April, 2017

**Multiple Research Associates (RA) Level I and Research Interns Positions**

**for Next Generation MRI Coils Prototyping at Cedars-Sinai Medical Center in LA**

To immediately recruit **Research Associate (RA) Level I** (Bachelor degree required) And **Research Interns** (undergraduate students) full time or part time multiple positions at flexible levels for a range of background and skills (**Electronic, Mechanical, Biomedical, Physics, etc**)

http://cedars-sinai.edu/Research/Research-Labs/Han-Lab/Lab-Members.aspx

- Be paid well if work outcome is satisfied.

- Electrical Engineering & Physics:

  RF spectrum bench measurement (S-parameters, Smith Chart) with Network Analyzer

  Medical device electronic hardware prototyping

- Prefer candidates with an inclination for a continuing PhD study in UCLA and Cedars-Sinai.

- Prefer strong hands-on bench skills.

- Preferably a commitment for a year besides full time in summer.

- Parking provided.

**Projects & work**:

- Novel MRI RF coil design and Prototyping. S-parameter and Smith Chart bench measurement using network analyzer.

- Electronic Medical Device Prototyping: Based on current prototype, design and develop the second generation prototype for a multi-channel DC current source supply (e.g., 32 channels) for real-time dynamic shimming for functional MRI. Arduino boards used in real-time multi-ch current control. This is one major hardware comprising next generation MRI coil technology.

- Mechanical design: Mechanical CAD design and construction of MRI coils housing and components using 3D printers, e.g, MRI head coil, cardiac coil, and etc.

- Software development. e.g., develop a monitor & control interface using a popular language like Matlab, VB, VC, Python and etc. Communicating with Arduino boards and MRI scanner console. Further develop user-friendly interface for monitoring and controlling MRI scanning parameters based on existing codes.

- Software development. e.g., MR imaging shimming simulation using Matlab based on

existing codes.

- Multi-ch DC current supply system assembly. PCB soldering. Lab management in setting up and maintaining the MR Engineering laboratory. Recruiting subjects or patients for MR scanning using developed novel MRI coils.

- Assist in MRI imaging, imaging data analysis (Matlab), fMRI, manuscripts and conference presentation preparation.

- Assist in lab management.

- Editing scientific publications.

**Any one of below skills apply:**

- RF spectrum bench measurement (S-parameters, Smith Chart) with Network Analyzer

- Electromagnetic field simulation, RF field and circuit simulation (COMSOL, CST Studio)

- Circuit design. Schematic and PCB board layout drawings.

- Arduino board. Rasberry PI. Interface between novel medical devices.

- CAD for 3D printing (SolidWorks, CATIA, Inventor)

- Mathematic computation, Matlab programming, Fitting algorithms.

- Software: Matlab, C, and others (VB, VC, Python and etc)

- Soldering. Mechanical assembly.

- Lab management.

- Image data analysis with Matlab. functional MRI (fMRI).

**PI Contact**: (moved to Cedars-Sinai from Cornell University)

http://cedars-sinai.edu/Research/Research-Labs/Han-Lab/index.aspx

Hui Han, Ph.D. Assistant Professor, Director of Magnetic Resonance Engineering

Email: hui.han@cshs.org

Tel: 310-423-9134 (Office)  607-379-3808 (Mobile)

Biomedical Imaging Research Institute (BIRI)

Cedars Sinai Medical Center (affiliated with UCLA)

Research Imaging Core. Davis Building, G-140

8700 Beverly Blvd. Los Angeles, CA 90048

## Introduction

‘iPRES’, a new hardware-based imaging platform for fMRI and cardiac MRI. The development of a 32-channel iPRES RF/DC human head coil and a novel 32-ch human cardiac imaging coil. Cedars-Sinai Medical Center is a world-leading hospital in Beverly Hills (also known as Hollywood's glamour hospital), and an academic medical center with a world-renowned faculty and extensive, highly competitive training programs. Biomedical Imaging Research Institute (BIRI) in Cedars-Sinai is world-leading on development of novel MRI scanner technologies and holds modern human MRI scanners devoted to research (1). Students at undergraduate level or master levels are very welcome to join our team (1,2).

