NIFTI1 can store data with different meanings. Imaging data, statistical values and other data (any vector, matrix, label set or mesh), can be saved in a nifti1 *.nii or *.hdr/*.img file. Once a data intent is chosen, the use of the nifti1 format is unambiguous since the use of particular fields for a certain intent is predetermined.
To determine the position of the voxel in the dataset, method 1 is used (translation). Methods 2 and 3 serve also for reconstructing rigid body and affine transformations so that the positions of the voxels within the dataset in a stereotactic space can be determined.

Locating position of voxel in dataset: how to use the nifti1 variables for datasets

- **Method 1 (translation):**
  
  \[ qform_code = \text{NIFTI XFORM UNKNOWN} = 0 \]
  
  \[ x/y/z = \text{pixdim}[1/2/3] \times i \]

- **Method 2 (rigid body transform):**
  
  \[ qform_code = \text{NIFTI XFORM unknown} > 0 \]
  
  \[ x/y/z = [\text{quatsum b/c/d}] [qfac (=\text{pixdim}[1/2/3]) \times i] + [q_{\text{offset x/y/z}}] \]
  
  NB: qfac (=\text{pixdim}[0]), describes coordinate system for data

- **Method 3 (affine transform):**
  
  \[ sform_code > 0 \]
  
  \[ x/y/z = srow_x/y/z[0] \times i + srow_x/y/z[1] \times j + srow_x/y/z[2] \times k + srow_x/y/z[3] \]

* used nifti1 variables are displayed bold

**Transformations**

- Rotation
- Scaling
- Shearing

**Coordinate System**

**Arbitrary Space:**

- NIFTI XFORM UNKNOWN: 0

**Standard Space:**

- NIFTI XFORM SCANNER ANAT: 1
- NIFTI XFORM ALIGNED ANAT: 2
- NIFTI XFORM TALAIRACH: 3
- NIFTI XFORM MNI 152: 4
Nifti1 can also be used to store values drawn from a given distribution. For this purpose, many intent_types are dedicated to describe statistical tests. Univariate and multivariate tests can be stored, including the used parameters. In nifti1, it is possible to save more than one values per voxel (even a matrix per voxel).

**How to use the nifti1 variables for statistical values**

\[ \textit{dim}[3] = 1: \text{single slice} \]
\[ \textit{dim}[5] = 1: \text{statistical parameters stored in } \textit{intent}_p1/2/3 \text{ (parameters applied to whole dataset)} \]

\[ \textit{dim}[3] > 1: \text{several slices} \]
\[ \textit{dim}[5] = 1: \text{statistical parameters stored in } \textit{intent}_p1/2/3 \text{ (parameters applied to whole dataset)} \]

\[ \textit{dim}[5] > 1: \text{voxel-wise statistical parameters stored in data planes after stat value plane, for example the degrees of freedom} \]
How to use the nifti1 variables for other intents

NIFTI_INTENT_ESTIMATE: 1001
parameter for estimate in intent_name

NIFTI_INTENT_LABEL: 1002
parameter at each voxel is index to label
defined in aux_file

NIFTI_INTENT_NEURONAMES: 1003
parameter at each voxel is index to label
in NeuroNames label set

NIFTI_INTENT_GENMATRIX: 1004
parameter at each voxel is matrix
\[
\begin{bmatrix}
  M & \times & N
\end{bmatrix}
\]
row order:
\[
\begin{bmatrix}
  m & \times & n
\end{bmatrix}
\]
dim[0] = 5
dim[5] > 1: M \times N
intent_p1: M (float)
intent_p2: N (float)

NIFTI_INTENT_SYMMATRIX: 1005
parameter at each voxel is symmetrical matrix
\[
\begin{bmatrix}
  N & \times & N
\end{bmatrix}
\]
\[
\begin{bmatrix}
  [0][0] & \cdots & [0][n-1] \\
  [1][0] & \cdots & [1][n-1] \\
  \vdots & \ddots & \vdots \\
  [n-1][0] & \cdots & [n-1][n-1]
\end{bmatrix}
\]
dim[0] = 5
dim[5] > 1: N \times (N + 1)/2
intent_p1: N (float)

NIFTI_INTENT_DISPVECT: 1006
parameter at each voxel is displacement vector
dim[5] = dimensionality of displacement
(e.g. 2 = in-plane, 3 = spatial)

NIFTI_INTENT_VECTOR: 1007
parameter at each voxel is vector

NIFTI_INTENT_POINTSET: 1008
value at each voxel is spatial coordinate
(vertices/nodes of surface mesh)
dim[0] = 5
dim[1] = nr of points
dim[2/3/4] = 1

NIFTI_INTENT_TRIANGLE: 1009
value at each voxel is triple of indices (forming triangle)
from a pointset
dim[0] = 5
dim[1] = nr of triangles
dim[2/3/4] = 1
dim[5] = dimensionality of space
intent_name can describe the objects where points
come from ("pial", "gray/white", "EEG" etc)

NIFTI_INTENT_QUATERNION: 1010
vector value at each voxel is quaternion
dim[0] = 5
dim[5] = 4

NIFTI_INTENT_DIMLESS: 1011
dimensionless value