Slice Ordering at Siemens Scanners

Quit recently, I have been frequently pumped for information regarding the order of acquisition of the slices in fMRI studies. It would be easy to say read:

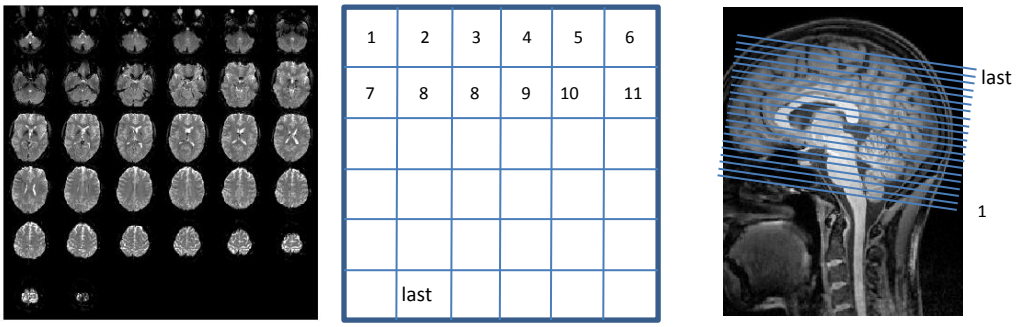
cbswiki.cbs.mpg.de/bin/view/MR/DicTov and cbswiki.cbs.mpg.de/bin/view/MR/MosaicBilder

but to be honest, I was not quite confident with that. The whole matter seemed to be somewhat confusing –at least to me. Therefore I have checked things out. Also to make sure it is still correct also for the new software versions we got in the meanwhile. Here is what I have found.

At the Bruker scanner, the sequence of acquisition can be selected at will. As an added advantage, you can see during scan which slice was acquired first.

At the TRIO or VERIO scanner, the selection of slice order is somewhat confusing –at least to me. If you use the Siemens EPI in an fMRI study, the result is always a so called "mosaic image". It always displays all slices of one volume from most inferior (upper left corner) to superior. That means the first slice in the image is the most inferior, independent on the time at which it was recorded. The order at which the slices were recorded is remains invisible.

Figure 1 Mosaic image



Some confusion arises because at the Scanner console two parameters seem to be regulating the slice ordering. In the good old times nobody was touching them and the slice ordering was always "ascending". These days everybody comes with his own wishes and it is also possible that somebody changed the values accidently. The change is transferred between studies by copying protocols which often creates some uncertainness.

Now let's discuss the two parameters. There is one parameter that is called "*Mehrschichtmodus*" ("multi-slice mode") which is – rather confusing – always set to "*verschachtelt*" ("interleaved") but this one is of no relevance in the Siemens EPI sequences. Therefore it cannot be changed anyway! The parameter that counts is the so called "*Serie*" ("series") which can be chosen to be "*aufsteigend*" ("ascending"), "*absteigend*" ("descending") or "*verschachtelt*" ("interleaved").

For “ascending”, the acquisition starts at most inferior. The slice being shown as first in the image was detected at first. Vice versa, in case of “descending”, the acquisition starts at most superior, i.e. the last image in the mosaic image (cf. Fig.1) was recorded first.

For “interleaved”, one has to distinguish the cases of an even number of slices or an odd number of slices.

1. Even number of slices: The even numbers of slices are acquired first in the order 2,4,6,8,… then followed by the odd numbered slices 1,3,5,. So for an even number of slices, the second slice is recorded at first.
2. Odd number of slices: The odd numbered slices are acquired first. So, for odd, the most inferior slice is acquired first.

You should be aware that there first slice that is recorded in the “interleaved” mode is always rather inferior! Got it? If not, here are a few examples. The time position at which a respective slice was recorded is drawn (in orange) directly on it.

Figure 2 Even number: 32 slices. The slices were recorded in the order [2,4,6,8,10,…,1,3,5]. That means the second slice in the image was recorded at first. The first slice (most inferior) in the image was recorded at the 17th time step.

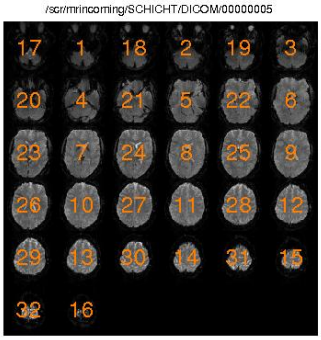
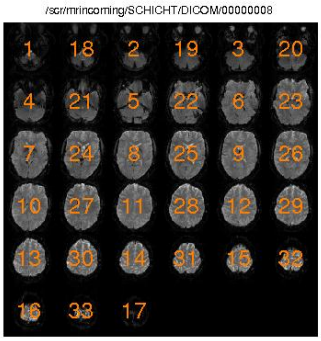


Figure 3 Odd number: 33 slices. The slices were recorded in the order [1,3,5, …, 2,4,6]. That means the first slice in the image was recorded at first. The second slice in image was recorded at the 18th time step.



The slice ordering is always applied as it was selected at the scanner. Recently, some people were not really aware about the ordering they had used in their studies. The slice order is stored in the scanning protocols on the scanner host – one just has to make sure the protocol that is stored at the scanner remained unchanged. If you use the conversion tools `brutov` resp. `dictov`, the slice time ordering is stored in the Vista file.

Unfortunately, it is rather difficult to find the slice time ordering in the DICOM files. For those who want check the slice ordering in their data I provide a tiny MATLAB script that picks out the relevant information from the DICOM files. The function returns a vector containing the sequence at which the slices were recorded. For your convenience, you will also get images like those shown above.

The scripts are provided at the Wiki.

April 4, 2011

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