# Target import and stimulus export using the SimNIBS coordinate format in visor2

The neuro navigation system visor2 features the import of target markers prior to a TMS session for session planning and the export of coil poses associated with the stimuli of a TMS session during session review.

Per default, visor2 operates using the nasion-ear coordinate (NEC) system and reports TMS targets as well as stimuli using a combination of 3D position and a quaternion in that NEC centric coordinate system. The NEC system is fully defined by three fiducial points, the nasion, left and right ear, which must be identified on the original MR image of the subject and prior to the TMS session, on the subject itself.

For SimNIBS compatibility, targets defined in the coordinate system of the original NIfTI MR image may also be imported as well as the export of coil poses from TMS stimuli is possible using that coordinate system as a reference. In addition, coordinates of coil poses may be described by a rigid, 4x4 transformation matrix. The NIfTI coordinate system is fully defined by the transformation parameters given in the header of the NIfTI MR image.

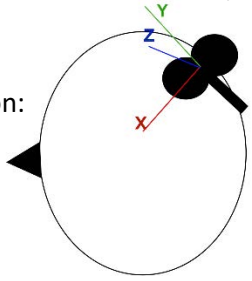
In this document a brief description of the SimNIBS-compatible import and export functionality is given.

## File format

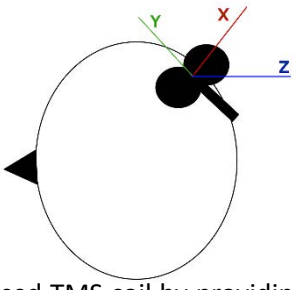
The exchange file format is the JSON-based MRK format. Refer to *Listing 1* for a minimal example of such an MRK file. Important aspects are:

- The configuration metadata must contain the *AssociatedImageInfo* field. This field consists of the file name (ideally a fully qualified absolute path) of the MR image associated with the coordinates, and the information from the NIfTI header of that NIfTI file. This information is used to verify that the same MR image was used for defining the target markers as during the creation of the subject/head model for neuro navigation.
- Each target marker must contain the following meta data:
    - If *CoilAxesConvention* is set to *simnibs,* the y-axis of the local coordinate system of the TMS coil is facing to the front, the x-axis to the left and the z-axis facing down (i.e. onto the head when positioning the coil at the head). If the value is not set or set to *visor2* the y-axis is facing to the front, the x-axis facing to the right and the z-axis facing up (i.e. away from the head, when positioning the coil at the head).

      SimNIBS coil axes definition:

      visor2 coil axes definition:

    - The field CoilInfo must contain information about the used TMS coil by providing the SimNIBS-ID of the coil model. The SimNIBS-ID is the relative path to the CCD file of the coil model within the SimNIBS repository: `simnibs\resources\coil_models`
    - For SimNIBS compatibility, indicate *ASSOCIATED_IMAGE* as the type of *CoordinateSystem*, which signals visor2 to use the coordinate system defined in the associated (NIfTI) MRI.

```
{
    "Configuration": {
        "AssociatedImageInfo": {
            "FileName": "C:\\Data\\MNI152_T1_1mm.nii",
            "NIfTI_pixdim": [-1.0, 1.0, 1.0, 1.0],
            "NIfTI_qoffset": [90.0, -126.0, -72.0],
            "NIfTI_quatern": [0.0, 1.0, 0.0]
        }
    },
    "TargetMarkers": [
        {
            "CoilTarget": {
                "CoilAxesConvention": "simnibs",
                "CoilInfo": {
                    "Id": "Drakaki_BrainStim_2022/MagStim_D70.ccd",
                },
                "CoilPose": {
                    "RigidTransformMatrix4x4": [
                        [-0.022059449926018715, 0.7964698076248169, 0.6042759418487549, -74.49970245361328],
                        [0.9424861669540405, 0.21820130944252014, -0.2531958520412445, -14.004987716674805],
                        [-0.3335166871547699, 0.5639362931251526, -0.7554751634597778, 73.63663482666016],
                        [0, 0, 0, 1]
                    ]
                },
                "CoordinateSystem": "ASSOCIATED_IMAGE",
                "Name": "Stimulus 1",
                "PositionalUnit": "mm"
            }
        }
    ]
}
```


**Listing 1**: *Example JSON based MRK format for coil pose coordinate exchange with visor2.*

## TARGET MARKER IMPORT

To be able to make use of the transformation information in the NIfTI header of an MRI file during im- and export of targets or stimuli respectively, you must first create a new patient using the same NIfTI-MR image the to-be imported coordinates are supposed to be valid for. In previous version of visor2, this transformation information was not persisted when creating a subject. Therefore, already existing subjects from previous version of visor2 cannot be used.

To import NIfTI-based targets from an MRK file of the previously described format, enter the “Session Planning” workflow, go to “Target Import” and switch the file format to “Image Markers (*.mrk)” (see *Figure 1*). Then, save the imported targets.

