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**Title:** « Time-dependent diffusion tensor of moving and deforming media measured by diffusion MRI »

**Abstract**:

Diffusion MRI of moving organs such as the heart is very challenging due to significant motion and deformation of the imaged medium during the signal acquisition. Recently, a rigorous mathematical formalism, starting from the Bloch-Torrey partial differential equation (which describes the complex transverse magnetization) and accounting for motion and deformation according to the laws of continuum mechanics, was formulated to quantify the effect of tissue motion and deformation during the diffusion MRI acquisition on the macroscopic scale. In this work, we analyze this problem on a smaller spatial scale, that of individual cells. We start with the Bloch-Torrey PDE defined on a cell that is moving and deforming and linearize the PDE around the magnitude of the diffusion-encoding gradient. The result is a simpler PDE model, that we call the ADC-D model (for the Apparent Diffusion Coefficent in a Deforming medium), that gives the time-dependent effective diffusion tensor attributable to the cell. We validate this model by simulating the reference Bloch-Torrey PDE model and compare the reference signal with that obtained by the ADC-D model for a variety of motion and deformation. We show that, indeed, the ADC-D converges to the reference model with the expected order of convergence.