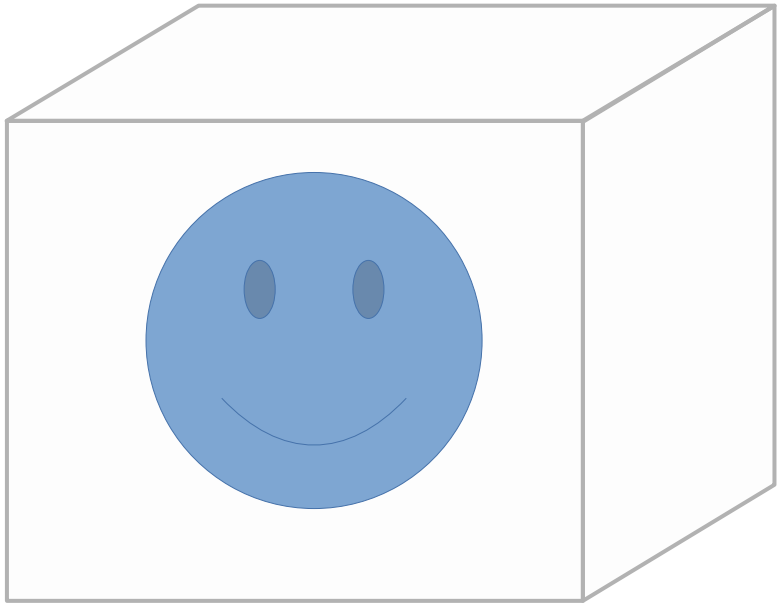
Acquiring EPI volumes: slice timing considerations

We speak about acquiring “a volume” of EPI data in the interval of one TR (say, 2s). That *sounds* like an instantaneous snapshot of the whole volume every TR, like this:



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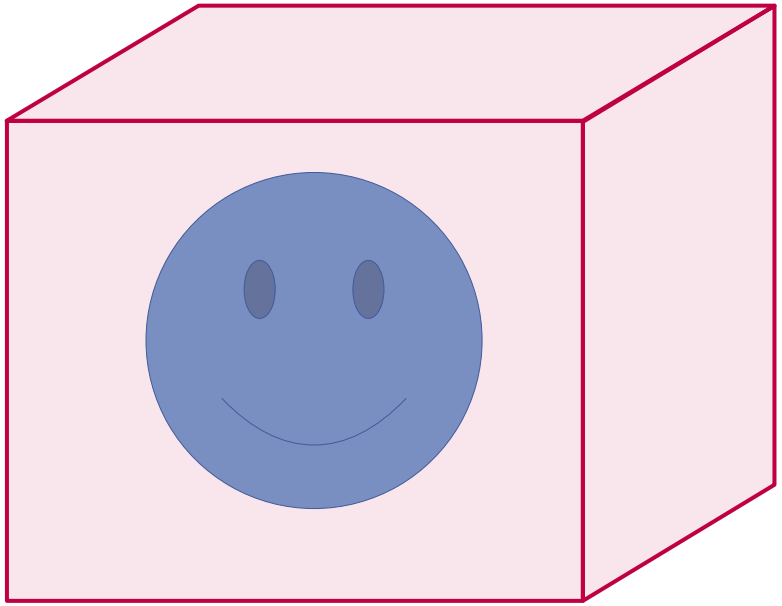

