A Paper Review about “Ensemble Controllability of the Bloch Equations” by Jr-Shin Li and Navin Khaneja

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1. **Goal of this paper**

The goal of this paper is to make an better explanation of the key aspects of the dynamics that make compensating dispersion which was accomplished by the use of composite pulses possible. Specifically, the authors of the paper wanted to start with Bloch Equations and then analyze it under a specific circumstances and finally make a better illustration of what kind of dispersion can be corrected and what cannot.

1. **Assumptions**

As for different examples, the authors proposed different assumptions from simple conditions to more complicated conditions so as to analyze the controllability under different circumstances. The authors first studied the Bloch Equations in a rotating frame with only RF inhomogeneity and no Larmor dispersion. Given the main idea, the authors considered 5 examples in the following especially analyzed the controllability of each system and pointed out that phase dispersions cannot be compensated. And finally came to the conclusion that noncommutativity is a key factor that leads to the possibility of compensation control.

1. **Limitations**

This paper “make explicit the role of noncommutativity as a key aspect pf the dynamics that makes the design of a compensating control possible” [1]. Also, this paper introduced the method of polynomial approximations to help the design of pulse sequences of compensation control for inhomogeneous ensembles. As the authors noticed, this paper did not propose the most effective schemes for compensation. Besides, this paper was based on mathematical proof and offered no experimental data to prove the conclusion. For future work, I think the empirical analysis is need like apply them to a certain circumstance and observe whether the conclusion can predict the result.

[1] J.-S. Li and N. Khaneja, “Ensemble controllability of the bloch equations,"

in IEEE Conf. Dec. Cont., San Diego, CA, Dec. 2006, pp. 2483~2487.