Module: Digitalization

HPI coils and anatomical landmarks

why and how

Why

Head positioning should be monitored either continuously throughout the acquisition or at the start and end of the recording. The MEG acquisition is done only with respect to the MEG device, instead of the anatomy of the subject. Therefore, MEG devices include a subsystem to determine the position of the head with respect to the MEG sensors. As MEG (unlike MRI) cannot directly measure the position of the head, small coils known as Head Position Indicator coils (HPI) placed at known locations on the scalp of the subject, when energized, will generate a magnetic field that helps us to localize the position of head in a three-dimensional space, with respect to the MEG sensor array. If continuous head position tracking is enabled, generally small movements are acceptable with a maximum error of 5 mm.

Why

Information about the patient's head position, orientation, and shape is obtained by digitizing (3D digitizer) the standard fiducial points, HPI coils, and the required additional points creating Cartesian co-ordinates in a 3D space. Digitization of four HPI coils, and landmarks, which include three bony fiducial points (Nasion, left, and right pre-auricular points), and additional points, is performed

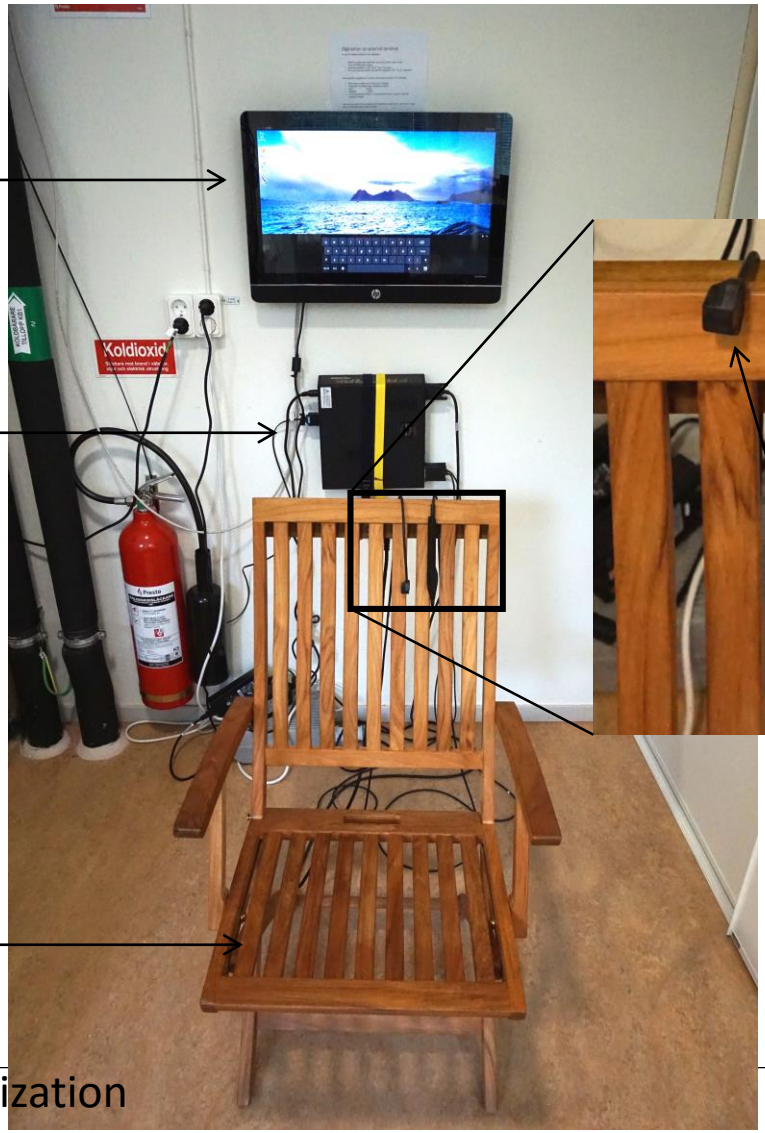
The HPI coil positions, and hence the head position, are estimated from the coil signals. This estimation is done several times per second, allowing the system to track also relatively fast movements. Once the head position is estimated, the MEG signals are transformed to a reference head position. This conversion is sequentially performed at each time point throughout the continuous (raw) data file.

