I. Content

I. Content 1
II. Head correction 2
Using cs5normpos 2
1. Choosing a session folder 2
2. The Reference Object File 3
3. Head Correction 4
4. Running the program 5
5. Quality of head correction 6
a) Taxonomic distances 6
b) Mutual distance of reference sensors 7
6. Filters 7
III. Revision history 7

II. Head correction

cs5normpos is a program for performing a head correction on pos-files of the AG50x. The program first generates a reference object from a given number of samples of a sweep-file containing a static configuration that serves as a target during head correction.
In a second step it performs the head correction.
The head correction (rigid body analysis) does two things: First, it determines a set of rotation and translation parameters per data frame that represent the optimal superimposition of the reference sensors in the reference object and the data frame analyzed in a least-squares sense. This roto-translation is organized as a 4x4 matrix of homogeneous coordinates. Second, this transformation matrix is applied to all sensors of a given data set resulting in the head corrected data that is the target of scientific analysis.

cs5normpos is a graphical interface for the normposcmd console application by Christian Geng using algorithms by Gower (1975)[1] as well as Rohlf and Slice (1990)[2].

Using cs5normpos

1. Choosing a session folder

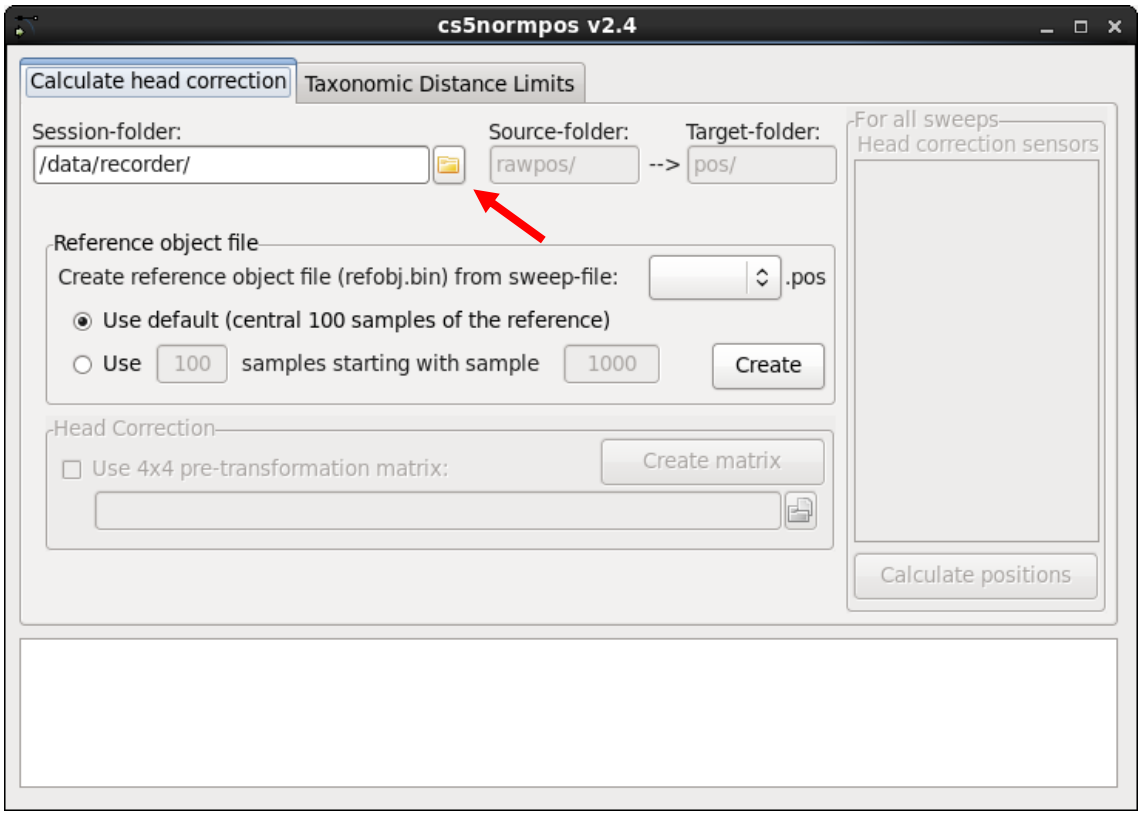

Figure 1: Selecting a session folder

The session folder is the working directory containing the “amps”- and “rawpos”-directories. The uncorrected raw position data is situated in the rawpos-folder (source-folder) whereas the reference object file (refobj.bin) and the head-corrected data that is processed are saved in the pos-folder (target-folder). The target-folder will be created if it does not already exist.