$n = 0$, $t = 0.000$ s

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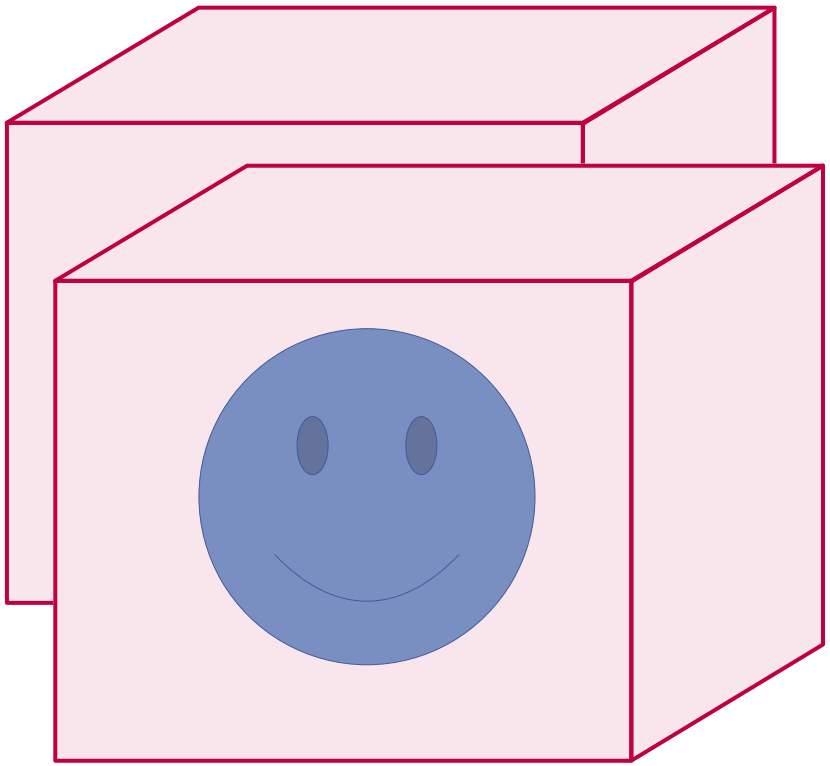

$n = 0$, $t = 0.000$ s

$n = 1$, $t = 2.000$ s

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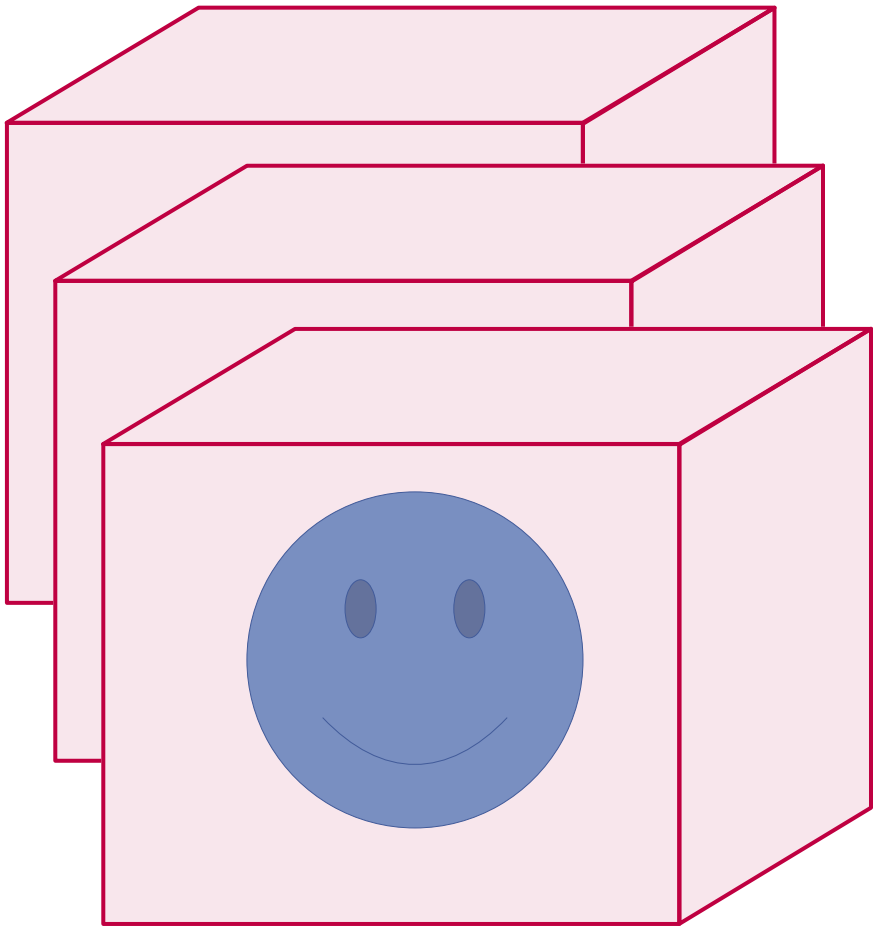


