

Conditional Entropy

Conditional Entropy (more specifically cross-conditional entropy) is a specific image metric that can be used by X4D when [matching X-Ray and digitally reconstructed radiograph \(DRR\) images](#).

Matching Process

The cross-conditional entropy, H , of the DRR image relative to the X-ray image is calculated and minimized by Wang et al.'s optimization algorithm ^[1].

$$H_{ccr}(DRR, Xray) = \sum_{i=0}^N \sum_{j=0}^N (pdf_{DRR}(j) * \log(pdf_{DRR}(j) / (pdf_{XRAY}(j) * pdf_{2D}(i,j))))$$

where: pdf_{2D} is the 2D histogram of the X-ray and DRR images
 pdf_{XRAY} and pdf_{DRR} are the histograms of the X-ray and DRR images, respectively
 N is the number of bins in each histogram
 i and j are the bin indices in the X-ray and DRR histograms, respectively

Parameters

Conditional Entropy Parameters

View Weighting:

0.50

Constant DRR Scaling:

☐

Parameter	Description
View Weighting	This factor is used when evaluating a bone pose by comparing the DRR images to the X-ray images. It is the relative weight of the two views in the final image metric, so 0.0 indicates all View 1, 1.0 indicates all View 2, and 0.5 indicates to weight each view equally.
Constant DRR Scaling	Indicates whether or not to scale the DRRs for each view by a constant value for all iterations of an optimization. If false, each DRR will be scaled so that its maximum value is equal to the DRR image scale value (X-ray/DRR Settings widget). If true, a single scale value will be calculated during the first iteration and be used to scale the DRRs in all subsequent iterations.

See Also

[Pixel Difference](#) is another image metric that can be used by X4D.

[↑] Wang F, Vemuri B, Rao M, Chen Y (2003). Cumulative residual entropy, a new measure of information & its application to image alignment. Proceedings of the Ninth IEEE International

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