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The MITK coordinate systems

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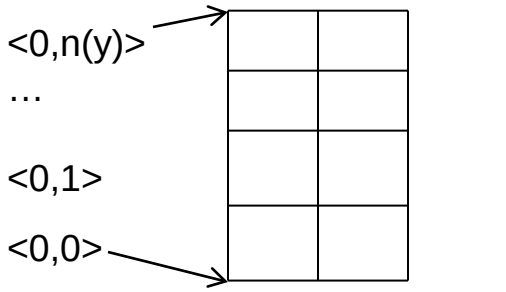
Overview

1. Index coordinates
2. World Coordinates
3. Difference / Example

Index coordinates

- Describe the numbering of voxels

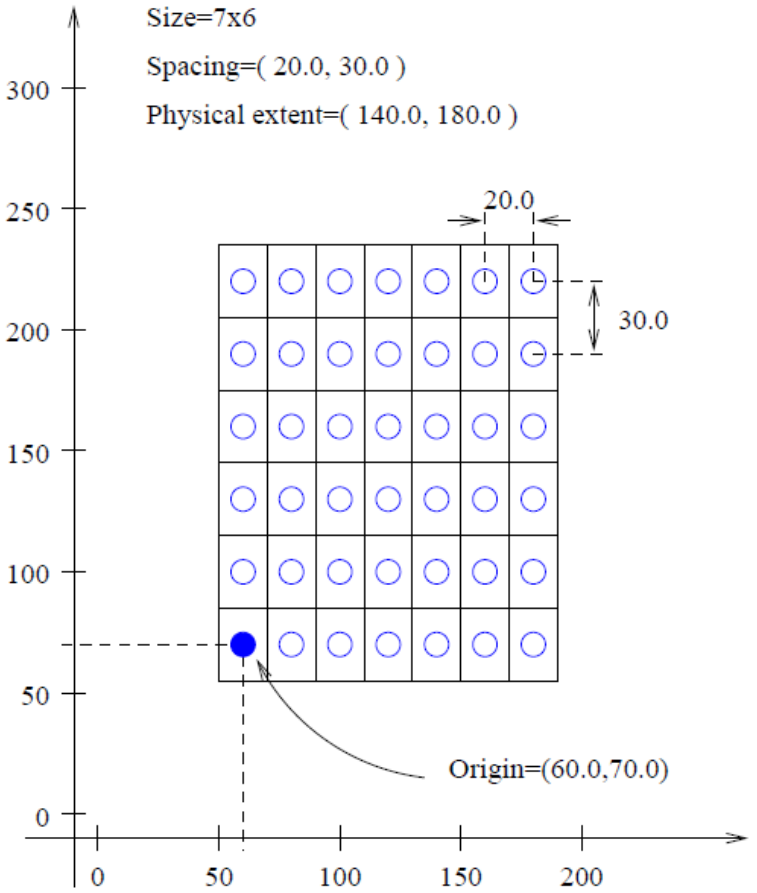


<1,0> usw.

- Corner-Based

- Pixel order (axis) and zero index are defined by data at acquisition, thus can be different

World coordinates



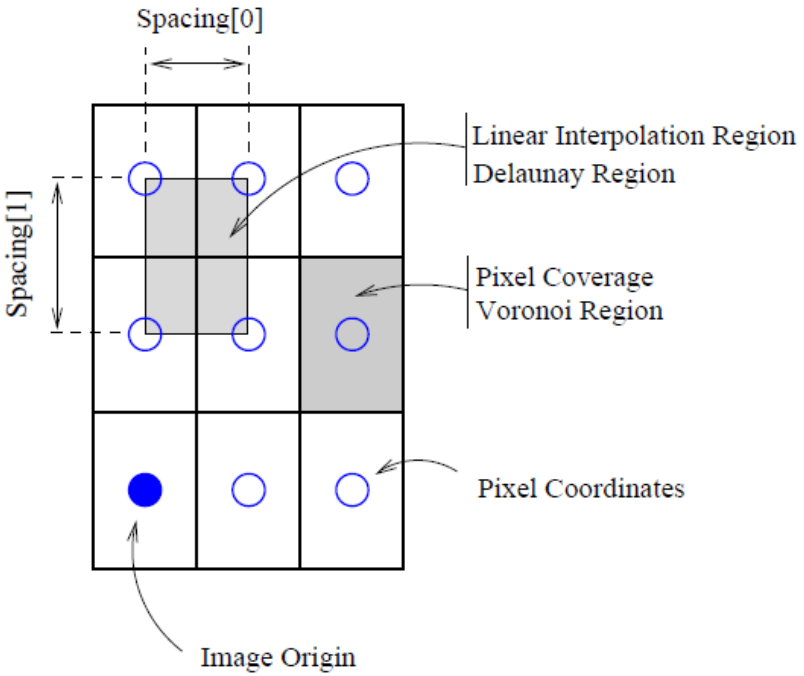


Image taken from ITK Software Guide

- Center-Based
- Default: Lower left back (llb) corner is center (DICOM definition)

Why World coordinates in pixel center???

- More intuitive. People from image processing interprete voxels as sampled data which is best represented at the center of the PSF.
- If a single coordinate is required for representing a voxel in an algorithm, the center is usually the better choice.
- Spacing is not necessarily equal to the extent (not stored in ITK images) of a voxel.
- Origin would not have to change when downsampling an image.
- Natural expression of formulas for interpolation.
- Lower-left(-back) coordinates do not remain lower-left(-back) coordinates after transformations like a 180-degrees rotation. Transformations mandatorily have to return center-based coordinates in order to work.
- Voxels do not have to be interpreted as rectangular objects. They could be circles, gaussians, ...
- Consistency with DICOM.

Discussion from ITK Bug Tracker

Consequence

- Even in images with zero offset and no rotation (CT usually):

Point (0,0,0) is not the same in index and world coordinates!

-> There is a shift of half a voxel between centers

Note: MITK Index is continuous, i.e. float.

-> Index(VoxelXYZ) = floor(ContinuousIndex(VoxelXYZ))

In world coordinates, center of voxel (x,y,z) is at [x,y,z] *mm*

In index coordinates, center of voxel (x,y,z) is at [x.5, y.5, z.5]

Note 2: Conversion is done in IndexToWorld() and WorldToIndex() methods;