SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

QUANTITATIVE ASSESSMENT OF LUNG MICROSTRUCTURE IN HEALTHY MICE USING AN MR-BASED ^{3}HE LUNG MORPHOMETRY TECHNIQUE

DISSERTATION DEFENSE
by

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Abstract: Recently developed in our laboratory the MRI-based technique – ^{3}He Lung Morphometry – is a unique tool allowing *in vivo* measurements of lung microstructural parameters such as alveolar volume, surface-to-volume ratio and alveolar density. These parameters are commonly used by lung physiologists and pathologists but were previously available only from invasive biopsy studies. ^{3}He Lung Morphometry was originally developed for human studies but there is a need to expand it for studies of small animals like mice and rats that are used to advance our knowledge of lung physiology in health and disease and for development of drugs. Such an expansion of ^{3}He Lung Morphometry technique is the subject of this dissertation. To achieve this goal we have developed theory of ^{3}He gas diffusion in lung airways and alveoli and tested this theory in two distinct experiments.

In the first experiment, using a Stejskal-Tanner method, we examine the diffusion of ^{3}He atoms as it happens in tiny airways of mouse lungs. Through series of magnetic resonance (MR) measurements we study the pattern of signal decay over very short periods of time. This decay crucially depends on the confining effects of the spins in very small compartments, lung acinar airways and alveoli. The signal decay is mathematically modeled after the theory developed in our laboratory that describes ^{3}He gas diffusion in the compartments that are at the scale of mouse lung airways. Applying our MR diffusion decay measurements in the mouse lung mathematical model allowed us to provide close estimation of lung microstructural parameters at the alveolar level. The values obtained for those parameters are in agreement with various histological findings published in the literature, as well as our own histological findings. These values are also in agreement with *in-vivo* mouse lung ^{3}He MR experiment also conducted in our laboratory.

Our theory of ^{3}He gas diffusion in lungs relies on an assumption that diffusion in the lung acinar airways is anisotropic. Thus, a set of experiments were performed to demonstrate that gas diffusion in mouse lungs is indeed anisotropic. The MR measurements that demonstrate anisotropy of the ^{3}He gas diffusion in mouse lung also use a series of MR diffusion measurements. These MR measurements are directionally interrelated in such a way that the results obtained unequivocally demonstrate diffusion anisotropy, one of the founding assumptions for our mathematical mouse lung model to work.

These two studies examine healthy lungs and allow us to develop robust and reliable tool to measure mouse lung parameters. We applied this tool in and provided first in vivo measurements of changes in lung microstructure that occur as a result of smoking.

DATE: Monday, July 25, 2011
TIME: 10:00 a.m.
PLACE: Bryan Hall, Room 305

Dissertation advisor:
Dr. Martin Arthur

This seminar is in partial fulfillment
of the Doctor of Philosophy degree

Washington University in St. Louis
SCHOOL OF ENGINEERING & APPLIED SCIENCE