MRI Simulator Notes

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Tasks

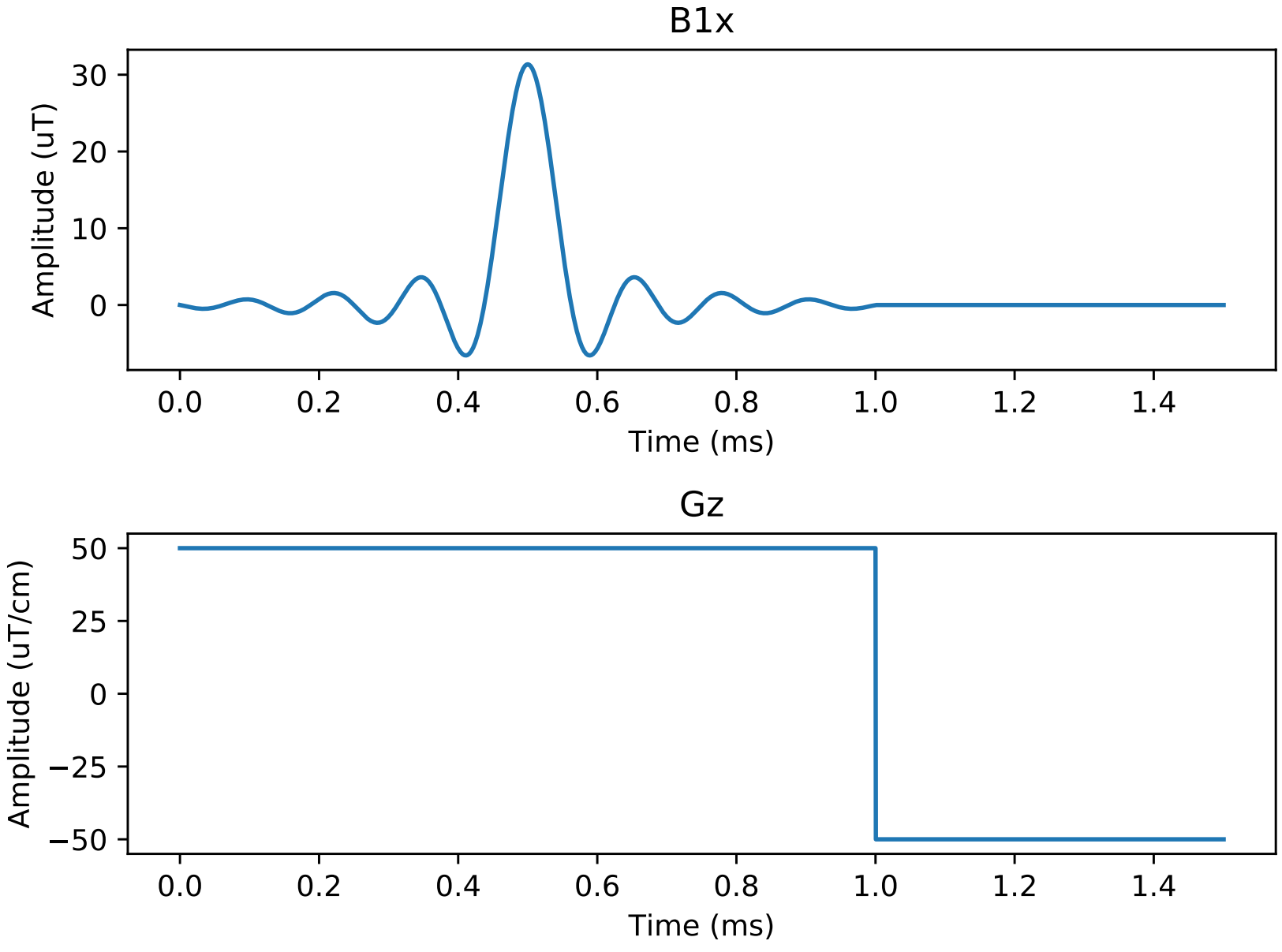
- I simulated selective excitation of a slice in the z direction to test my code
- I wrote a function to generate selective excitation pulses with a given slice width and tip angle.