The Magnetic Resonance (MR) field is an exciting interdisciplinary field which has received Nobel Prizes 6 times in the past century in Physics, Medicine, and Chemistry and has a wide range of career opportunities in hospital, industry, and academia (1). Promising students will work under the guidance by enthusiastic faculty (1). MRI scanner is one of the most complex and advanced medical devices. This opportunity is not only to gain substantial R&D experience but to make real contribution on developing the next generation MR coils, one of three major hardware comprising a modern MRI scanner.

We are known for being the first who have proposed a new concept for a general MRI platform, so-called ‘iPRES’ technology standing for ‘integrated Parallel Reception, Excitation, and Shimming’ (3,4), which will likely set the standard for next generation MR coils. The current generation technology has existed since 1990 (8). Since 2013, the 'iPRES' technology has become a hot topic in the world's largest MR community (ISMRM) (5-7), being highlighted in various plenary lectures (6,7). It has drawn great interests from GE and Siemens, and is currently under discussions on IP licensing and commercialization (6). It will likely replace the current generation MRI RF coils (8), one of three major hardware comprising a MRI scanner. This technology has been regarded as a major breakthrough in MRI scanner hardware in recent a decade (5-7).

We are at a stage on fully developing this technology and constructing prototypes with new designs for applications in brain and cardiac imaging. This work is strongly supported and highly expected by major leading vendors including Siemens and GE HealthCare (6-7). You will have unique opportunities involving the collaboration with Siemens and GE HealthCare, and have a unique experience from hardware & software development to clinical applications, and an experience from cutting-edge research leading to commercialization and start-up.

The concept of iPRES is to integrate Bo shimming to a conventional RF coil by revolutionizing coil design, thereby improving the MRI system in a simplified way. For application, it can make invisible visible for psychiatrists and neuroscientists to look at human brain key regions prefrontal cortex (PFC) and temporal lobes (TLs), where human emotion, cognitive control, working memory, and decision making play their

roles. Part of these key brain regions are previously inaccessible due to great MRI signal loss caused by air/tissue susceptibility variations due to their close proximity to the sinus cavities and ear canals. iPRES can well solve this long-standing unmet challenge in fMRI.

One project for students involves the construction of a multi-channel DC amplifier power supply. The DC supply is a major hardware for providing accurate dynamically-changing DC currents to 32 independent coil loops in the head coil. Every 20-50 ms, a new set of DC currents will be uploaded to 32 coil loops. The control of DC currents, i.e., turning on and off for each channel, needs be synchronized and updated along with fMRI data acquisition simultaneously. The maximum current for each channel is expected to be a few Amperes and the supply should be stable with low noise and a considerable accuracy of 1 % errors.

Another project is software development and to write a fitting algorithm using Matlab to obtain the optimized DC currents for each coil loop based on brain field map acquired by MRI, and to simulate and evaluate the Bo shimming performance with different coil geometries and arrangement. We have a good workable version of a 32-channel DC supply under development, and a fitting algorithm for calculating 32 currents, based on which students can work.

**Reference**:

1. https://youtu.be/7vJyigY1AUw?list=PL9CZabk3nD4F9eDpf6h2jRlFyxSv0BCIx

2. https://www.cedars-sinai.edu/Research/Departments-and-Institutes/Biomedical-Imaging-Research-Institute/Team.aspx

3. Han H, Song AW, Truong TK. Integrated parallel reception, excitation, and shimming (iPRES). Magn Reson Med 2013;70:241–247.

4. Han H, Truong TK, Song AW. Magnetic resonance imaging systems for integrated parallel reception, excitation and shimming and related methods and devices. United States provisional patent application no. 61/665,517 on June 28, 2012. US 2014/0002084. WO 2014/003918. EP2867687A1. CN104471421 A.

5. A. G. Webb, P. F. Van de Moortele. The technological future of 7 T MRI hardware, NMR in Biomedicine, 2015, 28, 10

6. General Electric. Pulse of MR. ISMRM Academic Issue. Spring 2015.

7. https://www.dropbox.com/sh/2vtgnkpjyvyvfi3/AAAOJxhZaFy-F3jXeEpWr6ufa?dl=0

8. Roemer PB, Edelstein WA, Hayes CE, Souza SP, Mueller OM. The NMR phased array. Magn Reson Med 1990;16:192-225.