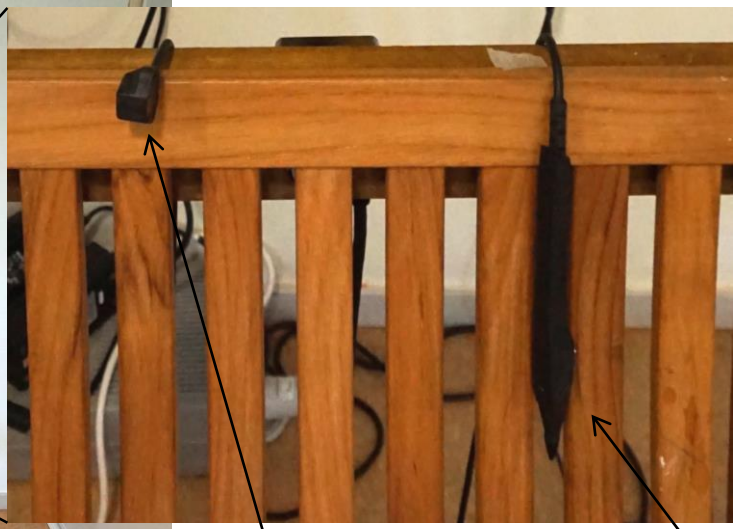
How

External terminal
Touch screen

Polhemus
On/off switch
button

HPI chair





Tracker
Need to be attached between the eyebrows of the subject with skin tape.

Isotrak stylus

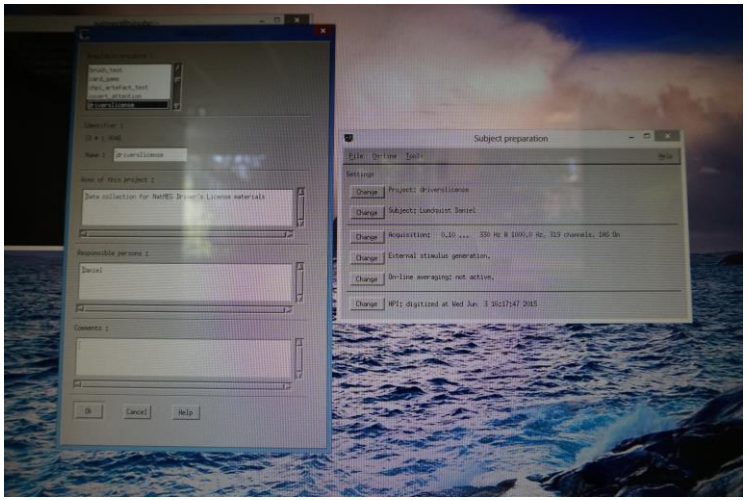
How

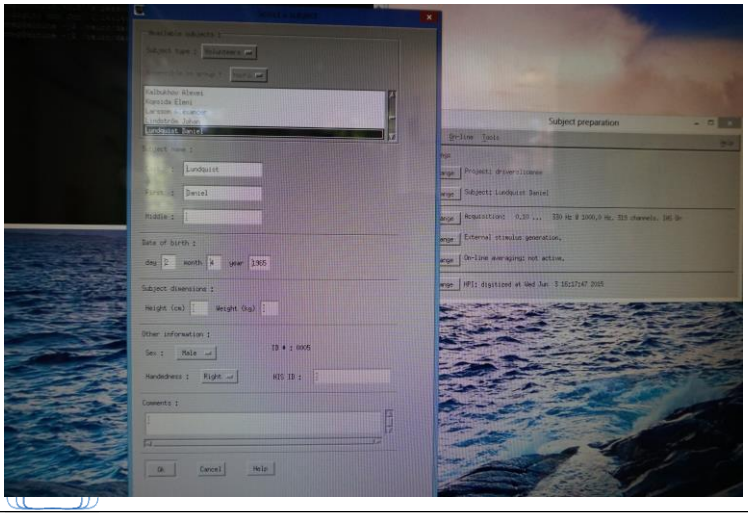
1- The digitization system is equipped with a tracker which trace head movements during the digitization. **The subject should be seated on the HPI chair. Place the tracker firmly on the subject's head with skin tape.** This should not move during the digitalization. Check that nasion and the coil centers are still accessible with the Isotrak stylus.

Make sure the digitization chair is sufficiently far (over 1.5 m) from large metal objects and that the door to the MSR and the door of the cabinet are closed as they severely distort the digitizer and compromise its accuracy. Tell the subject to avoid excessive head movement.