Selective excitation of a slice for testing

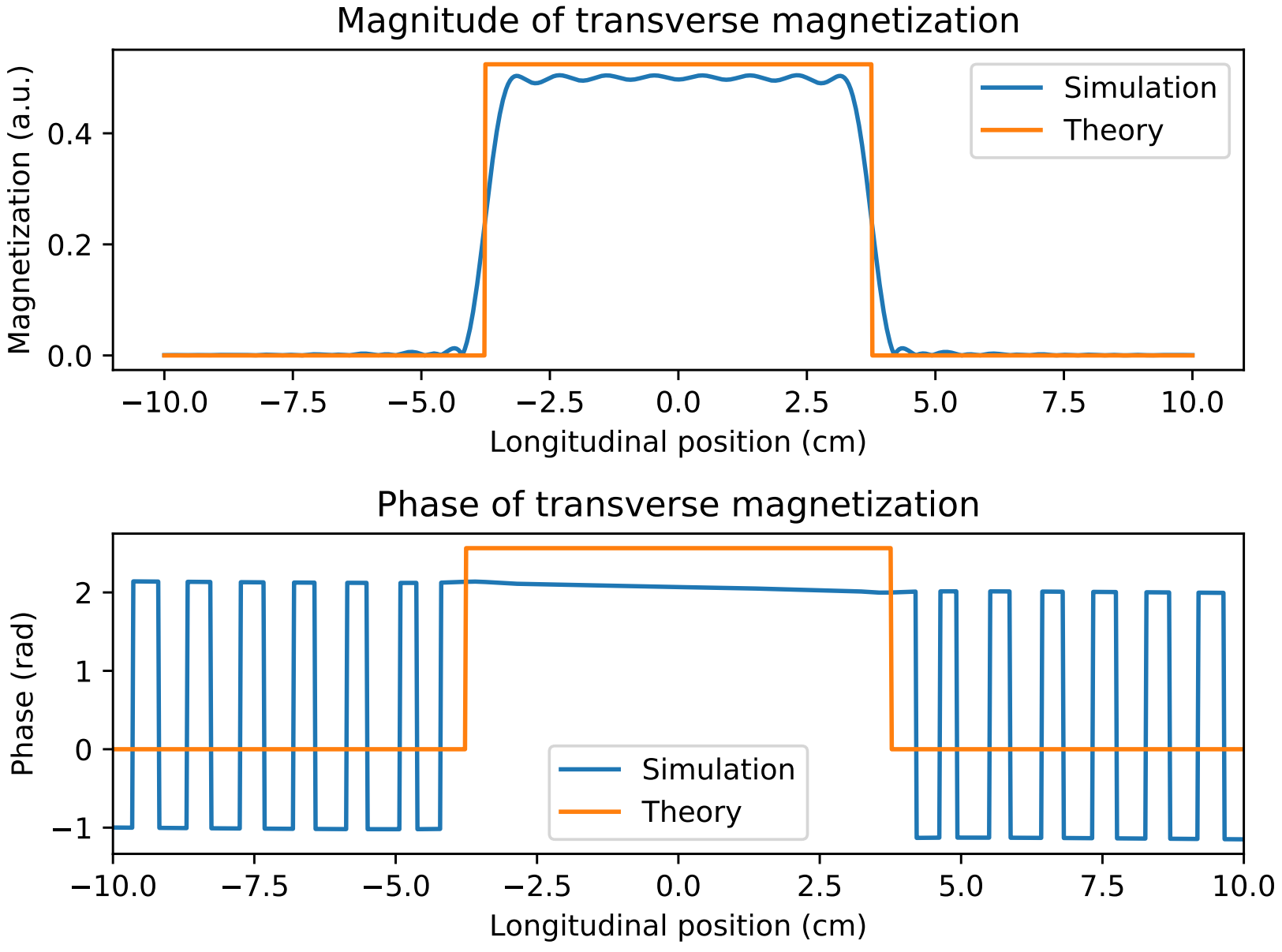
Summary

- I distributed 1000 ems evenly-spaced from -10 cm to 10 cm.
- I simulated selective slice excitation with more realistic parameters, e.g. using the actual gyromagnetic ratio of H-1.
- I used a Gaussian-windowed sinc waveform for the RF pulse and a constant z gradient with a refocusing lobe.