[1] Gower, J.C. (1975). Generalized Procrustes Analysis. Psychometrika 40, p. 33-51
[2] Rohlf, F.J. and Slice, D. (1990). Extensions of the Procrustes Method for the Optimal Superimposition of Landmarks. Systematic Zoology 39, p. 40-59.

2. The Reference Object File

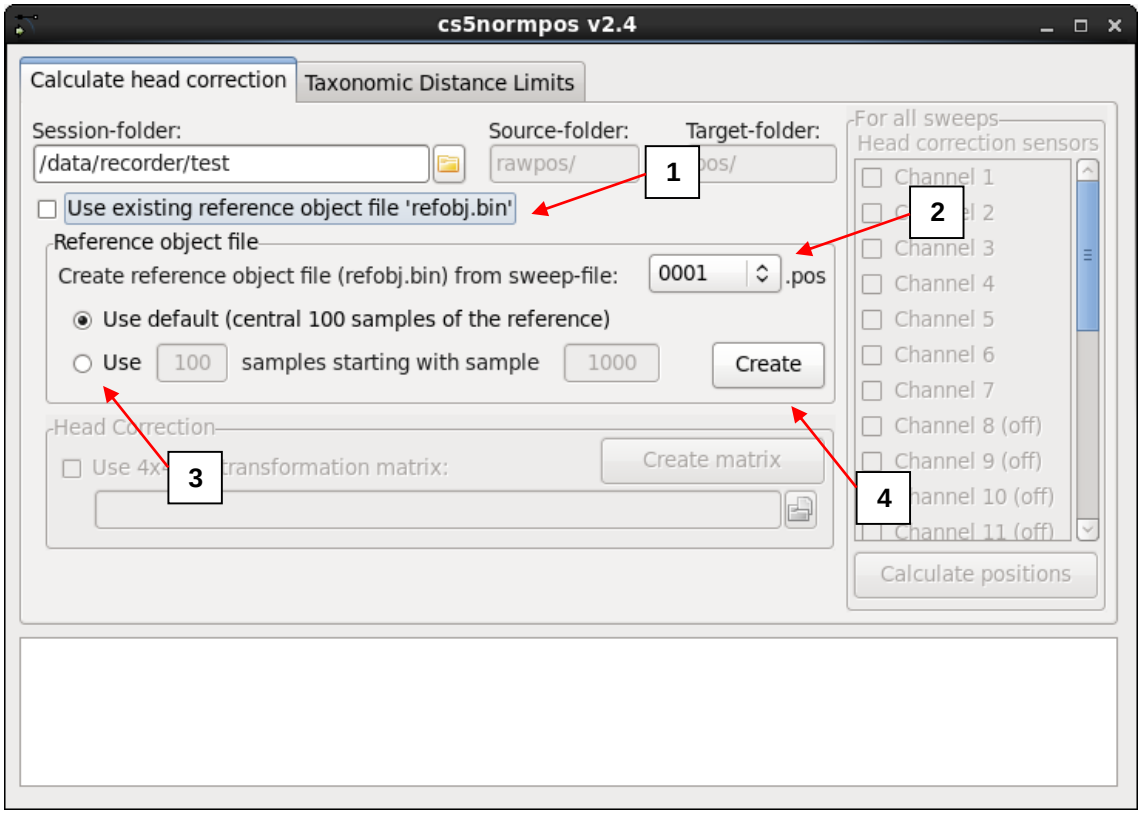

Figure 2: Generating the reference object

The program detects whether a reference object file ('refobj.bin') already exists in the pos-folder and marks the “Use existing reference object file”-option if applicable (Figure 2-1).
To create a new reference object file, the “Use existing...”-option has to be unchecked. The new reference object file will be created from the specified sweep-file ('0001.pos' in Figure 2-2). Please make sure the file exists in the rawpos-folder.
By default the central 100 samples of the chosen sweep-file will be used to generate the reference object file. However, by selecting the lower option (Figure 2-3) you can specify the samples of the sweep-file to be used for the reference object generation.