The digitization can be done from the acquisition computer, but to make it easy we have installed an external terminal and a touch screen on the wall next to the Polhemus. You have to make sure that the polhemus is turned on and that the digitalize program on the acquisition system is not open. If it is, you need to close it before starting.

How





2 – Tap on the touch screen to turn it on.
Press the first change button to select your project on the menu.
Then, press the second Change button to select your subject.

Finally press the last Change button to start the HPI dialog. When you click the HPI **Change** button, *megacq* connects to and initializes the 3D digitizer (also referred as “Isotrak” in the software) used for this purpose. Digitizer initialization takes a few seconds. You are informed about this in a dialog. Once the initialization is complete the HPI dialog appears.

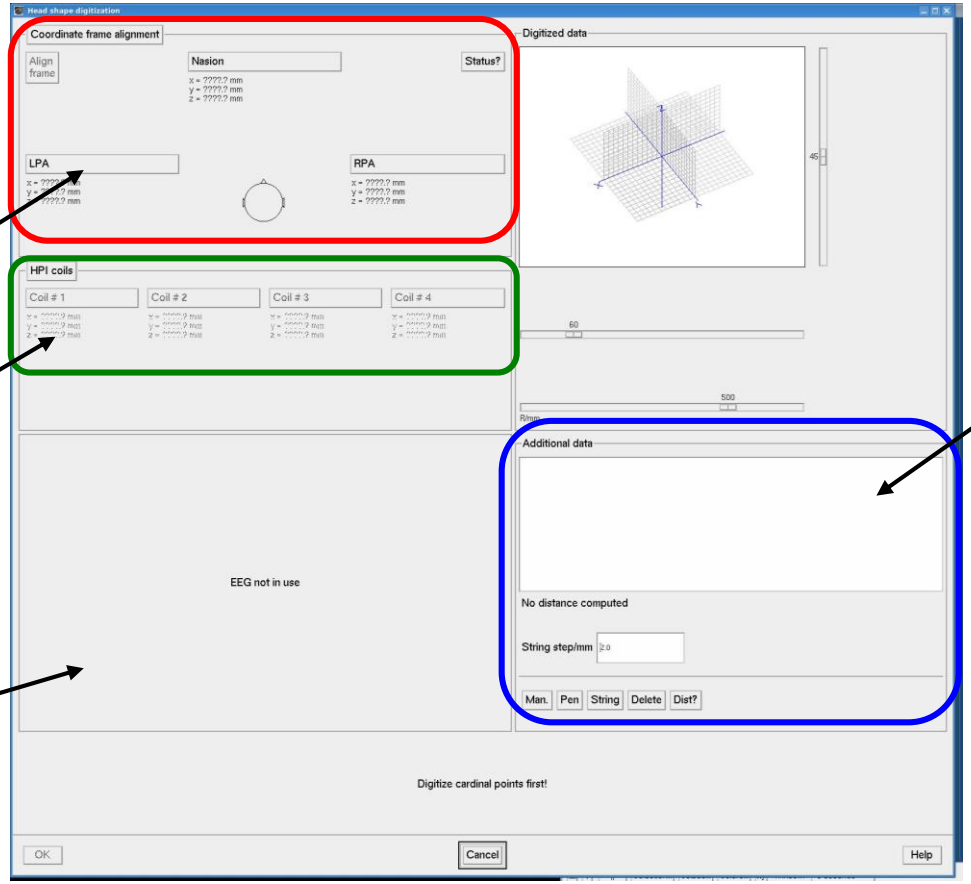
How

Define coordinate frame (fiducials)

Mark HPI-coils

(EEG)

