

Supplementary Material for Paper 3065

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1 Point Cloud data Generation

In this chapter, we introduce the point cloud data generation process in detail. Figure 1 illustrates the point cloud generation process, the difference between manual and automatic depends on how point set is generated. We follow the following steps to acquire point cloud data:

1. Point set acquisition: For manual data, each MRI section has corresponding boundary labeling data, which is represented as a set composed of several points. For the segmentation model, the segmented mask of the included area of the femur and tibia corresponding to each MRI slice is segmented, and the set of several points for each slice is obtained by sampling points at the edge of the mask.
2. MRI parameter acquisition: From each slice of the MRI sequence, we obtain the following information: PixelSpacing, ImagePositionPatient, ImageOrientationPatient, SliceLocation. Their meanings are shown in the Table 1.
3. Construct an affine matrix: From the ImageOrientationPatient we get the row and column vectors by dot-multiplying the first and last three values with the first and second values of the pixel spacing, respectively. The slice vector is obtained from the cross product of the row and column vectors. For each of these three vectors, we add a value of 0 to the end to become a four-dimensional vector. We gain a position vector from ImagePositionPatient to from vector $(x_0, y_0, z_0, 1)$. Finally, we combine the above four vectors together to form an affine matrix.
4. Point cloud generation: For each point in slice, The xyz coordinate to be converted is the point coordinate value concatenate zlocation to from vector (x, y, z) . Use the affine matrix acquired above to dot product this coordinate, we can get the real xyz coordinates of this point in 3D space.

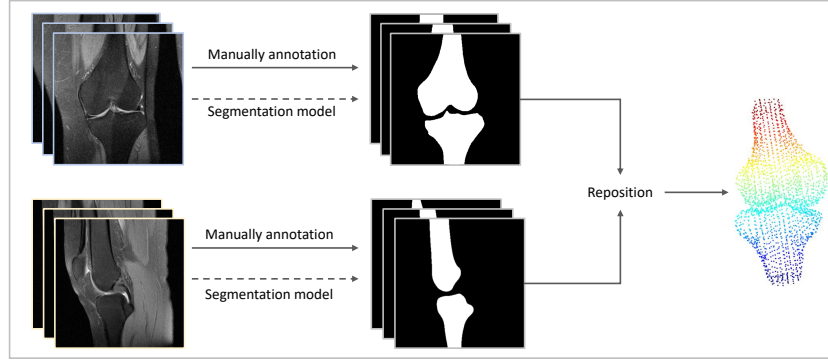


Fig. 1. Flow chart for generating point clouds, the difference between manual and automatic is whether the mask is manually labeled or generated by segmentation model.

Table 1. The meaning of each parameter extracted from MRI.

Label	Data format	Meaning
PixelSpacing	(i, j)	The spacing between coordinates in the slice.
ImagePositionPatient	(x_0, y_0, z_0)	The position of the upper left corner of the slice in the real coordinate system, consistent to the origin coordinate.
ImageOrientationPatient	(a, b, c, d, e, f)	The first three values are the row vectors of the image, the last three values are the column vectors of the image, indicating that the meaning is the Angle cosine between the coordinate system xyz.
SliceLocation	(z)	Represents the z-value before the slice position in the sequence.