Click *Create* (Figure 2-4) to generate the reference object file.

3. Head Correction

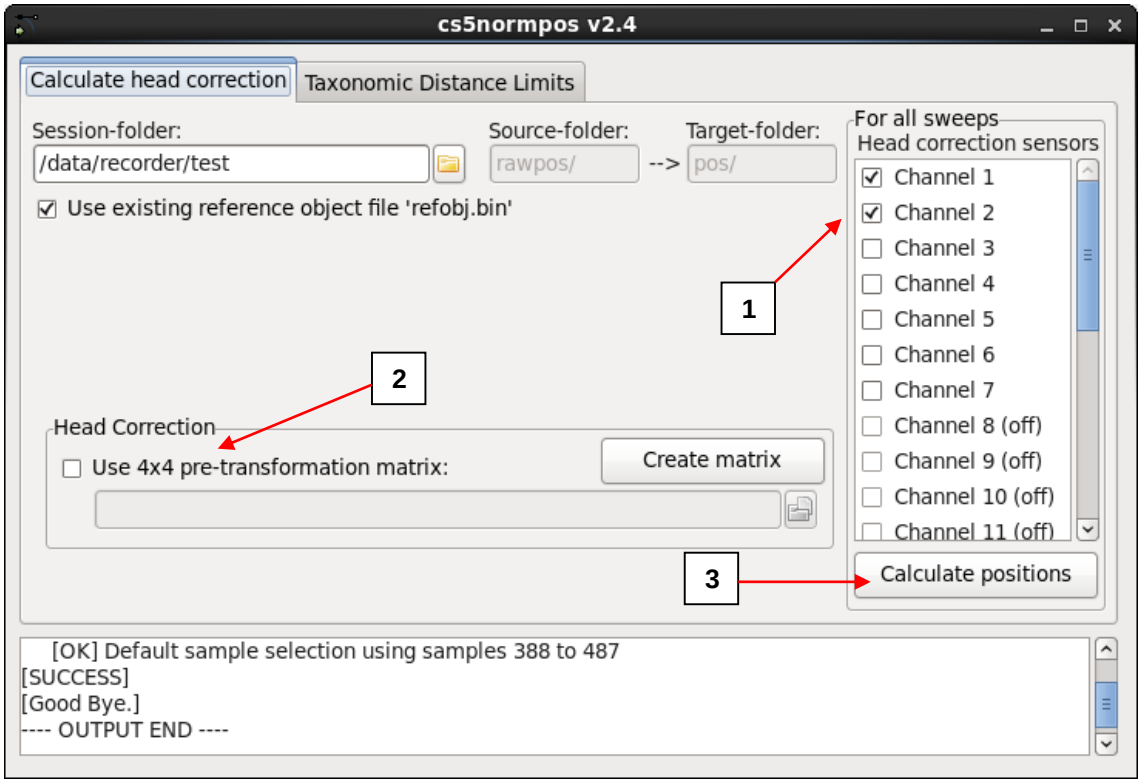

Figure 3: Head correction

For the head correction, the program requires at least two sensors (channels) to function as reference sensors but it is good practice to use more than that - if available.
Any quasi-stationary location on the head could in principle serve as a gluing location but in practice the most common locations are the upper incisors, the nasion, and behind the left and the right ear. The corresponding channels have to be selected in the “Head correction sensors”-section (Figure 3-1).

Optionally a pre-transformation matrix can be applied prior to the head correction. This allows moving the data to a defined reference object (for instance the biteplane to the horizontal centered to the midsagittal plane). Please refer to the Head Correction HowTos (AI-05) for details on creating a pre-transformation matrix.

