Progress Towards the Use of Pulsed Field Gradients With Field Regulation by Feedforward Gradient Correction

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Introduction

This work will enable the use of pulsed field gradients with a field regulation system used to reduce field fluctuations in powered magnets, in particular, the 36 T series-connected-hybrid (SCH) magnet. MRI and many NMR techniques require the application of pulsed field gradients. At present, our field regulation system measures and attempts to attenuate pulsed field gradient signals. Here we introduce a feedforward gradient correction filter to remove the gradient signal from the field measurement. Preliminary tests in a 7 T persistent superconducting magnet show significant reduction in the gradient component of the field measurement.

Experimental

Bipolar pulsed field gradients with a magnitude of 50 G/cm were applied in a 7 T persistent superconducting magnet and the relationship between the input gradient signal and the output field measurement was identified. The resulting estimate was subtracted from the field measurement, removing the gradient component and leaving only the field fluctuations.

Results

Figure 1 shows the result of feedforward gradient correction. The upper subplot shows the commanded bipolar gradient input (blue) of 50 G/cm. The lower subplot shows the resulting field measurement in red. The inductive field sensor as placed to minimize pickup from the gradient coils, but a significant residual gradient signal remained. With feedforward gradient correction, the residual gradient signal was suppressed by greater than a factor of 10 (green).

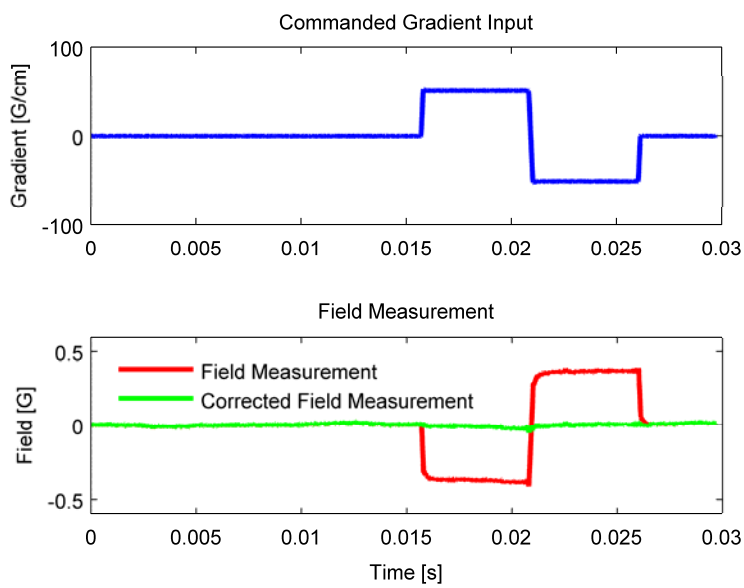

Figure 1. Pulsed field gradient signals before and after feedforward correction

Conclusions

We have demonstrated that feedforward gradient correction can remove gradient signals from inductive field measurements. We expect to apply this method to NMR experiments requiring the use of pulsed field gradients and field regulation on the 25 T Keck powered magnet. This work supports the development of the 36 T series-connected hybrid magnet scheduled for completion in 2015.

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