BIOGRAPHICAL SKETCH

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NAME	POSITION TITLE
Sahin, Mesut	Professor of Biomedical Engineering
eRA COMMONS USER NAME	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Istanbul Technical University	B.S.	1986	Electrical Engineering
Case Western Reserve University	M.S.	1993	Biomedical Engineering
Case Western Reserve University	Ph.D.	1998	Biomedical Engineering
Case Western Reserve University	Post-Doc	1998-2001	Biomedical Engineering

A. Personal Statement

My expertise is neuromodulation, neural engineering, and in the general area of neural prosthetics. I have developed and tested a number of novel neural prosthetic ideas in anesthetized and behaving animal models with experiments focusing on electrophysiological recordings and stimulation. Later, I moved to the spinal cord with the motivation to develop wireless neural stimulators powered using infrared light (Floating light activated microelectrical stimulators – FLAMES). I have become interested in the cerebellum about ten years ago due to its unique neuroanatomy and its potential for treatment of motor and cognitive disorders. We have begun working on neuromodulation of the cerebellum using transcranial AC and Focused Ultrasound (FUS) Stimulation with my collaborators from NYU-Langone Center and North Carolina State University with support from NIH a few years ago.

B. Positions and Honors

Positions and Employment

1987-1990 R&D Engineer, Teletas Inc., Istanbul, Turkey
1998-2001 Post-Doctoral Researcher, Biomedical Engineering, Case Western Res. Univ., Cleveland, Ohio
2001-2005 Assistant Prof. of Biomedical Engineering, Louisiana Tech University, Ruston, LA.
2003-2005 Research Associate, Overton Brooks VA Medical Center, Shreveport, Louisiana.
2005-2009 Assistant Prof. of Biomedical Engineering, New Jersey Inst. of Technology, Newark, NJ
2009-2015. Associate Prof. of Biomedical Engineering, New Jersey Inst. of Technology, Newark, NJ
July 2015- Professor of Biomedical Engineering, New Jersey Inst. of Technology, Newark, NJ

Honors and Awards

2020- Co-Chair, Neural and Rehabilitation Engineering Theme, IEEE/EMBC, Montreal, CA, July 2020
2020- Guest Editor, Special Issue on Selected Papers from ISICAS 2020, IEEE Tran. on BioCAS, Oct 2020.
2019- Guest Editor, Special Issue on "Electronic Circuits and Systems Challenge in Large-Scale Recording and Stimulation," IEEE Tran. on BioCAS, Dec 2019.
2009- Associate Editor for IEEE Tran. on Biological Circuits and Systems (TBioCAS)
2006- Senior Member of Institute of Electrical and Electronics Engineers (IEEE)
2000 Whitaker Post-Doc Conference Travel Award, June 12-14, 2000
1999 Post-doc Fellowship from Christopher Reeve Paralysis Foundation#SBI-9909-2, "Recordings of Motor Signals from the Spinal Cord", $50,000, 5/15/1999-2/15/2001.
1998 Region two finalist in the IEEE/EMBS Whitaker Foundation Student Paper Competition, Hong Kong
1994 Open Finalist in the IEEE/EMBS Whitaker Foundation Student Paper Competition, Baltimore
1989-1995 Scholarship from the Ministry of National Education of Turkey to pursue PhD in the USA
1982 Scored within top 1% in the Nationwide University Entrance Exam in Turkey

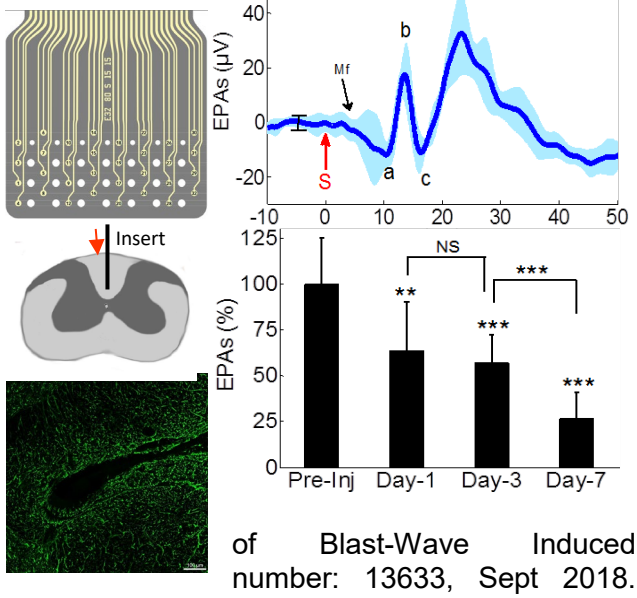
Patents

- US Patent # 6587725, “Method and apparatus for closed-loop stimulation of the hypoglossal nerve in human patients to treat obstructive sleep apnea”, Dominique Durand, Mesut Sahin, and Musa A. Haxhiu, July 1, 2003.
- US Patent # 9526904, “System and Method for Neural Stimulation via Optically Activated Floating Microdevices,” Mesut Sahin, Selim Unlu, David Freedman, Ammar Abdo, 10/27/2016.
- US Patent # 9895547, “Biocompatible and Implantable Optical Conduits,” Mesut Sahin, Ali Ersen, 2/20/2018.
- System and Method for Electroacoustic Recording Device for Wireless Sensing of Neural Signals, Mesut Sahin, Provisional patent # 61/983,843, filed on 4/24/14.
- A System and Method for Brain-Computer Interfacing, 61/159,740, Provisional Patent filed on 3/12/2009.