- I debugged until the simulation and theory profiles agreed.

Pulse sequence



Transverse magnetization profile



Comments

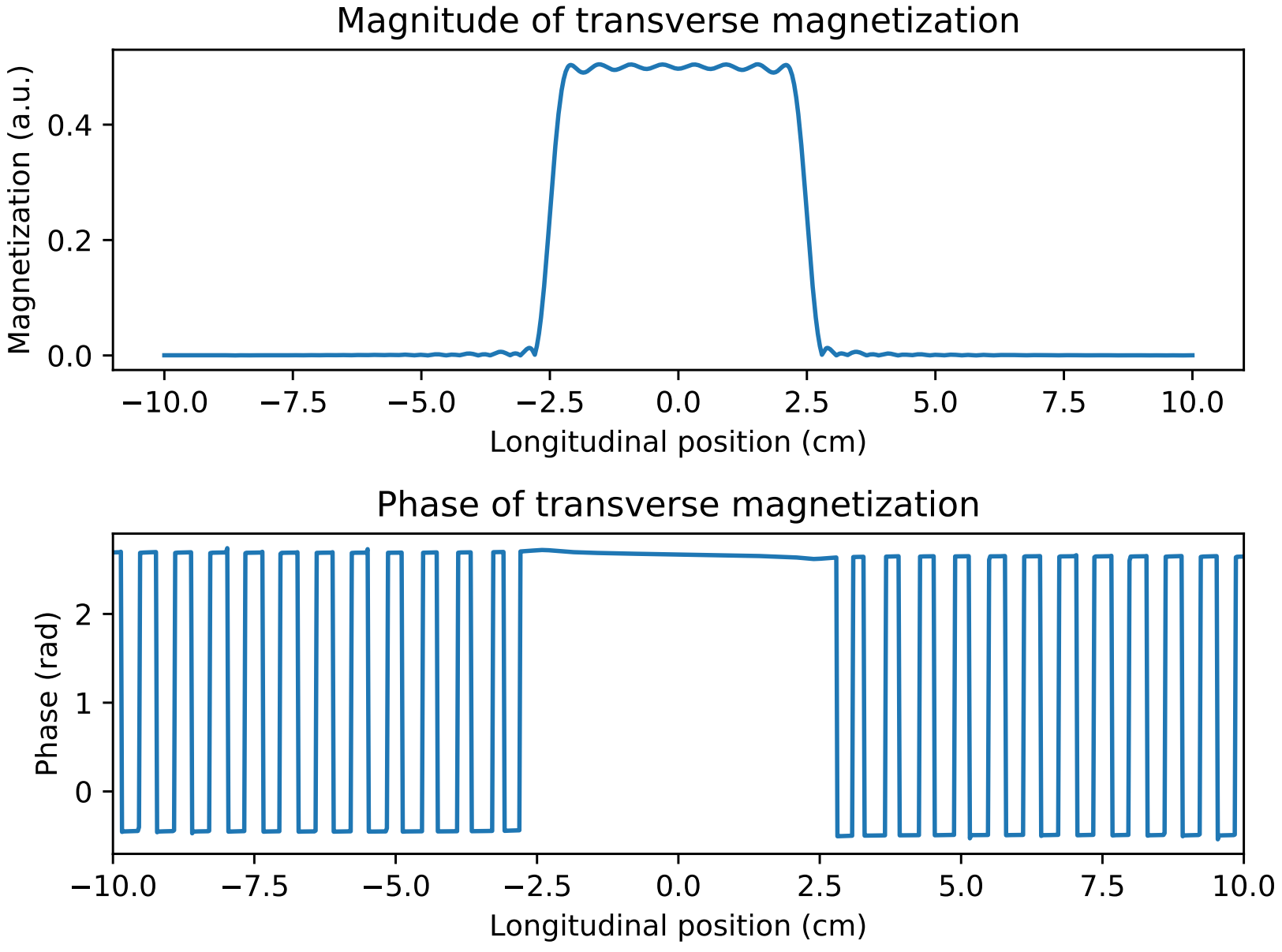
- The profile looks as expected in the excited slice.
- I'm not sure what's going on with the phase outside of the excited slice.
- I take these results as evidence that the excitation and precession routines are working as expected.

