

EVALUATION OF THE ROBUSTNESS OF OPTIMAL CONTROL-BASED RF PULSES IN THE FRAMEWORK OF MAGNETIC RESONANCE ELASTOGRAPHY

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Magnetic Resonance Elastography (MRE) quantifies the mechanical properties of tissues based on the properties of shear wave propagation [1]. Classically, MRE applies oscillating motion encoding gradients (MEGs) to encode the external induced motion. Their presence involves long echo times, limiting the technique to very short relaxation times (T2) tissues and high excitation frequencies. RF pulses designed with an optimal control (OC) algorithm applied with a constant gradient demonstrated their ability to simultaneously perform slice selection and motion encoding enabling short echo times independently of the excitation frequency [2,3]. However, a mismatch between experimental and optimization parameters could affect the performance of the OC pulses. A prior knowledge of the acquisition parameters is thus required to compute the OC pulse. In this study, we evaluated the robustness of the OC pulses to the variability of two critical parameters: the T2 and the shear wave amplitude. From simulations, we found that motion is still encoded when T2 is bigger or slightly smaller than the optimized one and when the excitation amplitudes are smaller than the amplitudes fixed for the optimization (Figure 1). Experimental acquisitions carried out on a T2-heterogeneous phantom are in agreement with the results found by simulation (Figure 2). In conclusion, we validated the robustness of OC pulses to the sample T2 variability. This means that an OC pulse could be used in a wide range of different T2s. Also, we demonstrated that OC pulses can encode the motion attenuation along the sample. This would facilitate the use of the OC-based MRE strategy on clinical setups since just a few pulses could be sufficient for different applications. Further studies are needed to confirm the applicability of OC pulses *in vivo*.

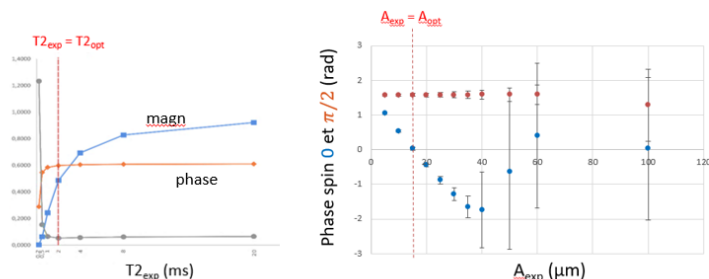


Figure 1. Numerical evaluation of the robustness of an OC pulse. Left: simulated transverse magnetization amplitude and phase variation with respect to sample T2-value. Right: simulated accumulated phase variation with respect to excitation amplitude.

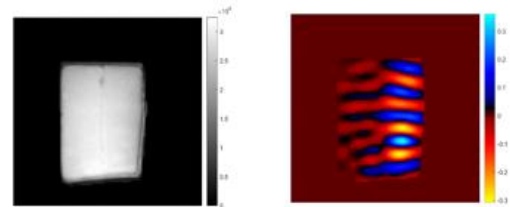
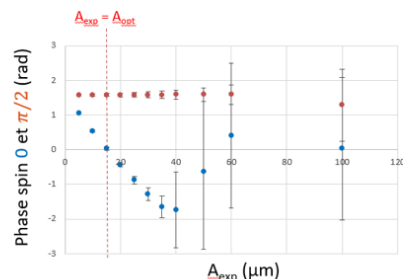


Figure 1. Experimental results on a bi-layer phantom with T2 values of 1ms (left-layer) and 5 ms (right-layer): magnitude (left) and phase (right) images.

References:

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