4. Running the program

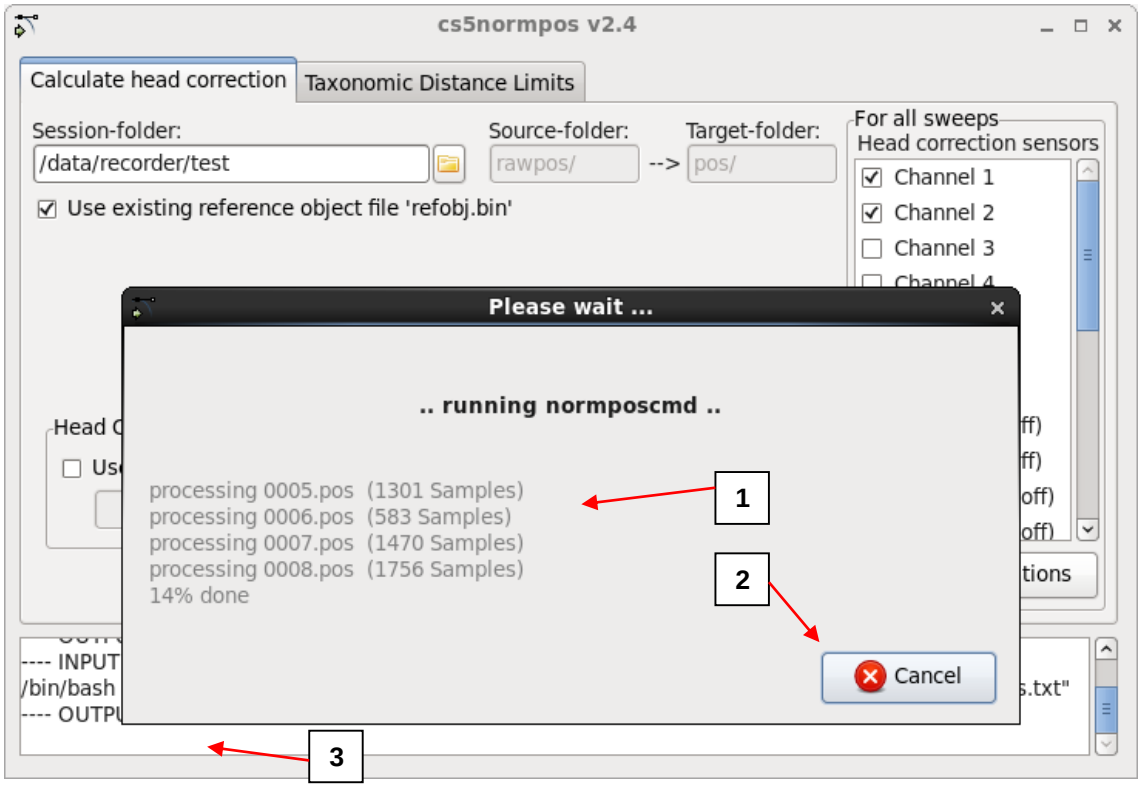

Figure 4: Calculating the positions

Once the channels of the reference sensors are selected, the head correction can be started by clicking the “Calculate positions”-button (Figure 3-3).

During calculation a status dialog provides information on which files are being processed (Figure 4-1) and enables you to abort the calculation (Figure 4-2).

Since the program does no calculations itself but calls the console application normposcmd with all chosen parameters, the text field taking up the bottom of the window (Figure 4-3) shows the input and output of the console application.

Please check the output of the program for generation details and possible error messages or warnings.

5. Quality of head correction

a) Taxonomic distances

The taxonomic distance is a measure of the distance between the head-corrected reference sensors in the sweep data and in the reference object. It is the square root of the average of the squared distances between all reference sensors and their corresponding position in the reference object.

The taxonomic distance indicates how well the head corrected reference sensors of a sweep match the position of the reference object.

