**In vivo Diffusion MRI of Mouse Brain with Motion Compensation**

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**Introduction**

*In vivo* MRI biomarkers are crucial for drug development and tailored individualized tumor therapy. Among these biomarkers, diffusion MRI attracts increasing attention for its potential to monitor tumor response to therapy [1, 2]. However, diffusion MRI *in vivo* is strongly affected by the presence of slight motions inevitably present in live animals. A new pulse sequence for diffusion mapping was developed for the Bruker MRI scanner (UWB900). The implemented motion compensation method was suggested earlier by others [3]. This approach is additionally attractive because a set of three orthogonal diffusion gradients can be applied at the same interval, thus, decreasing duration of the diffusion MRI mapping experiment by three times.

**Results and Discussion**

The MR imaging experiments were performed with a normal mouse (C57BL/6J) using UWB 900 magnet, Bruker Avance console and PV4.0 / TopSpin 1.5 software. The imaging gradient set (Bruker Micro 2.5) has a 40 mm internal diameter and a maximum gradient of 1.5 T/m. The specially designed MRI probe had a pressure sensitive pad to monitor the animal’s breathing rate inside the magnet. Animals for MR imaging were anesthetized using an isoflurane/oxygen mixture. All animal experiments were conducted in accordance with the protocol approved by FSU ACUC. Fully motion compensated gradient waveforms were incorporated into Spin Echo pulse sequence and are shown on Fig. 1. All diffusion gradients were orthogonal to each other and their cross terms were set to zero. MRI imaging experiments were performed for a mouse head using both a conventional square gradient shapes and a motion compensated gradient set (Fig. 2). Echo time was 30 ms, orientation of the PE gradients was along X axis. Dramatic differences in quality of both images are very noticeable, demonstrating the advantages of the motion compensated diffusion gradients.

![Fig. 1. SE pulse sequence with the motion compensated diffusion gradient waveforms.](image1)

![Fig. 2. Diffusion weighted MR images of mouse brain (b=100 s/mm²): A – an application of the motion compensated diffusion gradient shapes, B – an application of the conventional square diffusion gradient shapes.](image2)

**Conclusions**

Application of the novel diffusion gradients dramatically diminishes effects of *in vivo* motion during diffusion weighted MR imaging at UWB900. It also reduces duration of the isotropic diffusion mapping experiments three times relative to the conventional diffusion pulse sequence. The new *in vivo* MR imaging capabilities create variety of opportunities for users to conduct biomedical research at 21T.

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**References**