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Comparison of time-series registration methods in breast dynamic infrared imaging

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Abstract:

Automated motion reduction in dynamic infrared imaging is on demand in clinical applications, since movement disarranges time−temperature series of each pixel, thus originating thermal artifacts that might bias the clinical decision. All previously proposed registration methods are feature based algorithms requiring manual intervention. The aim of this work is to optimize the registration strategy specifically for Breast Dynamic Infrared Imaging and to make it user−independent. We implemented and evaluated 3 different 3D time−series registration methods: 1. Linear affine, 2. Non−linear Bspline, 3. Demons applied to 12 datasets of healthy breast thermal images. The results are evaluated through normalized mutual information with average values of 0.70 ±0.03, 0.74 ±0.03 and 0.81 ±0.09 (out of 1) for Affine, Bspline and Demons registration, respectively, as well as breast boundary overlap and Jacobian determinant of the deformation field. The statistical analysis of the results showed that symmetric diffeomorphic Demons' registration method outperforms also with the best breast alignment and non−negative Jacobian values which guarantee image similarity and anatomical consistency of the transformation, due to homologous forces enforcing the pixel geometric disparities to be shortened on all the frames. We propose Demons' registration as an effective technique for time−series dynamic infrared registration, to stabilize the local temperature oscillation.