$n = 0$, $t = 0.000$ s

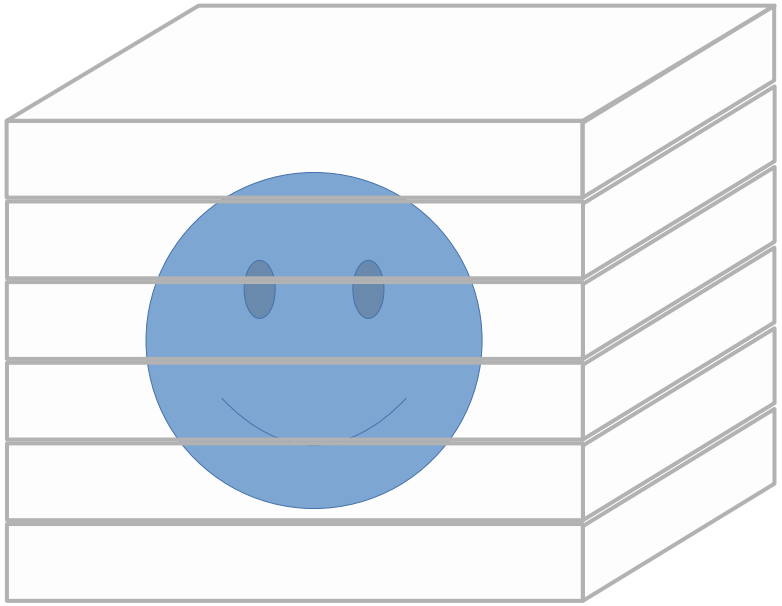
$n = 1$, $t = 2.000$ s

$n = 2$, $t = 4.000$ s

...

Acquiring EPI volumes: slice timing considerations

But in reality, a volume is acquired slice-by-slice throughout the TR interval. Moreover, the ordering is typically *not* sequential, but like this:



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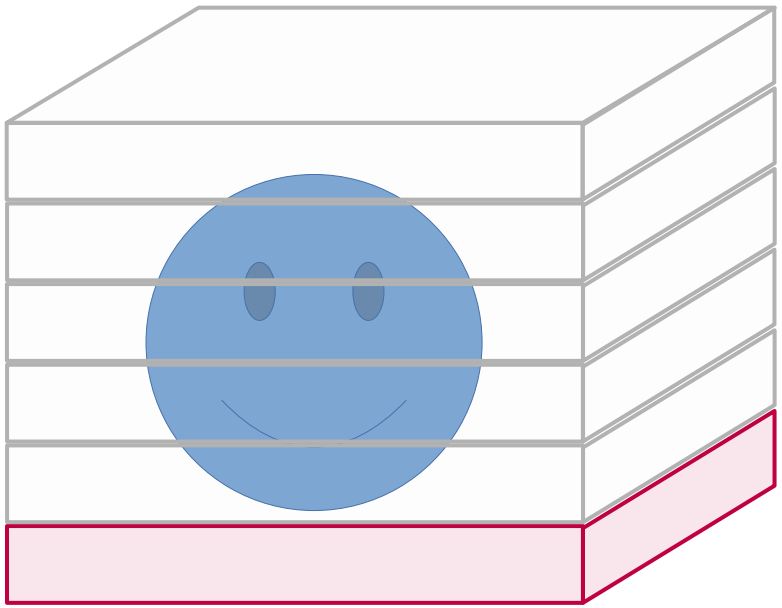

