plotted on a logarithmic scale (Figure 8).

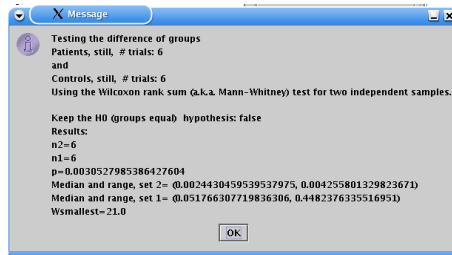


Figure 7: The results from an Energy expenditure analysis.

**Energy expenditure test-retest** Comparison of EEI between two groups with matching trials. Uses the Wilcoxon matched-pairs signed rank test. The trials are matched up if they are from the same test subject and the same test type. The results are presented as in Figures 9 and 10.

**Diagnose** Goes through the trials in a group and checks for unexpected large values of EEI. If found, the data for the trials are plotted.

**Edit the database entries** Will display all the trials in the selected group in the list in the Search tab (Figure 3).

**Print info** Prints out on the comman prompt the subject ID number, the Test type, and the timestamp for each trial in the group.

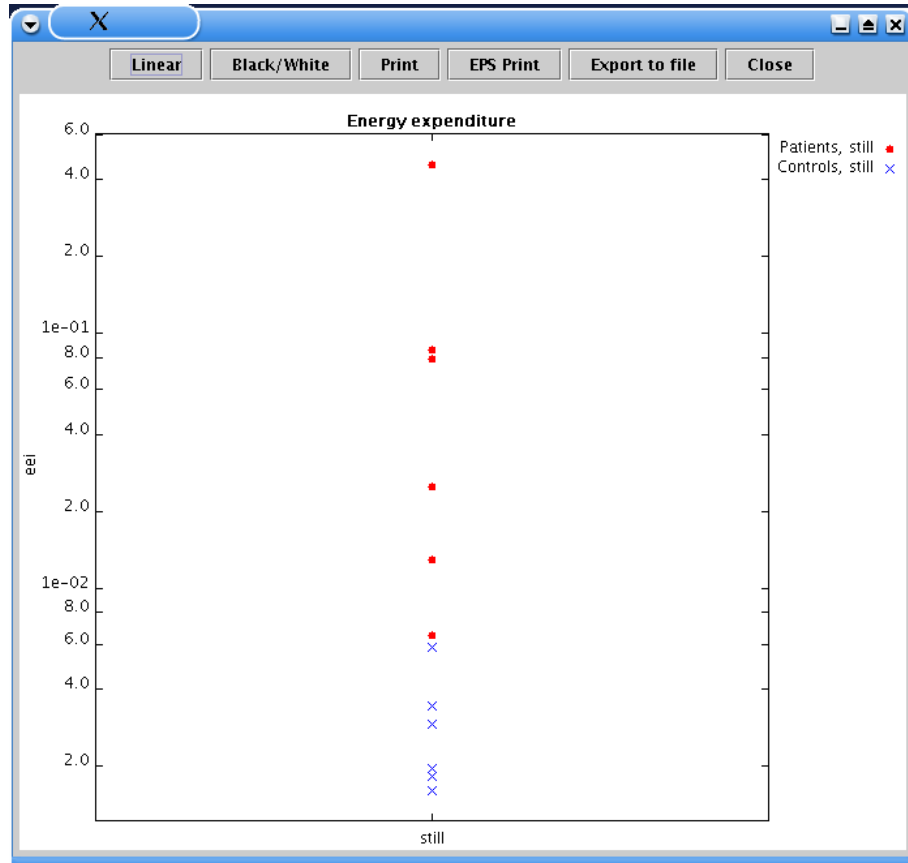


Figure 8: Resulting Energy Expenditure Index plotted.

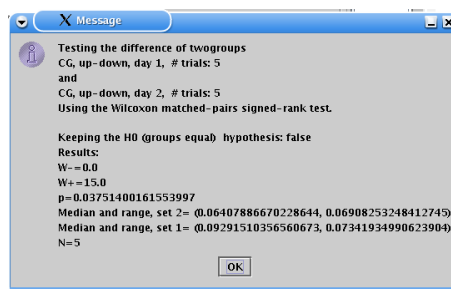


Figure 9: The results from an Energy expenditure test-retest analysis.

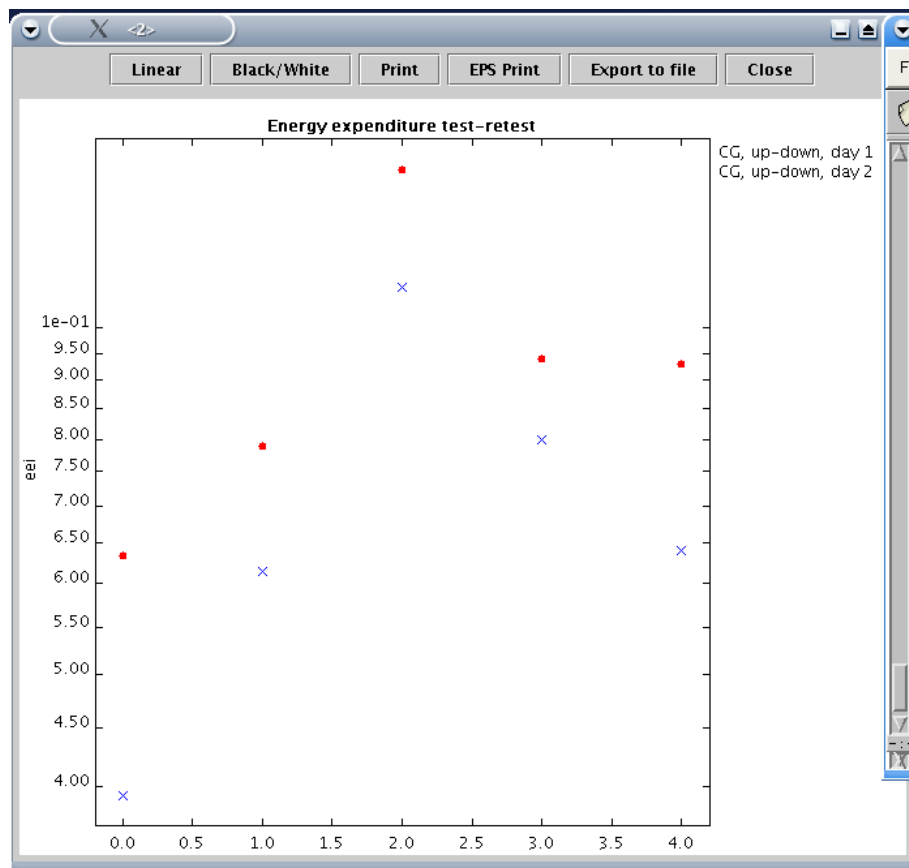


Figure 10: Pairs of matched Energy Expenditure Index values are plotted.