A high mean or standard deviation of the taxonomic distance points to some sort of problem of the recorded sweep - a loose reference sensor, a reference sensor glued to a moving part of the skin of the probant or some other assorted issues.

Limits for the taxonomic distance mean and standard deviation can be set on the *Taxonomic Distance Limits*-Tab (Figure 5). Use the corresponding buttons (Figure 5-1) to save limits or restore default values. If the limits are exceeded when performing head correction a warning will be displayed (Figure 6). To disable the distance check set the limits to 0.

The *Check now*-button (Figure 5-2) checks the taxonomic distances of already existing pos-files in the pos-folder of the selected session directory.
With the *Show values*-checkbox (Figure 5-3 and Figure 7-1) the chart can be hidden and the output text with the taxonomic distances is displayed.

The taxonomic distances are saved in the pos-folder as *taxdistances.txt*.

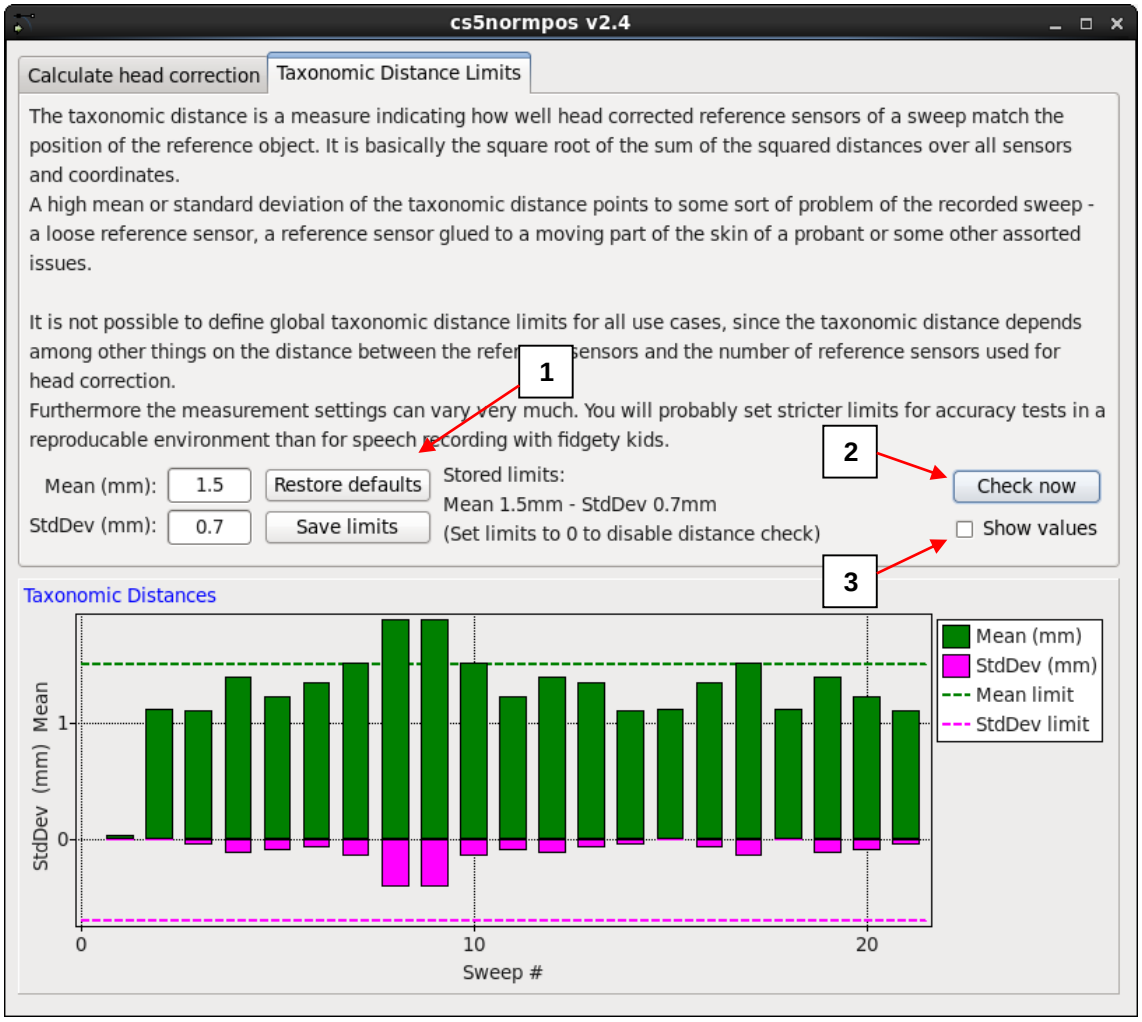

Figure 5: Taxonomic Distance Limits-Tab

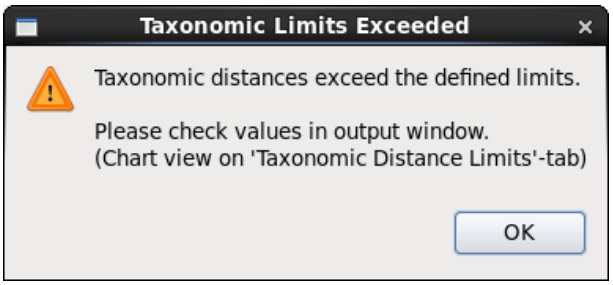

Figure 6: Warning that taxonomic distances exceeded the defined limits

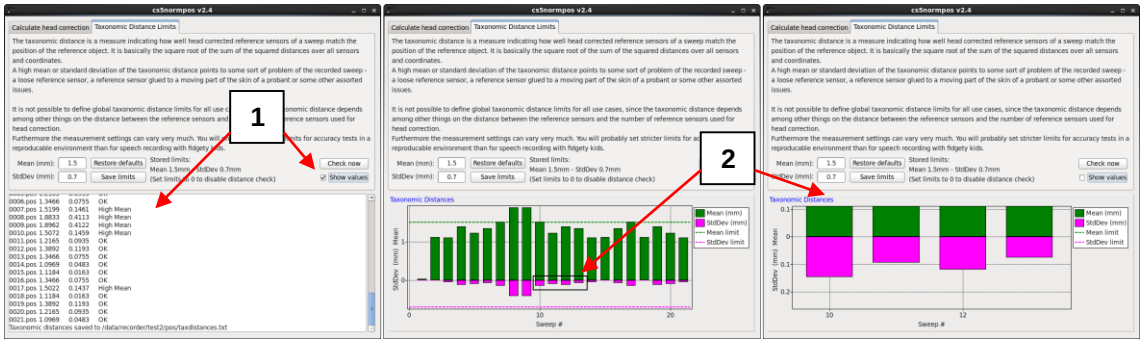

Figure 7: Further options include hiding (1) and zooming in on sections of the graph (2)

Please note: *It is not possible to define global taxonomic limits for all use cases, since the taxonomic distance depends among other things on the distance between the reference sensors and the number of reference sensors used for head correction.*

Furthermore the measurement settings can vary very much. You will probably set stricter limits for accuracy tests in a reproducible environment than for speech recording with fidgety kids.

b) Mutual distance of reference sensors

In the rawpos- and pos-folder a text-file *refDistances.txt* will be created. It contains the mean distances as well as the standard deviation and the range of the distances between the reference sensors for each calculated sweep.

Since the distance between the reference sensors should stay fairly constant, a change in the mean distance or a high standard deviation or range of the distances always points to some problem during recording.

6. Filters

Per default all data is lowpass filtered. Reference sensors are filtered with Kaiser window low-pass filter with 5Hz pass and 15Hz stopband edges respectively.

Speech data is lowpass filtered with a Kaiser window low-pass filter with 40Hz pass and 50Hz stopband edges and designed to achieve 60dB damping.

Filter coefficients are located in `/opt/age/bin/filter/`.

III. Revision history - Normpos - Head movement correction

Date	Revision	Annotation
February 20th, 2014	1	Ulrich Szagun
November 16th, 2015	2	Added pre-transformation matrix and taxonomic limits