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FULL PAPER

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A deep learning method for image-based subject-specific local SAR assessment

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Purpose: Local specific absorption rate (SAR) cannot be measured and is usually evaluated by offline numerical simulations using generic body models that of course will differ from the patient's anatomy. An additional safety margin is needed to include this intersubject variability. In this work, we present a deep learning–based method for image-based subject-specific local SAR assessment. We propose to train a convolutional neural network to learn a "surrogate SAR model" to map the relation between subject-specific B_1^+ maps and the corresponding local SAR.

Method: Our database of 23 subject-specific models with an 8–transmit channel body array for prostate imaging at 7 T was used to build 5750 training samples. These synthetic complex B_1^+ maps and local SAR distributions were used to train a conditional generative adversarial network. Extra penalization for local SAR underestimation errors was included in the loss function. In silico and in vivo validation were performed.

Results: In silico cross-validation shows a good qualitative and quantitative match between predicted and ground-truth local SAR distributions. The peak local SAR estimation error distribution shows a mean overestimation error of 15% with 13% probability of underestimation. The higher accuracy of the proposed method allows the use of less conservative safety factors compared with standard procedures. In vivo validation shows that the method is applicable with realistic measurement data with impressively good qualitative and quantitative agreement to simulations.

Conclusion: The proposed deep learning method allows online image-based subject-specific local SAR assessment. It greatly reduces the uncertainty in current state-of-the-art SAR assessment methods, reducing the time in the examination protocol by almost 25%.