Slice-select pulse function

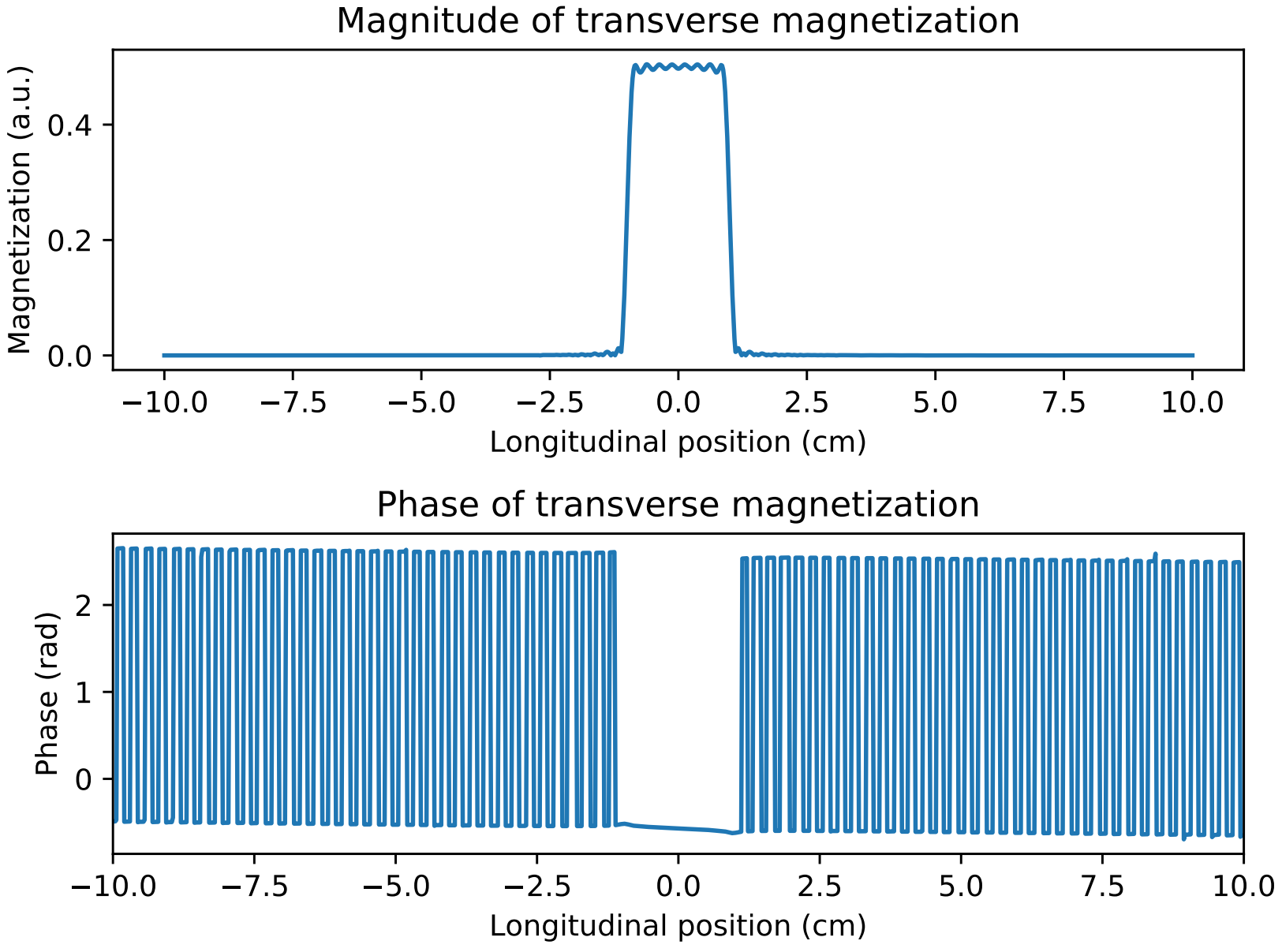
Summary

- I tested my selective excitation pulse function by simulating the effect of the generated pulses on 1000 