MAGNETIC RESONANCE
Discussions

Magn. Reson. Discuss., referee comment RC3
https://doi.org/10.5194/mr-2022-4-RC3, 2022

Comment on mr-2022-4

Anonymous Referee #3

Referee comment on "A portable NMR platform with arbitrary phase control and temperature compensation" by Qing Yang et al., Magn. Reson. Discuss., https://doi.org/10.5194/mr-2022-4-RC3, 2022

This manuscript describes an interesting novel CMOS-based NMR platform. Fully integrated NMR-on-a-chip approaches are around for a long time already, starting of with the seminal work of Giovanni Boero and his coworkers at EPFL. The novelty of the current design is that it allows arbitrary phase control without compromising the timing of the pulses. Furthermore, the authors use the dual DDS system to implement a frequency-field lock to adapt the frequency of the excitation pulse to the field of a drifting magnet of e.g. a permanent magnet without thermal stabilization. It is an overall interesting manuscript that deserves publication.

The paper is well-written but very technical, I think the first part is somewhat beyond the imagination of much of the readership of "magnetic resonance" and would be more fitting in a more engineering focused journal. The experimental validation is convincing, however, and very accessible for the magnetic resonance community.

I have some remarks relating to the "temperature compensation". What the system does is adjust the frequency of the excitation pulse to the variation of the magnetic field strength, so I would not call this temperature compensation. This is called a frequency-field lock and has been used already in the early days of NMR to acquire spectra in unstable magnets. Notably it has also been used to signal average NMR signals in ultra-high-field Bitter magnets which display temporal instabilities because of inlet cooling water temperature variations and ripple of the power supply. In those cases, the signal of a separate reference signal was used to track the field variations. In the current implementation the frequency is adjusted based on the frequency variations in the signal of the sample of interest. This precludes signal averaging for samples with very low signal intensity, as the SNR of a single scan needs to be high enough to allow the determination of the frequency shift due the magnet field drift. Furthermore, I think that signal averaging in a permanent magnet without any temperature regulation will not only suffer from drift of the magnetic field, but also there will be temporal variations of the homogeneity due to temperature gradients, so even with the frequency-field lock the resolution will deteriorate. If a separate reference signal would be acquired simultaneously this could be addressed by reference deconvolution. I feel these considerations should be discussed in the paper.