2022 Jobs and Interns on High-End Medical Device Prototyping (Engineering)

– **Next Generation MRI Coil Prototyping at Cedars-Sinai Medical Center in LA**

To immediately recruit **Research Associate (RA) Level I** (Bachelor degree required) and/or **paid Research Interns** (undergraduate students) part-time multiple positions at flexible levels for a range of background and skills (preferred: **Mechanical Engineering; Electrical Engineering; Imaging processing**)

PI and Lab: https://bio.cedars-sinai.org/hanhx/index.html

Hui Han, Ph.D. Associate Professor, Director of MRI Engineering Email: hui.han@cshs.org

Job description and desired skills:

- Well paid for good work delivered.
- **Preferred Mechanical Engineering (SolidWorks, CAD for 3D printing)**
- **Preferred MRI data and image process.**
    - Software development. Machine and deep learning. MATLAB computation & algorithms. PCA/SVD algorithms, mathematical modelling.
- **Preferred Electrical Engineering (hands-on hardware prototyping skills)**
    - Hands-on skills on RF antenna, microwave, electromagnetics, RF spectrum bench measurement (S-parameters, Smith Chart) using RF Network Analyzer
    - Hands-on skills, e.g., circuit design, schematic & PCB layout, soldering, assembly, circuit board debugging, software control, Arduino / Raspberry Pi etc, GUI.
- **Performing MRI scans, study coordination**, image acquisition, process and reconstruction.
- Prefer strong hands-on bench skills.
- Preferably a commitment for at least a year.
- Potential to continue as a PhD student in the UCLA Bioengineering Department.

- Parking provided.

More details:

- Mechanical design: Mechanical CAD design and construction of MRI coils housing and components using 3D printers for Next Generation MRI Head Coils for brain imaging, and etc.

- MRI imaging, imaging data analysis (Matlab), fMRI

- **Peer-reviewed journal manuscripts and conference presentation preparation**.

- 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. This is one major hardware comprising next generation MRI coil technology.

- 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 lab management.

- Editing scientific publications.

- Attend weekly lab group meetings.

- Coil setup, test, human imaging on state-of-the-art MRI scanners (Siemens).

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

PI Contact:

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

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Biomedical Imaging Research Institute (BIRI)

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Project Introduction and Background:

Next-generation MR medical devices

Cedars-Sinai Medical Center, affiliated with the UCLA, is a world-leading hospital and is currently ranked **#6** nationally on the Best Hospitals Honor Roll (Introduction to Cedars-Sinai), which is located in Beverly Hills and known as Hollywood's glamour hospital. It is also an academic medical center with a world-renowned faculty and highly competitive training programs. Biomedical Imaging Research Institute (BIRI) in Cedars-Sinai is world-leading on development of cutting-edge MRI scanner technologies and holds state-of-the-art human MRI scanners devoted to research (1). Students at master or undergraduate level levels are very welcome to join our team (1,2).

BIRI Research Core Facility houses a state-of-the-art 3T whole-body scanner (Siemens MAGNETOM Vida), a whole-body PET/MR system (Siemens Biograph mMR), and Bruker BioSpin 9.4T small animal scanner, all dedicated to research. Our research and clinician scientists collaborate closely with physicians to synergistically bring together technical and clinical expertise in areas such as cardiology, neurology, and oncology imaging. (Introduction to BIRI)

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 components comprising a modern MRI scanner.

We are internationally known for pioneering a new concept for a general MRI platform, so-called '**iPRES'** technology standing for 'integrated Parallel Reception, Excitation, and Shimming' (3,4), which is setting a new benchmark for next generation MR coils. The current generation coil technology has existed since 1990s (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 Healthcare and is being adopted by major vendors (6). It will likely replace the current generation MRI RF coils (8). This technology has been regarded as a major advance in MRI scanner hardware in recent a decade (5-7).

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

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 applications, 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.

There are many projects involving a wide range of engineering skills to put together a new imaging system in both hardware and software.

Reference:

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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. US patents 9,864,025 and 9,874,616. 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;16:192-2