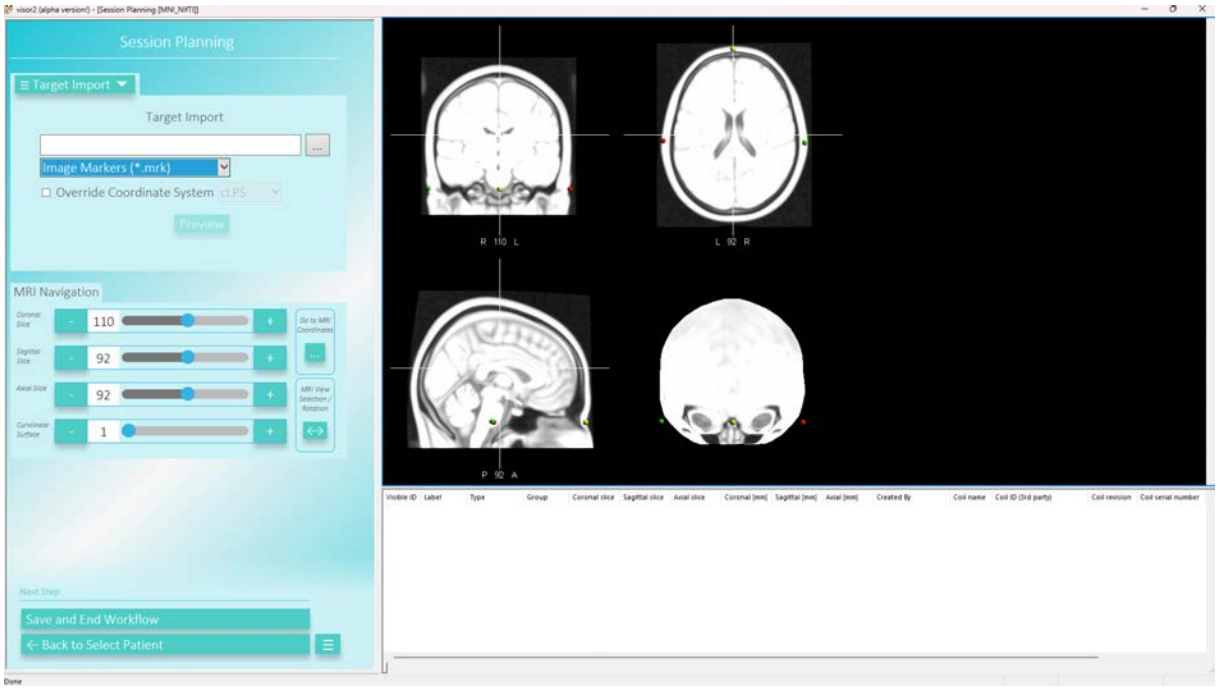



**Figure 1:** Importing target markers during Session Planning.

## Target marker export

You must have performed a neuro navigation session using the head model created from the NIfTI MRI in order to export the stimuli of that session in the SimNIBS compatible format. Furthermore, the session must have been performed with a coil type supported by SimNIBS, i.e. a coil type SimNIBS exhibits a coil model for.

If these preconditions are met, you can export stimuli of a TMS session in a SimNIBS compatible format in the usual “Session Review” workflow. Select “Export Data” and set the “Export Format” to “Marker File (*.mrk)”, set the tool compatibility to “SimNIBS” and click “Export to marker file” (see *Figure 2*).

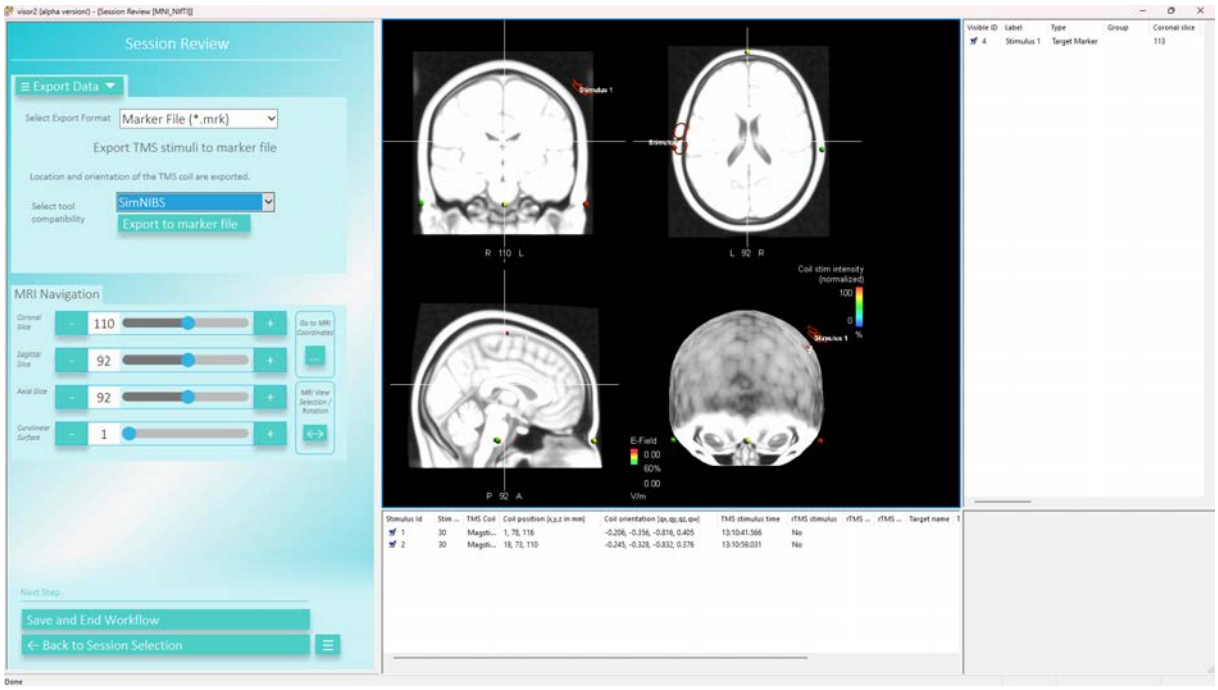



**Figure 2:** Exporting stimuli of a TMS session during Session Review.