C. Contribution to Science

1. *Modulation of Purkinje Cell Activity with Alternating and Direct Currents:* We have applied AC electric fields for the first time on the cerebellar cortex and investigated the underlying principles of transcranial AC and DC stimulation with direct recordings of the spiking activity from the Purkinje cells, the last order of neurons as an output from the cerebellar cortex. The data collected from anesthetized rats have shown that the electric fields applied at low intensities can modulate the spontaneous firing frequency of the Purkinje cells, and furthermore entrain the timing of the spikes to the stimulus cycle up to frequencies as high as 100 Hz. The results also showed that the rostro-caudal component of the electric field is much more effective than the medio-lateral component, suggesting the importance of electrode placement and montage in transcranial applications in human trials.
   a. Asan, Ahmet S, Lang, Eric J., Sahin, Mesut, “Entrainment of cerebellar purkinje cells with directional AC electric fields in anesthetized rats,” Brain Stimul. 2020 Sep 9;13(6):1548-1558.
   b. Asan, AS, Gok S, Sahin M. “Electrical fields induced inside the rat brain with skin, skull, and dural placements of the current injection electrode,” PLoS One. 14(1), 2019. (PMID: 30629578)
   c. Asan, AS, and Sahin M., “Modulation of Multiunit Spike Activity by Transcranial AC Stimulation (tACS) in the Rat Cerebellar Cortex," Annual International Conference of the IEEE-EMBC, Berlin, July 23-27, 2019. PMCID: PMC7258686.

2. *Electrophysiological Assessment of Cerebellar Injury:* The primary objective of this project was to establish the use of electrophysiological method, the electro-corticogram (ECoG) technique, for investigation of mild traumatic brain injuries in experimental animals. The changes of excitability in the affected neural networks were used as a marker to study the temporal course of brain injury due to a traumatic event. Electrophysiological information collected *in vivo* with chronically implanted multi-electrode arrays (EPAs) revealed information about progression of injury over time without the need to sacrifice the animal. The correlation between the electrophysiological findings and the perturbations in the animal’s behavior during a task that involves the forelimb was investigated. The use of polyimide based MEAs on the cerebellar surface was not attempted by other groups previously.

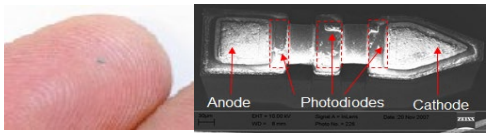


   a. Gokhan Ordek, Ahmet S. Asan, Esma Cetinkaya, Maciej Skotak, Venkata R. Kakulavarapu, Namas Chandra, Mesut Sahin, “Electrophysiological Correlates of Blast-Wave Induced Cerebellar Injury,” Scientific Reports, Vol. 8, Article number: 13633, Sept 2018. (doi:10.1038/s41598-018-31728-4)

b. Jonathan D. Groth, and Mesut Sahin, “High Frequency Synchrony in the Cerebellar Cortex during Goal Directed Movements,” Frontiers Syst. Neuroscience, July 21, 2015. (PMID: 26257613)
c. Gokhan Ordek, Archana Proddutur, Vijayalakshmi Santhakumar, Bryan J. Pfister, and Mesut Sahin,“ Electrophysiological monitoring of injury progression in the rat cerebellar cortex. Front. Syst. Neurosci. 8:197, 2014. (PMID: 25346664)
d. Gokhan Ordek, Jonathan Groth, Bryan Pfister, and Mesut Sahin, “Electrophysiological Monitoring of Cerebellar Evoked Potentials Following Fluid Percussion Injury,” IEEE Neural Engineering Conference, San Diego, Nov 2013. 10.1109/NER.2013.6696098
e. Gokhan Ordek, Jonathan Groth, Mesut Sahin, “Differential effects of ketamine/xylazine anesthesia on the cerebral and cerebellar cortical activities in the rat”, J. of Neurophysiol., vol. 109: 1435–1443, 2013. (PMID: 23236007)