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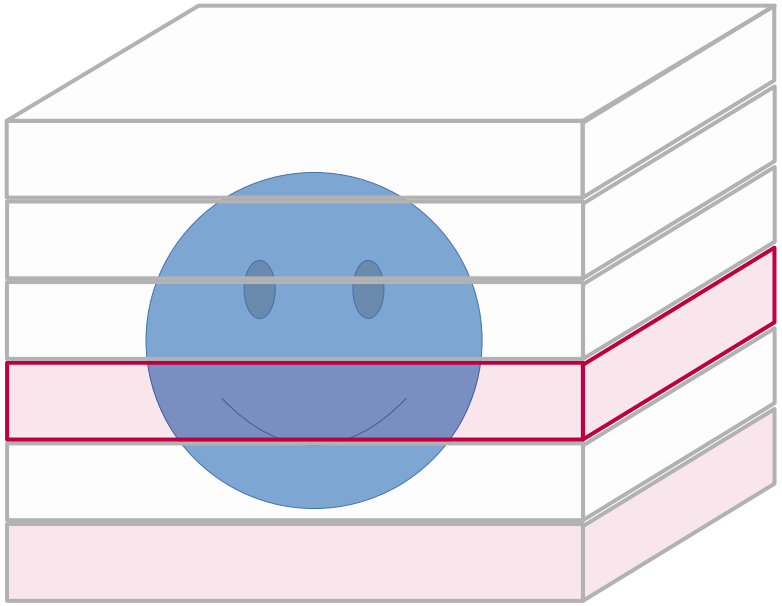

$k = 2$, $t = 0.333$ s

Acquiring EPI volumes: slice timing considerations

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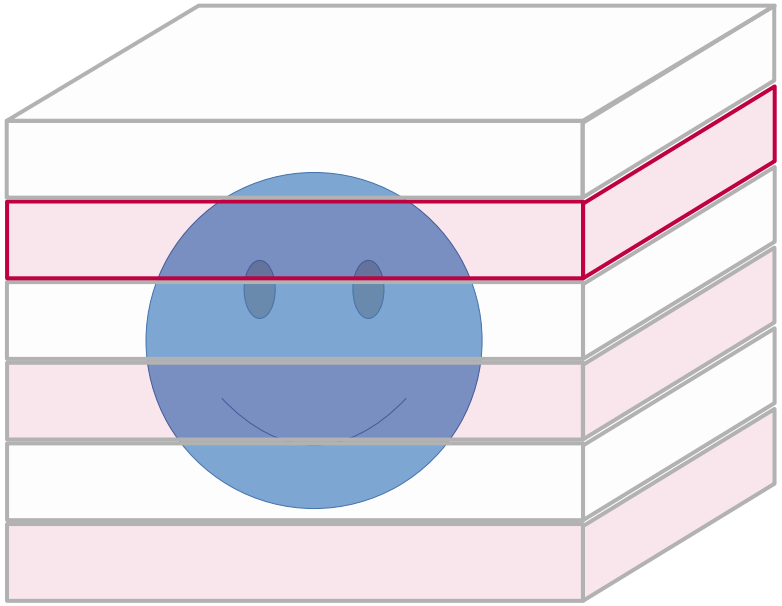
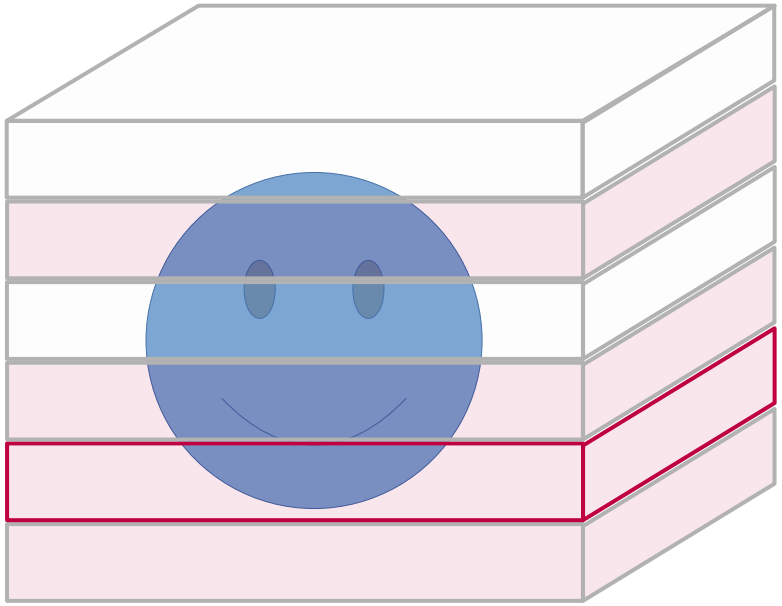