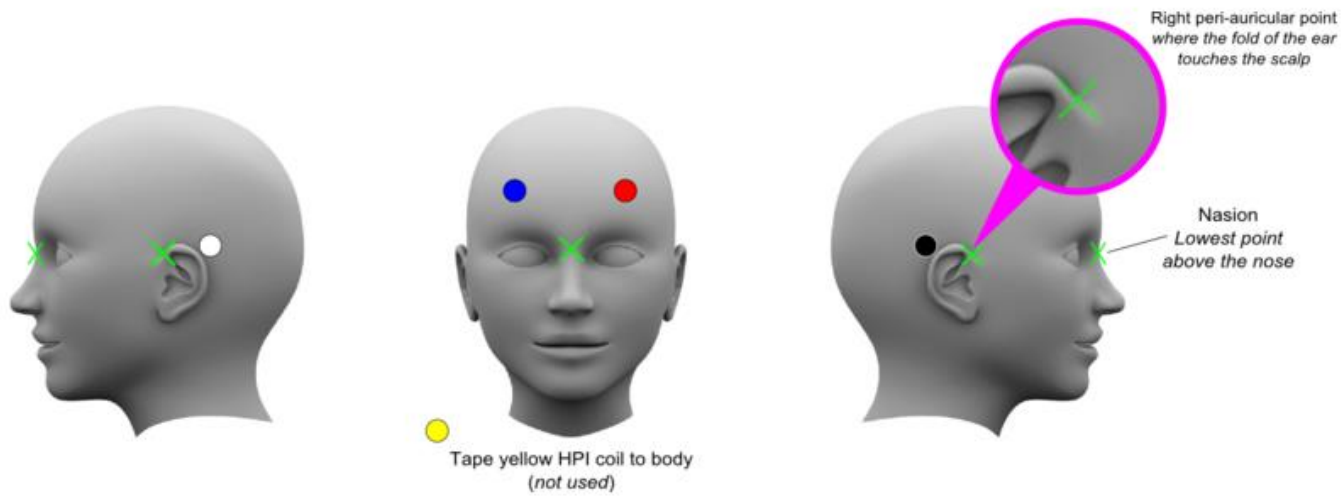
Head-points



The left section of the dialog contains the controls for the tasks which are necessary to complete the HPI procedure. The lower right section (**Additional data**) contains controls for optional items. The label above the dialog buttons will dynamically indicate the task to be performed next.

How

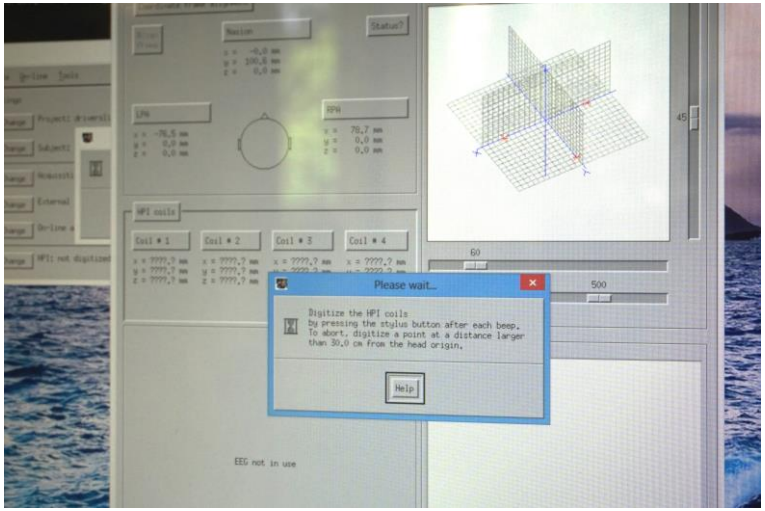
3 – To digitize, position the tip of the 3D digitizer stylus at the desired point and click the corresponding button in the HPI dialog. Start by digitize the anatomical landmarks: the nasion and the two auricular points. Be sure to record which points were used to be able to correctly identify them later on the anatomical MR images. Digitize the landmarks in any order; the system will automatically associate the points with proper landmarks.



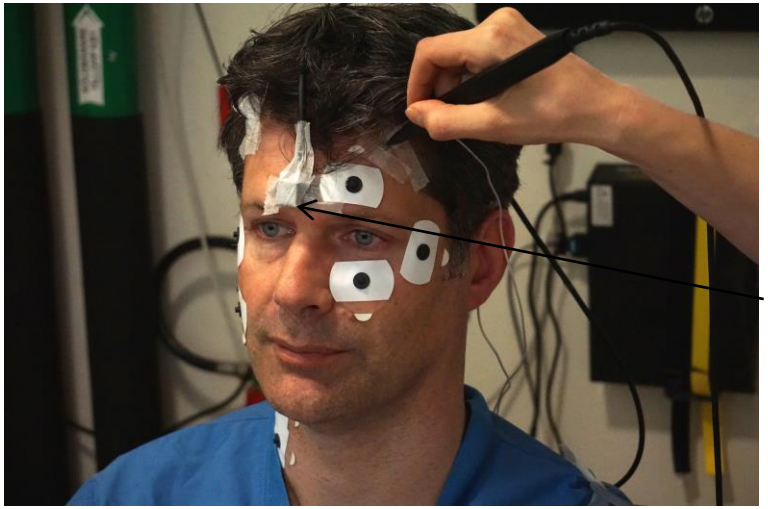
X = anatomical landmarks to digitalize

How

4 - Digitize the HPI coils (order does not matter).
By placing the pen in the middle of the coil and press the stylus'button.



