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Optimized Radio Frequency Pulses Generated From Magnetic Resonance User Defined Parameters

Technology No. 20170394

IP Status: Pending US Patent; **Application #:** 16/861,506

Pre-optimized RF pulse shapes improve efficiency

A novel bottom-up approach allows magnetic resonance users to custom design optimal radiofrequency (RF) pulses. The method generates pulses using an algorithm that allows users to design RF pulses with a control variable not normally available to them. The tool optimizes pulse shapes up front to match desired bandwidth, thus minimizing power, boosting the signal-to-noise ratio and optimizing performance across the bandwidth. Pre-optimizing RF pulse shapes improve NMR and MRI efficiency and may be less damaging to samples. This unprecedented approach generates efficient pulse sequences in magnetic resonance applications, including MRI and liquid- and solid-state nuclear magnetic resonance (NMR).

Unique optimal phase surface algorithm

Currently, NMR users use pre-defined pulse shapes that require power and time duration to excite the desired bandwidth. Hardware limitations reduce the performance of these pulse sequences and often jeopardize outcomes. These methods can reduce efficiency and their high power can overheat samples. This new algorithm allows users to specify parameters such as bandwidth, RF inhomogeneity compensation and/or the nutation angle. The iterative algorithm searches for pulse shapes in an optimal phase surface tailored to maximize performance. The algorithm includes an optimization segment (OS), which evaluates an optimal phase surface based on a specified target operation (such as an inversion or excitation), and a search segment (SS). Advantages of the new algorithm and pulses over classical shaped pulses include the ability to generate optimal pulses for a number of broadband and selective excitation and inversions with reduced RF power dependency. These new generated pulses optimize time durations for any specified bandwidth, provide high-fidelity operation within the given bandwidth and can generate optimal pulses for many systems in under two seconds.

Phase of Development

- Proof of concept. Beta tested algorithm and software. New pulse shapes already developed and tested with liquid-state NMR experiments.

Benefits

- Minimizes power
- Reduces time
- Fast determination of optimum pulse shape (<2 seconds)

Features

- Custom RF pulse design
- Generates optimal pulses and pulse durations for a variety of MR operations
- Solves power limit problems for many protein NMR experiments
- Compatible with current MR spectrometer software

Applications

- NMR spectroscopy
- MRI
- MR Spectrometers
- NMR instrumentation software
- Instrumentation companies or research labs

Researchers

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