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An Optimized Spline-Based Registration of a 3D CT to a Set of C-Arm Images

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Abstract

We have developed an algorithm for the rigid-body registration of a CT volume to a set of C-arm images. The algorithm uses a gradient-based iterative minimization of a least-squares measure of dissimilarity between the C-arm images and projections of the CT volume. To compute projections, we use a novel method for fast integration of the volume along rays. To improve robustness and speed, we take advantage of a coarse-to-fine processing of the volume/image pyramids. To compute the projections of the volume, the gradient of the dissimilarity measure, and the multiresolution data pyramids, we use a continuous image/volume model based on cubic B-splines, which ensures a high interpolation accuracy and a gradient of the dissimilarity measure that is well defined everywhere. We show the performance of our algorithm on a human spine phantom, where the true alignment is determined using a set of fiducial markers.

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