$k = 4$, $t = 0.667$ s

Acquiring EPI volumes: slice timing considerations

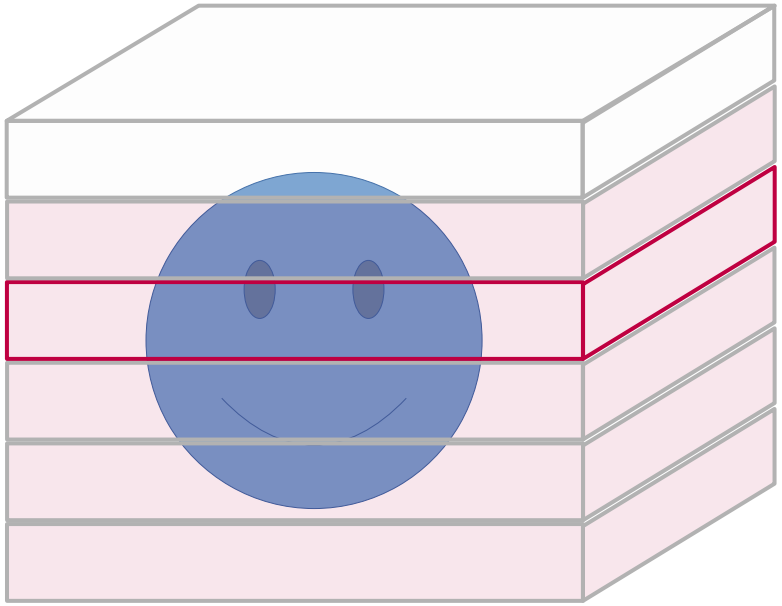
But in reality, a volume is acquired slice-by-slice throughout the TR interval. Moreover, the ordering is typically *not* sequential, but like this:



$k = 1$, $t = 1.000$ s

Acquiring EPI volumes: slice timing considerations

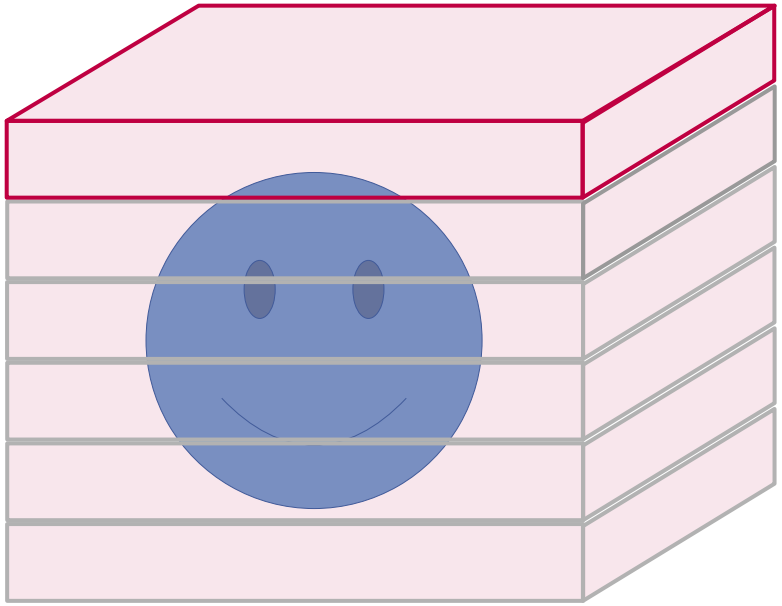
But in reality, a volume is acquired slice-by-slice throughout the TR interval. Moreover, the ordering is typically *not* sequential, but like this:



$k = 3$, $t = 1.333$ s

Acquiring EPI volumes: slice timing considerations

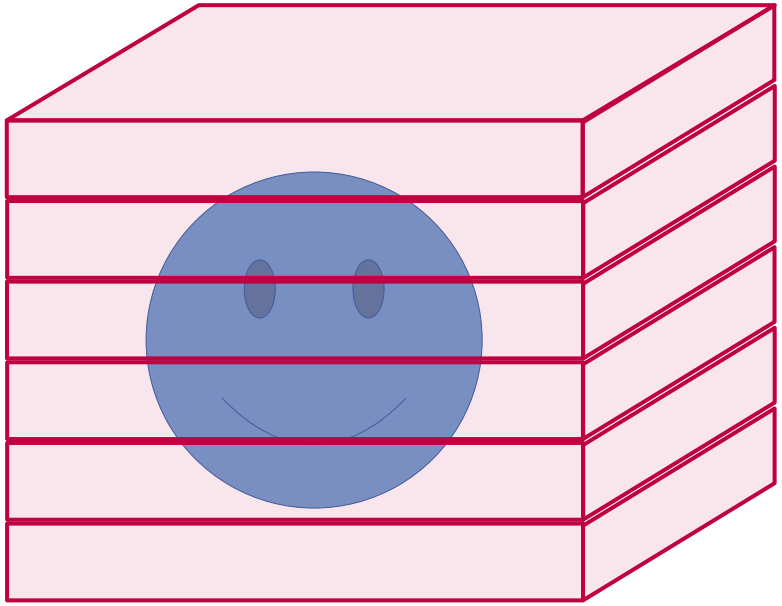
But in reality, a volume is acquired slice-by-slice throughout the TR interval. Moreover, the ordering is typically *not* sequential, but like this:



k = 5, t = 1.667 s

Acquiring EPI volumes: slice timing considerations

But in reality, a volume is acquired slice-by-slice throughout the TR interval. Moreover, the ordering is typically *not* sequential, but like this:

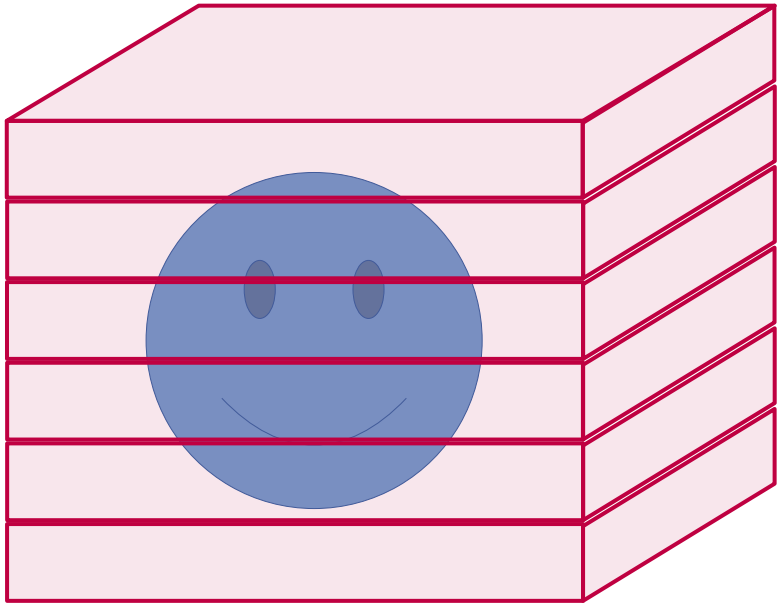


The slice selection pattern is called **interleaved**. This is done to reduce signal contamination from neighboring slices by acquiring them approximately ½ TR apart in time.

This particular slice selection alternates upward through the *z*-axis, so it is abbreviated **alt+z.**

Acquiring EPI volumes: slice timing considerations

In the special case of multiband acquisitions, multiple subsets of the slices are acquired simultaneously, where each set could use alt+z timing, for example.



k = 5, *t* = 0.333 s (like k = 2)

k = 4, *t* = 0.667 s (like k = 1)

k = 3, *t* = 0.000 s (like k = 0)

k = 2, *t* = 0.333 s

k = 1, *t* = 0.667 s

k = 0, *t* = 0.000 s

Slicewise acquisition means that time series throughout the volume are *not* sampled simultaneously, and this can affect the results of linear regression modeling.