ems evenly-spaced between -10 cm and 10 cm and plotting the resultant magnetization profile.

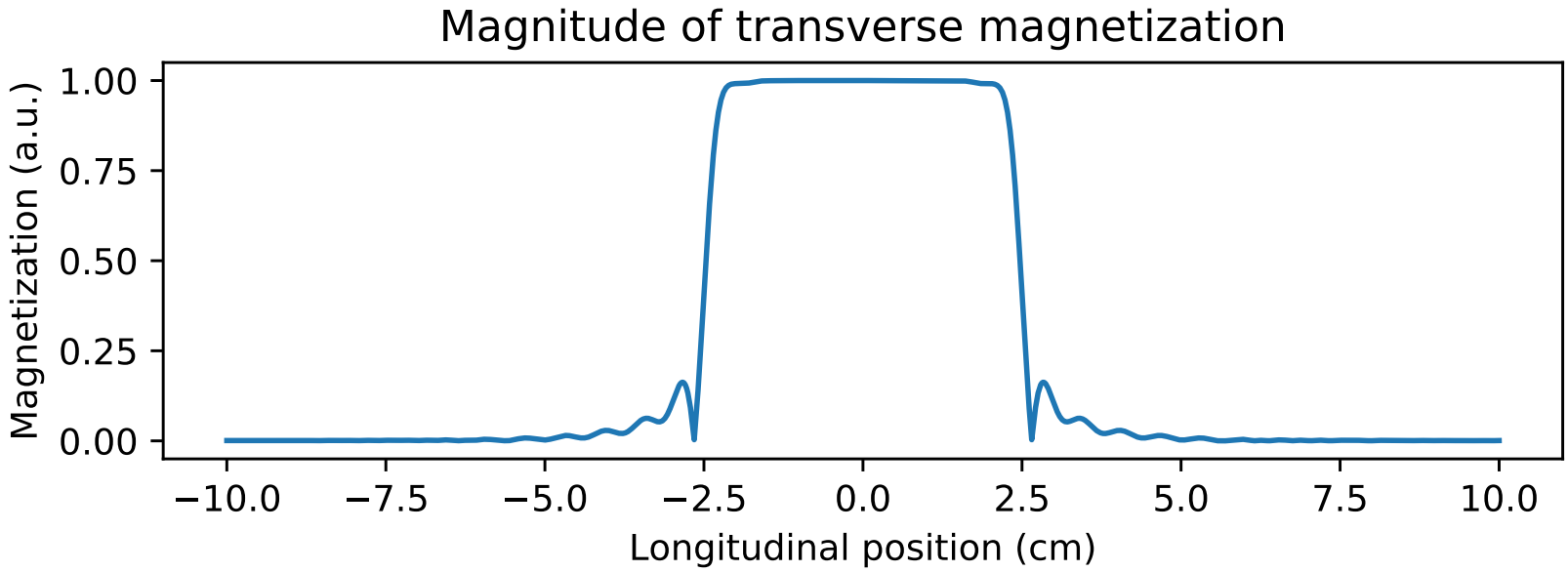
Slice width 5 cm, tip angle 30 degrees (0.52 rad)

