B_1 field mapping and correction for MR spectroscopic imaging at 3T and 7T
(Project number: 61p4)

Final Report

In order to correct for MR spectroscopic imaging data quantification difficulties caused by B_1 magnetic field non-uniformities we aimed to develop and implement new B_1 mapping sequence and perform MR in vivo examinations using sensitive surface coils on two whole body systems working at different magnetic fields. MR measurements at 3T were performed at the MR Unit of the Institute for Clinical and Experimental Medicine (IKEM) in Prague; the MR measurements at 7T were done at the MR Centre of Excellence, Medical University of Vienna.

Following the approval of the ethics committees in Prague and Vienna, first visits of Drs. Chmelík, Valkovič and Krššák in Prague (06.-08.11.2011) and of Drs. Dezortová and Hájek in Vienna (04.-06.12.2011) served for the discussion about the ongoing development of the method for surface coils flip angle (FA) maps acquisition. The new field-mapping method was afterwards derived from the pulsed steady state method and adapted for the use with phosphorous setup at high and ultra-high field strengths.

From February 2012 to June 2012, in vitro flip angle maps using surface coil (3T and 7T) and breast coil (7T) were acquired on testing objects containing phosphorus solutions. Two typical excitation pulses used in clinical practice were mapped – conventional Sinc3 pulse with durations of 600 μs and 1280 μs and an adiabatic half passage (AHP) pulse with duration of 2500 μs (see Fig. 1). Data acquired during these measurements were processed by Drs. Chmelík, Valkovič and Jírů, and the analysis showed high potential of the developed field mapping sequence. Reconstructed field-maps proved to be usable for the B_1 field corrections of ^{31}P MR spectroscopic imaging data.

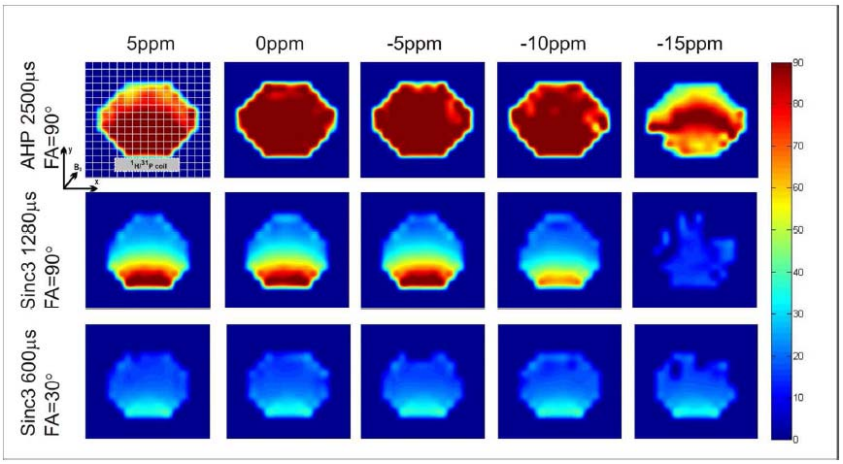

Figure 1. Experimentally determined FA maps of a 2.5-ms long 90˚ AHP (top row), a 1.28-ms long 90˚ Sinc3 (middle row), and a 0.6-ms long 30˚ Sinc3 pulse used for excitation for 5, 0, -5, -10, and -15 ppm offsets.

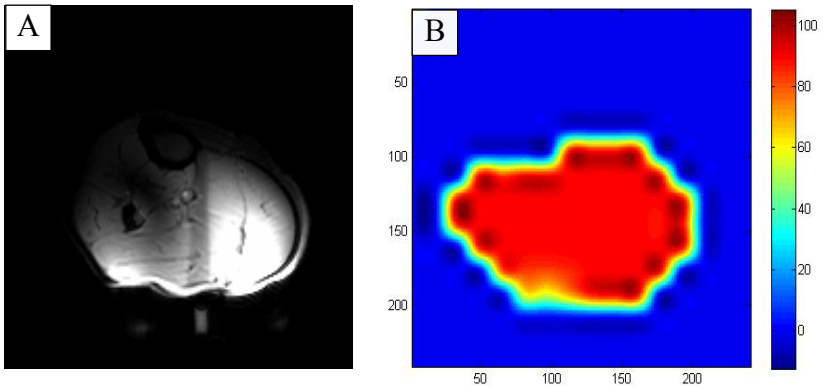

Figure 2. (A) Transversal MR image of human calf muscle (B) corresponding experimentally determined *in vivo* FA map of a 2.5-ms long 90˚ AHP pulse.

Volunteer measurements (see Fig. 2) were required to show the applicability of the developed method in vivo. These were performed on a 3T system mainly during the second visit of partners from Vienna to Prague (23.-25.07.2012). The new B_1 mapping method has been demonstrated on the calf muscle because of the latest project interests in muscle energy metabolism, but is usable for correction of the MR spectroscopic imaging data acquired also from human brain, breast or liver *in vivo*. The project was concluded with the final volunteer measurements at 7T MR system and data analysis during the visit of Dr. Dezortová and Dr. Hájek in Vienna (20.-22.08.2012). This visit served also for the intensive discussion and preparation of the manuscript, which is planed for the submission to scientific journal (Magnetic Resonance Materials in Physics, Biology and Medicine) in due time. Further on, the preliminary results of the study were already presented at joined international workshop "MR Studies" in Oberschwarzenberg, Austria, June 25-27, 2012 (project AKTION, No. 63p18), and are to be presented at MR related international conferences (International Society of Magnetic Resonance in Medicine, European Society for Magnetic Resonance in Medicine and Biology) in 2013.

Next to the scientific output of quantification corrections of ^{31}P MR spectroscopic imaging data, our project proved the usability of sharing measurement time on mid-size instrumentation in international projects.

Dr. Monika Dezortová
MR Unit
2nd Faculty of Medicine
Charles University in Prague

Dr. Marek Chmelík
MR Centre of Excellence
Department of Radiology
Medical University of Vienna

Scientific output (List of presentations at local and international conferences)

1. Int. workshop "MR Studies" 2012 in Oberschwarzenberg (under the project AKTION 63p18)
2. Manuscript in preparation to Current Contents indexed int. journal Magn Reson Mater Phy
3. Abstract in preparation for the annual meeting of the ISMRM 2013 in Salt Lake City

List of Participants of respective project visits:

Vienna to Prague (06.-08.11.2011)

1. Marek Chmelík
2. Ladislav Valkovič
3. Martin Kršňák

Prague to Vienna (04.-06.12.2011)

1. Monika Dezortová
2. Milan Hájek

Vienna to Prague (23.-25.07.2012)

1. Marek Chmelík
2. Ladislav Valkovič
3. Wolfgang Bogner

Prague to Vienna (20.-22.08.2012)

1. Monika Dezortová
2. Milan Hájek