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Study of the distortion of images of MRI scanners

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MRI has now become the preferred choice in many clinical trials due to its superior ability to distinguish one tissue type from another. However, the likelihood of geometric distortion (distortion) present in MR images limits the use of MRI in some areas where high accuracy is required.
The main sources of geometric distortion from MRI equipment are inhomogeneity in the main magnet, nonlinearity of gradient fields and eddy currents associated with switching gradient coils [1]. The amount of geometrical distortion due to field inhomogeneity depends on the magnitude of the field used. For example, at a field value of 1.5 T, a 1% drop in the field value will lead to a distortion of 1 mm. The magnitude of the gradient nonlinear distortion usually reaches 4–6 mm [2].
The objective of the study is to quantify geometric distortions by analyzing MR images of a special phantom, obtained on MRI scanners with different magnetic field strengths, and subsequent data processing.
Comparison of the obtained data from the tomograph and the true data of the phantom is one of the methods for measuring distortion. The study of images will allow to deduce the patterns of distortions, as well as algorithms to overcome these distortions in the future.
Correction of geometric distortions in MR images is often performed as a post-processing stage and consists in finding functions that relate the coordinates of the space of the distorted image and the undistorted space.
The result of the work is the values of the deviation of the points of the phantom on the MR image from the real position. Approximate dependences of the deviation from the distance to the isocenter of the coil are obtained.
Based on the data obtained, it is planned to develop a set of corrective functions for the most popular MRI scanners used in Russia in the future. The results of the study can be used to overcome the uncertainties associated with geometric distortions, which will allow more efficient use of MRI in radiation oncology.
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