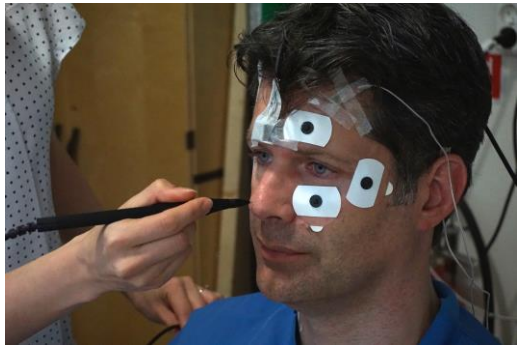
Screen shot of the touch screen
before the digitalization of the coils

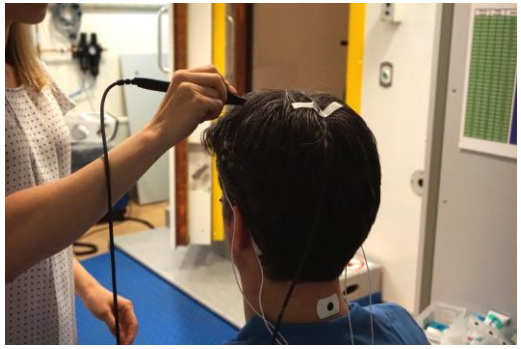


digitalization of the red coil

How

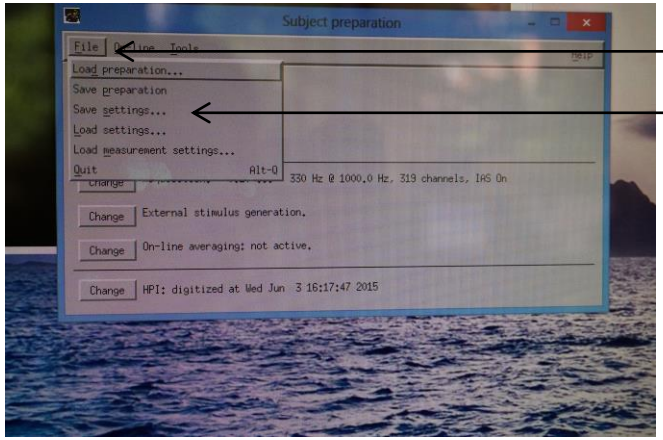
5- You should digitize **additional points** to obtain information about the head shape, which allows more accurate alignment with the anatomical MR images.
You can digitalized the eyebrows, nose, and the shape of the head by slicing the head into equal portions.
Press the center of the stylus continually while digitalizing those regions.
At least 150 additional points are necessary.



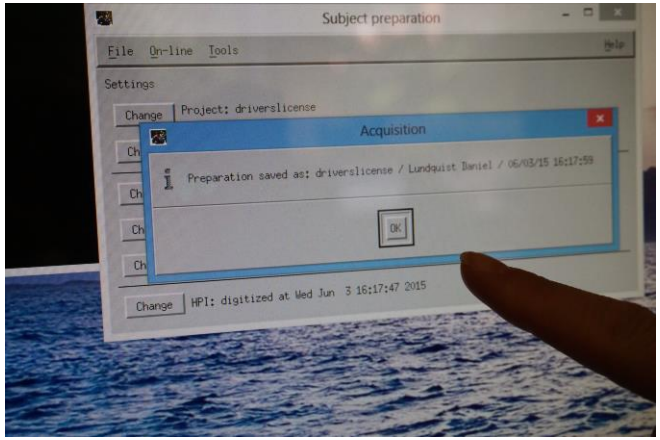


Once you have completed the digitization, place the pen in the air far away from the participant and click to finish the digitalization

How



6- When you are finish click on
File
Save preparation



7- Remove the tracker from the participant's forehead.

How

The digitalization is now over. Your participant is ready to be placed in the MEG room.

If you want to see how to digitalize please watch the video titled : Digitalization

Thank you for taking part of this module.