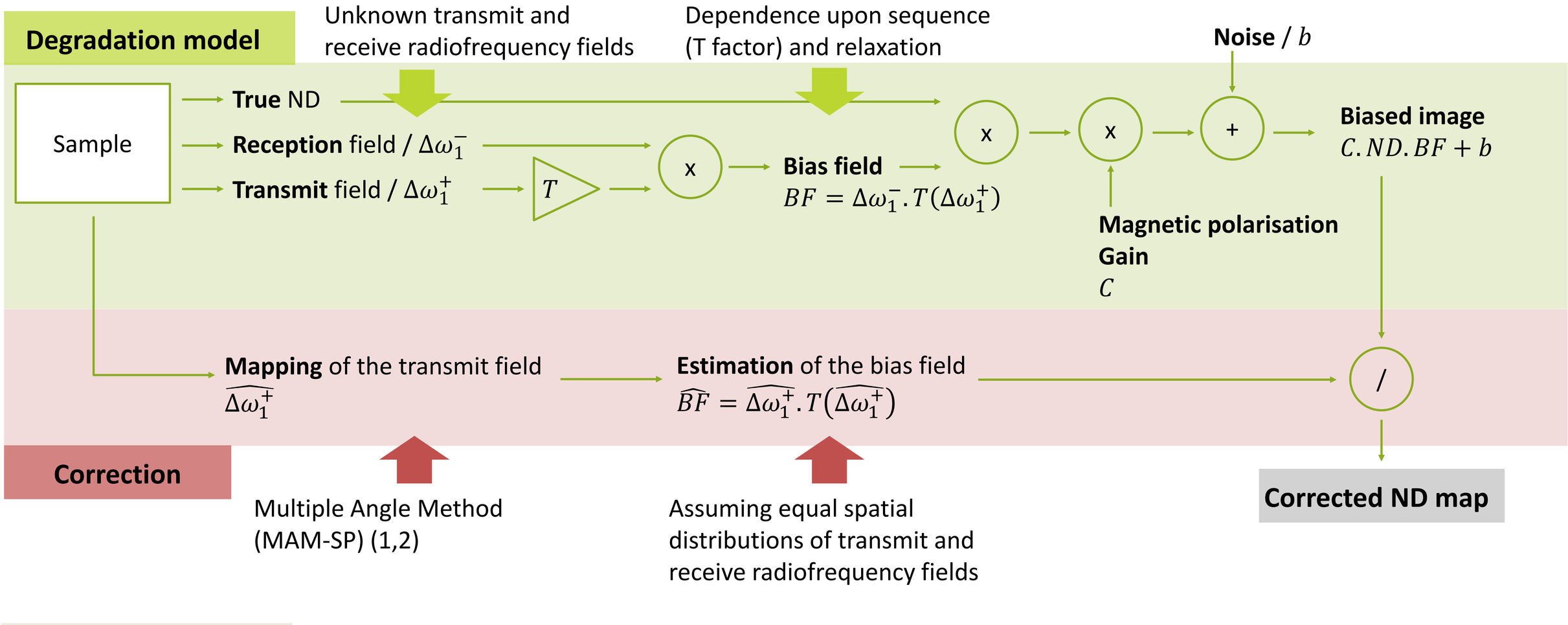
A framework for nucleus density quantitative mapping corrected for B_1-errors