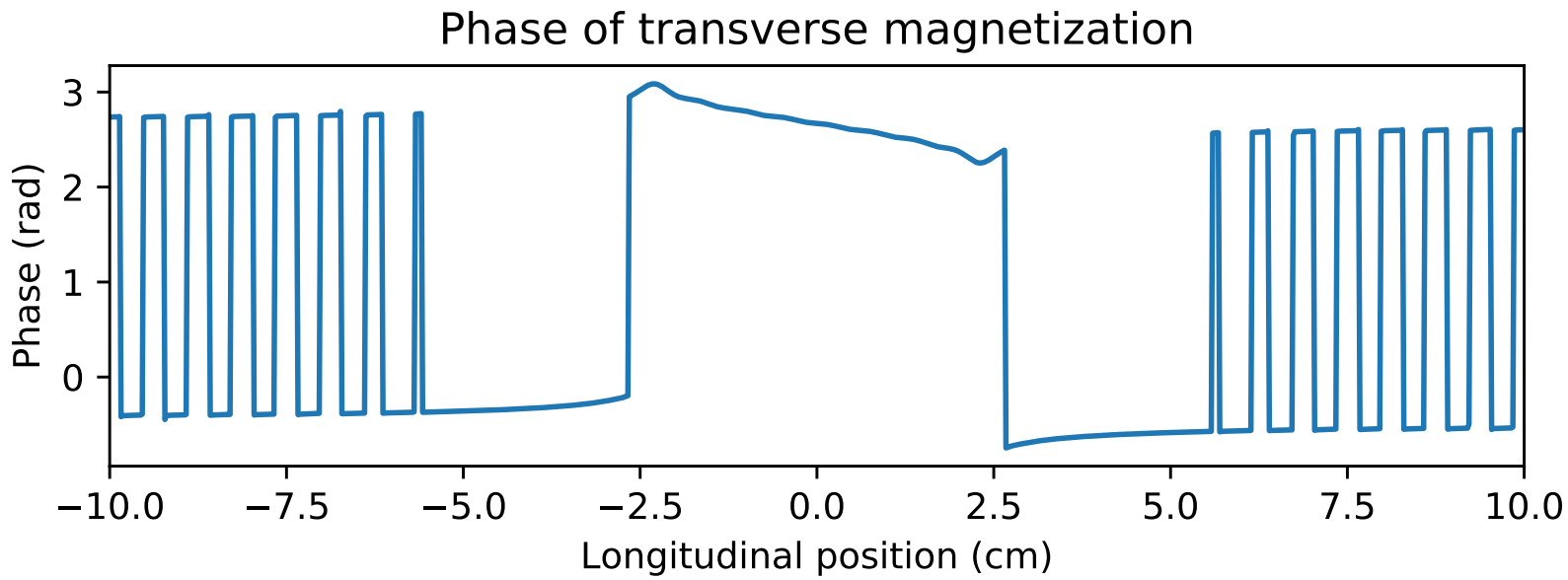


Slice width 2 cm, tip angle 30 degrees (0.52 rad)



Slice width 5 cm, tip angle 90 degrees (1.57 rad)





Comments

- The function appears to be working as expected.
- The phase profile in the final plot is slanted. I think this is due to the time step being too large – the phase advance in a single time step is substantial. See the following figure for the last profile with a time step of 10^{-7} seconds instead of 10^{-6} seconds.

Slice width 5 cm, tip angle 90 degrees (1.57 rad), $\Delta t = 10^{-7}$ s