Ashutosh Chaturvedi

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SUMMARY

Although formally trained in neural engineering and medical imaging, my adaptability, resourcefulness, hard-work, patience, and tenacity have positively contributed to many interesting and unique projects in diverse areas. While on cross-functional teams, the creativity of building and maintaining something novel and purposeful from concept through deployment is most enjoyable. Passionate about finding opportunities that challenge me to learn new things while applying my current knowledge and expertise to solve tough problems.

EXPERIENCE

AR/VR Optical Engineer

Meta

September 2022 - September 2024, Menlo Park, CA

- · As a contractor, led full-stack computational modeling software development efforts related to helping design optical waveguide technologies for the AR/VR product portfolio. This included functionality for automated design optimization, Monte Carlo-based tolerancing, and a seamless user experience from the creation of a multi-component optical system to its analyses.
- · Integrated software tools with available internal infrastructure to enable high-performance computing, version control, and streamlined deployment to the users.
- Created a GUI interface for the modeling software for a better user experience by shortening the learning curve for novice users.
- Developed an API to connect internal software tools to commercially available ones to enable additional system design capabilities.
- Developed a software application for external vendors to help them characterize prototype builds for metrology purposes.

Senior Data Engineer

Mayo Clinic

- · As a consultant, created a data pipeline for ingesting relevant patient data (e.g., medical images, stimulation parameters, clinical observations, outcomes) and automating the execution of useful computational modeling algorithms on that data to provide useful insights regarding the mechanisms of clinical therapy and its side-effects.
- In the process of publishing the findings of a retroactive clinical study analyzed using the above data pipeline in a peer-reviewed journal.

Principal Scientist

Kernel

- · Led computational modeling and medical imaging-related projects for both invasive and non-invasive wearable technologies, and collaborated with other groups within the company (e.g., data analysis, neuroscience, software, test, mechanical, and hardware).
- Created a GPU optimized end-to-end pipeline for photon diffusion modeling inside the brain for 3D reconstruction of neural activity for an fNIRS product called Kernel Flow. This also included managing the efforts to enable 3D visualization of the neural activity after recording.
- Explored computational modeling of non-invasive optical and ultrasound detection systems using multi-physics and/or Monte Carlo solvers.
- Developed a machine learning based pipeline to segment various tissue layers of the human head using multi-modal MRI scans from the
- open-source Human Connectome Project. This was done to enable more realistic head models for subsequent computational analyses.
- Created biophysical computational models of novel electrode lead designs for customized deep brain stimulation therapy applications.

Senior Scientist

Medtronic

- · Led cross-functional technical projects to create novel algorithms and computational biophysical models to improve advanced invasive stimulation therapies for current and emerging neurological indications (e.g., Parkinson's disease, depression, obsessive-compulsive disorder, chronic pain, incontinence).
- Modeled unique electrodes designed for deep brain stimulation and local field potential recordings for the next generation of medical devices.
- Presented novel technologies and exchanged ideas on the future of stimulation therapies with key clinical customers from around the world.

Postdoctoral Research Scholar

Case Western Reserve University

• Investigated the activation of potentially relevant neural pathways in the brain surrounding an electrode during deep brain stimulation for Parkinson's disease, using a 7T patient imaging dataset that included MRI, CT, DTI, and fiber tractography.

Postdoctoral Research Fellow

Cleveland Clinic Foundation

- Implemented a methodology to efficiently quantify and visualize neural activation patterns during deep brain stimulation across multiple patients, or longitudinally at multiple time steps within a single patient.
- Developed novel biophysical fiber tractography computational models to quantify the activation of individual or bundles of neurons using anatomical trajectories reconstructed from diffusion tensor imaging scans combined with 3D electric field models of brain stimulation.

