Paper ID: 19582
oral

SPACE LIFE SCIENCES SYMPOSIUM (A1)
Poster Session (P)

Author: Dr. Gordon Sarty
University of Saskatchewan, Canada, gordon.sarty@usask.ca

Ms. Somaie Salajeghe
University of Saskatchewan, Canada, s3salajeghe@gmail.com
Ms. Mahsa Mafi
University of Saskatchewan, Canada, mahsa.mafi67@gmail.com
Dr. Paul Babyn
University of Saskatchewan, Canada, Paul.Babyn@saskatoonhealthregion.ca
Dr. Jonathan Sharp
NRC Institute for Biodiagnostics, Canada, Jonathan.Sharp@nrc-cnrc.gc.ca
Dr. Boguslaw Tomanek
NRC Institude for Biodiagnostics, Canada, Boguslaw.Tomanek@nrc-cnrc.gc.ca
Dr. Krzysztof Turek
AGH University of Science and Technology, Canada, kturek@mri-tech.home.pl

PROGRESS IN THE DESIGN OF A MAGNETIC RESONANCE IMAGER FOR SPACEFLIGHT

Abstract

A magnetic resonance imager (MRI) suitable for spaceflight must be of low mass and of high reliability. These goals may be achieved through the use of permanent magnets and image encoding techniques that do not require complex magnet field gradient hardware to encode spatial information into the nuclear magnetic resonance (NMR) signal. Magnetic gradient-free NMR imaging may be achieved through the use of spatial phase gradients in the transmitted radio frequency (RF) magnetic field. Without the magnetic field gradients, the MRI is reduced to a light-weight permanent magnet assembly with simple RF coil inserts. The RF coils are driven by a radio amplifier following a programmed pulse sequence program. That is, a portable computer driving an RF amplifier plus the magnet and coil hardware define the simplified hardware required for a gradient-free MRI.

Two designs of gradient-free MRIs suitable for spaceflight - especially on board space stations like the International Space Station or the one planned for flight around 2020 by the CNSA - will be presented. One is a 50 kg size MRI suitable for imaging wrists, ankles, knees and elbows; the other is an 800 kg whole body size MRI. The 50 kg extremity MRI is primarily a proof-of-concept design but will nevertheless be capable of providing detailed time-series data on the progression of bone and muscle loss in astronauts in long-term spaceflight. The whole body MRI will be able to provide a much wider range of research and medical diagnostic information, including the critical hip region for the assessment of bone loss and whole body imaging to follow fluid distribution changes.

Plans to construct a prototype of the extremity size MRI in 2014 will be presented and progress towards expanding the capability of the gradient-free MRI beyond pure anatomical imaging will be reviewed. We expect that our initial prototype designs for gradient-free MRI in a 50 kg magnet will be demonstrated in 2014 advancing the MRI in space concept to technology readiness level 4.