# A framework for nucleus density quantitative mapping corrected for B1-errors

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## A framework for nucleus density quantitative mapping corrected for $B_1$-errors

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The quantification of nucleus density (ND) by magnetic resonance imaging (MRI) is of major importance for many applications, and particularly in food science (e.g. moisture or salt content). Nevertheless, ND mapping techniques are underemployed, mainly due to the lack of reliability on the obtained ND estimates. Bias is due to the inhomogeneity in the sample to be imaged of both transmit and receive radiofrequency fields. These $B_1$-related inhomogeneities should be taken into account because their effects cumulate, and bias the image intensities in a multiplicative way. The problem is badly conditioned so that even a small $B_1$ deviation could induce large errors in ND estimation.
Assuming equal spatial distributions of transmit and receive radiofrequency fields, we introduced a generic $B_1$ correction approach consisting in (i) mapping the transmit $B_1$ field in the presence of the sample, (ii) inferring the bias field and (iii) correcting the ND map using the calculated bias field. Because acquiring ND and $B_1$ maps require long acquisition times to prevent $T_1$-contamination, we developed a method to reconstruct both maps from the same radiofrequency-spoiled gradient echo MRI data. This approach was supplemented by a theoretical framework which allowed predicting the quality of the corrected ND maps in terms of residual bias and spatially-varying uncertainties. By this way, we can readily optimise the different steps required for ND mapping as well as the accuracy over a wide range of radiofrequency field variations. This global approach dedicated to the high-precision mapping of ND by MRI was validated on various simulated and experimental datasets.