MAGNETIC RESONANCE
Open Access
Discussions

Magn. Reson. Discuss., referee comment RC1
https://doi.org/10.5194/mr-2021-4-RC1, 2021

Comment on mr-2021-4

Fabien Ferrage (Referee)

Referee comment on "Approximate representations of shaped pulses using the homotopy analysis method" by Timothy Crawley and Arthur G. Palmer III, Magn. Reson. Discuss., https://doi.org/10.5194/mr-2021-4-RC1, 2021

Crawley and Palmer introduce the use of the homotopy analysis method to obtain approximate analytical representations of the effect of radiofrequency pulses on magnetization. After presenting the (not so well known) Ricatti equation used to derive the three Euler angles that define the effect of a radiofrequency pulse, they introduce an advanced mathematical approach, homotopy analysis method (HAM). The use of HAM to obtain approximate analytical expressions for the three Euler angles that describe the effect of an arbitrary pulse is detailed and applied to a series of shaped and adiabatic pulses. The approach is original, the results are convincing and the time saving linked to the manipulation of analytical expressions rather than numerical propagation is demonstrated.

I would like to issue a disclaimer: I have not verified the calculations presented in this article. The numerical results presented in the results section validate the approach and ensure that any error would have only minor consequences.

I list below a series of minor points that should be addressed to improve the quality of the manuscript.

- The matrix form of the propagator given in Equation 1 is expressed in which basis?
- I may have missed it but the author should mention that all calculations are performed in the rotating frame.
- Are omega_x and omega_y, first introduced below Equation 4, the radiofrequency field amplitudes along the x and y axes of the rotating frame?
- It is only just below Equations 13 and 14 that the authors introduce the idea that the value of the homotopy defined in Equation 10 should be zero. For easier understanding by readers, I believe it could be mentioned with Equations 10-12 that we aim at solving H = 0, right?

- In equation 13, should the last remaining q be replaced by 0?
- The derivation of Equations 24 and 27 does not seem trivial. Can the authors mention at least the method used to obtain these two expressions?
- The function delta(t) is introduced discreetly in Equation 33. However, it is used extensively and could benefit from being defined in a separate equation.
- Just below Equation 38, the fact that y(t) is defined by a power series in Omega, which can be large, is intriguing and raises the question: does the series converge? The results section seems to confirm the doubt about quick convergence of the series. Maybe this aspect could be discussed in more detail either below Equation 38 or in the results section.
- It can be hard to read the figures as many overlapping curves are “shown”. The authors may wish to make an effort to make as many curves visible as possible, for instance by using dashed or dotted lines for the curves sitting on top of another one.
- The alpha (tp) label seems to have drifted too far to the left in Figures 2 and 3.
- The authors conclude their abstract and conclusion with the mention that the HAM can be applied to many problems in NMR. Without saying too much, could the authors give a few hints, beyond the optimization of shaped pulses? Could the effects of relaxation be introduced by modifying the Ricatti equation, for instance?
- A couple of comments on references: (i) in the introduction, the reference to Cavanagh et al. 2007 for shaped pulses is very relevant, but the authors may wish to add a few other references to reviews or original work on this topic; (ii) it seems that SNOB pulses are mentioned but the original reference is not cited.
- “the” is repeated in line 121.