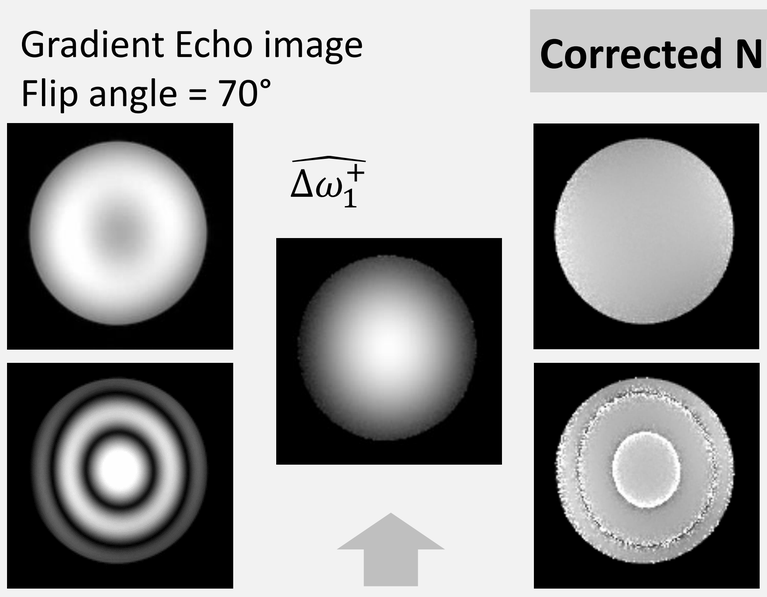
Jean-Marie Bonny, Sylvie Clerjon

AgroResonance, UR 370 QuaPA–INRA, F-63122 Saint-Genès-Champanelle, France

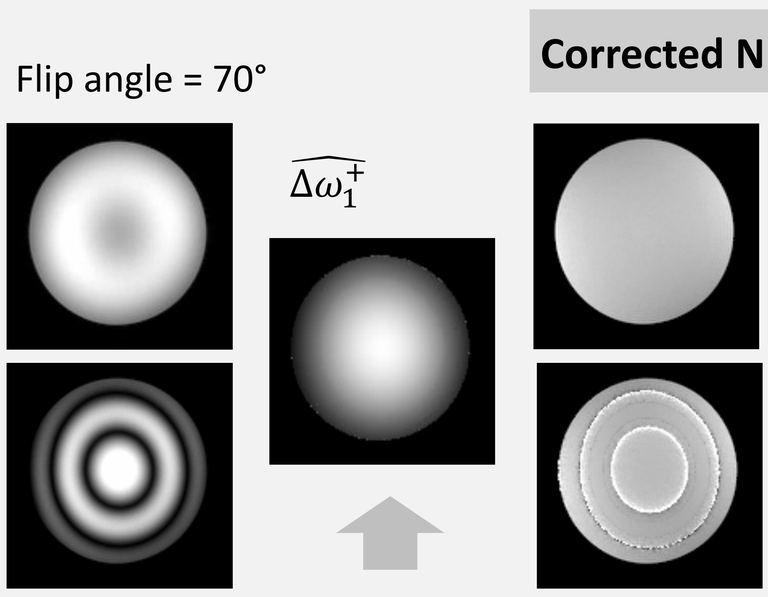
The quantification of nucleus density (ND) by magnetic resonance imaging (MRI) is of major importance for many applications, and particularly in food science (e.g. moisture or salt content). Nevertheless, ND mapping techniques are underemployed, mainly due to the lack of reliability on the obtained ND 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.



Results



- 13 cm-diameter homogeneous phantom filled with a 15mM $CuSO_4$
- Acquisition at 4.7 T
- Quadrature coil for both emission and reception



- Our correction framework was validated on real images showing exacerbated B_1-related inhomogeneities
- Accurate determination of ND requires an estimation of bias field with low residual bias and high signal-to-noise ratio (see figure on the right)
- Bias field can be mapped from the transmit field provided by MAM-SP (2), for any sequence and any selective pulse(s)
- Small bias locally persists due to probable differences of transmit and receive radiofrequency fields
- It provides an integrated approach for high-precision mapping of ND by MRI

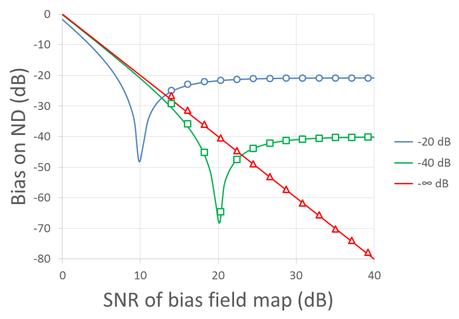


Figure showing that bias on (corrected) ND estimate converges to the bias on BF, only at high signal-to-noise ratio

(1) M. Bouhrara and J.-M. Bonny (2012) B1 mapping with selective pulses, *Magnetic Resonance in Medicine* (68) 1472 – 1480

(2) J.-M. Bonny and S. Clerjon (in prep.) High precision B1+ mapping for quantitative imaging of nucleus density

AgroResonance, UR370 QuaPA – INRA
F-63122 Saint-Genès-Champanelle, France
http://www6.inra.fr/agroresonance