May 2017 - September 2022, Los Angeles, CA

October 2022 - Present, Rochester, MN

September 2013 - January 2017, Fridley, MN

January 2013 - September 2013, Cleveland, OH

January 2012 - December 2012, Cleveland, OH

Scientific Consultant

Intelect Medical

• Developed an artificial neural network based approach to determine near real-time estimates of multipolar volumes of tissue activated for two different Medtronic deep brain stimulation electrode leads.

• Provided a 3D visualization of the brain tissue activation regions that could be estimated mathematically using ellipsoids within the patient's anatomical medical imaging data.

Scientific Consultant

Boston Scientific

• Using biophysical computational modeling techniques, modeled the applicability of a new current-controlled deep brain stimulation system with multiple independent current sources to selectively activate various targeted neural populations in the brain using current steering.

- Analyzed and compared the results of this modeling study with state-of-the-art voltage-controlled systems to highlight stimulation capability improvements that can be made in patients undergoing this therapy.
- Software Engineer

Philips Medical Systems

• In the role of a co-op and internship, added software features related to the functionality and safety of a frameless, stereotactic guidance system attached to a CT scanner used for whole body interventional surgical procedures.

EDUCATION

Ph.D. Biomedical Engineering (Neural Engineering)

Case Western Reserve University \cdot Cleveland, OH \cdot January 2012

M.S.E. Biomedical Engineering (Medical Imaging)

Case Western Reserve University • Cleveland, OH • May 2006

B.S.E. Biomedical Engineering

Minor in Artificial Intelligence · Case Western Reserve University · Cleveland, OH · May 2003

SELECTED PATENTS / PUBLICATIONS

Patents

- "Systems and methods for data representation in an optical measurement system." US20210374458A1
- "Imaging markers for stimulator leads." US11318297B2
- "Non-invasive optical detection system and method." US20190336057A1
- "Activation map based individualized planning for deep brain stimulation." US9937347B2
- "Therapy program selection for electrical stimulation therapy based on a volume of tissue activation." US10583293B2
- "System and method to estimate region of tissue activation." US8589316B2
- "Methods for identifying target stimulation regions associated with clinical outcomes for neural stimulation." US8649845B2

Publications

- "Kernel Flow: a high channel count scalable time-domain functional near-infrared spectroscopy system." JBO: 2022.
- "A novel lead design enables selective deep brain stimulation of neural populations in the subthalamic region." JNE: 2015.
- "Engineering the next generation of clinical deep brain stimulation technology." Brain Stim: 2015.
- "Artificial neural network based characterization of the volume of tissue activated during deep brain stimulation." JNE: 2013.
- "Tractography-activation models applied to subcallosal cingulate deep brain stimulation." Brain Stim: 2013.
- "Current steering to activate neural pathways during deep brain stimulation of the subthalamic region." Brain Stim: 2012.
- "Patient-specific models of deep brain stimulation: influence of complexity on neural activation predictions." Brain Stim: 2010.
- "CT-integrated robot for interventional procedures: Preliminary experiment and computer-human interfaces." CAS: 2002.

SKILLS

Professional

Computational modeling, ultrasound, fNIRS, biophysics / multi-physics modeling (photon, electric fields), optical waveguide modeling, algorithm / software development, code optimization (vectorization, parallelization, distribution), software pipeline automation, cloud computing, brain imaging (3D source reconstruction), brain-machine interface software for invasive and wearable technologies, medical imaging (CT, MRI, DTI, PET, SPECT), 2D / 3D image processing, 3D visualization, data analysis (fNIRS, EEG, MEG, EMG), signal processing.

Technical

Python (NumPy, SciPy, CuPy, pandas, Jupyter, Matplotlib, Plotly), GIT / Mercurial, AWS (EC2, CloudFormation, S3, EBS, EFS), Atlassian (Confluence, Jira, Bitbucket), MATLAB, COMSOL / ANSYS / SCIRUN / Sim4Life, NEURON, MongoDB / MySQL, Linux / Bash, C++, HTML / PHP.

August 2008 - December 2010, Boston, MA

April 2009 - December 2010, Boston, MA

January 1999 - January 2002, Cleveland, OH