

## Recording Headshape with Polhemus Digitizer

At the DCCN, in order to co-register the data recorded in the MEG system with a participant's individual anatomical MRI scan, we typically make use of 3 anatomical landmarks. These are the nasion and the left and right periauricular points (defined by the ear molds inserted in participants' ears during recording). This provides a reasonably accurate coregistration, but there can be some imprecision in the coregistration due to slight differences in the position of these points in the MEG recording and their definition based on the anatomical MRI. In particular the definition of the nasion can be very important and small imprecision can make a large difference. One way to minimize such issues is by recording participants' head shape using a head shape digitizer. At the DCCN in the MEG lab, we have an older version of the following Polhemus Digitizer:

<https://polhemus.com/scanning-digitizing/digitizing-products/>

The idea is to collect approximately 200-300 points across the participants' scalp and use that information to match those points to the scalp surface definition extracted from the participants' anatomical MRI. The points can be co-registered manually but FieldTrip also implements an algorithm that attempts to find a best-fit solution for you. To do so you would use the function [ft\\_volumerealign](#).

In a first step, you need to use the function in interactive mode to define the nasion and the two periauricular points manually. Then in a second step, you can use the same function to refine the co-registration using the head shape information. Make sure in the second step to set the `cfg.method = 'headshape'` and to provide the function with the filename (`PATH/FILENAME.pos`) of the data recorded with the Polhemus system as input to the argument `cfg.headshape.headshape = 'PATH/FILENAME.pos'`.

### Polhemus Recording Procedure:

First, select the ear molds you will use for recording your MEG data for the participant. Make a careful note of the position of the ear molds (best practice is to take a digital photo but this is sometimes not practical and would require the participant's permission). They should be placed in the participants' ears in precisely the same way in the MEG system when recording MEG data and in the MRI scanner when obtaining the anatomical MRI scan. Next, seat the participant in the wooden chair and ask the participant to put on the safety goggles with the Polhemus sensor attached to it. These can be adjusted and should not move during the Polhemus recording. Open the digitizer software on the Polhemus PC and select 'define coordinate system' to define a coordinate system based on the nasion and two periauricular points. The steps for doing this should appear on screen. Take care to avoid pressing the recording button on the Polhemus stylus more than once, it is very sensitive. Having defined a coordinate system, check that you get an oval on screen with a triangle at the top (2D representation of the 3D recording).

Now you are ready to collect head shape information. Select 'digitize start/stop' to begin recording. In a first step run the stylus down the participant's nose, along the side, and along their cheek until you reach the ear mold. Do this once on the left and once on the right. Go at a relatively slow pace to get many samples. These anatomical landmarks are very prominent in the anatomical MRI and will be useful for matching the head shape recording to the scalp surface from the MRI scan. Next, take a sample of points from front to back over the scalp surface. Make sure that the stylus is touching the scalp at all times so that you are not recording too many points away from the scalp surface. Try to fill in at least the midline of the head and 2 lines from front to back on either side of the midline. The more points the better, and be sure to take at least 200. You can record multiple points by holding down the button on the stylus and moving it across the scalp. Try to oversample the ridge at the back of the head, because this shape can often be neglected in the recording. After you obtain the 200-300 points, be sure to save the data in your user directory on the Polhemus PC with a filename corresponding to your participant ID. There is software (FileZilla) on that PC for transferring files to your project directory at a later stage. You can find a briefer description of Polhemus recording procedure at MEG checklist as well.