3. *Spinal Cord-Computer Interface:* As an alternative method to brain computer interfaces (BCI), my laboratory proposed the spinal cord-computer interface (SCCI) to extract the volitional motor signals from the proximal spinal cord that is still intact above the site of injury in the spinal cord and use the multi-unit activity of the axons in the motor tracts rather than single spikes. Spinal cord approach has at least two important advantages. First, the recorded neural signals are expected to be strongly coupled to the motor function due to closeness of the spinal cord to the motor apparatus in the signal path. Second, the neural recordings are much more stable because the method relies on the multi-unit activity rather than single spikes. Following publications proved the principle of a spinal-cord computer interface. We developed a chronic recording method using polyimide based multi-electrode arrays (MEAs) in the cervical spinal cord of rats as a part of this project.
   a. Sinan Gok, and Mesut Sahin, “Prediction of Forelimb EMGs and Movement Phases from Corticospinal Signals in the Rat During the Reach-to-Pull Task.,” Int. J. of Neural Systems, vol 29(7), 2019. (PMID: 31111753)
   b. Yi Guo, Sinan Gok, and Mesut Sahin, “"Convolutional networks outperform linear decoders in predicting EMG from spinal cord signals,” Front. Neurosci., 17 October 2018. (PMID: 30386200).
   c. Yi Guo, Foulds RA, Adamovich SV, Sahin M., “Encoding of forelimb forces by corticospinal tract activity in the rat,” Front Neurosci., vol 8(62), Feb 2014. (PMID: 24847198).
   d. Abhishek Prasad and Mesut Sahin, “Can volition be extracted from the spinal cord,” Journal of NeuroEngineering and Rehabilitation, vol 9:41, 2012. (PMID: 22713735)
   e. Abhishek Prasad, and Mesut Sahin, “Characterization of Neural Activity Recorded from the Descending Tracts of the Rat Spinal Cord.” Frontiers in Neuroscience, vol. 4, pp. 1-7, June 2010. (PMID: 20589238)
   f. Abhishek Prasad and Mesut Sahin, “Extraction of motor activity from the cervical spinal cord of behaving rats,” J. Neural Eng., vol. 3, pp. 287-292, 2006. (PMID: 17124332)

4. *Floating Light Activated Micro-Electrical Stimulators:* The brain and the spinal cord experiences significant amounts of movement. The movement of the tissue surrounding implanted micro electrodes causes significant shear forces due to the fact that the electrodes are made of materials that are much less compliant than the neural tissue. These shear forces, exacerbated by the tethering forces generated by the electrode interconnects, cause an encapsulation tissue that forms around long term implants. This has been a major obstacle preventing or otherwise impeding the implementation of many new neural prosthetic ideas in the central nervous system from moving into clinical trials. My lab pioneered the development of an optically activated micro-stimulator free from any interconnects, thus without any tethering forces, and individually addressable for selective stimulation. The stimulator is energized optically through a fiber located just outside the dura mater. This innovative floating light activated micro-electrical stimulator (FLAMES) technology can be instrumental in translation of neural prostheses dealing with spinal cord micro stimulation and the brain into the clinical phase. The principle device operation was demonstrated in the rat spinal cord. Several other critical aspects of project feasibility have been completed. For instance, penetration of near infrared (NIR) light into neural tissue, the temperature effect of the NIR light on the neural tissue, and the chronic tissue response to the floating micro-stimulators have been studied. A US patent on the device has been filed.



a. Ali Ersen*, and Mesut Sahin, “Polydimethylsiloxane-based optical waveguides for tetherless powering of floating microstimulators,” J Biomed Opt., vol. 22(5):55005. May 2017. (PMID: 28500857)
b. Ali Ersen, Stella Elkabes, David Freedman, Mesut Sahin, "Chronic Tissue Response to Untethered Microelectrode Implants in the Rat Brain and Spinal Cord," J. of Neural Eng., 12, 2015. (PMID: 25605679)
c. Ali Ersen, Ammar Abdo, Mesut Sahin, “Temperature elevation profile inside the rat brain induced by a laser beam,” J. Biomed. Opt. 19 (1), 015009, January 27, 2014. (PMID: 24474503)
d. Seymour EÇ, Freedman DS, Gökkavas M, Ozbay E, Sahin M, Unlü MS, “Improved selectivity from a wavelength addressable device for wireless stimulation of neural tissue,” Front Neuroeng. 2014 Feb 18;7:5. (PMID: 24600390)
e. A. Abdo, Ali Ersen, Mesut Sahin, “Near-infrared light penetration profile in the rodent brain,” J Biomed Opt. 2013 Jul;18(7):075001. (PMID: 23831713).

5. *Closed Loop Hypoglossal Nerve Stimulation in OSA:* Hypoglossal nerve stimulation as a treatment method of obstructive sleep apnea was proposed in early 1990s. We contributed two new ideas to this neuroprosthetic approach in late 1990s and early 2000. First, we demonstrated that the neural activity of the HG nerve could be used for detection of obstructions in the upper airways, and that the HG nerve can be stimulated using its own activity as a feedback signals in a closed-loop manner whenever the obstructions occur. This was my PhD dissertation. The second idea was to use multi-contact peripheral nerve electrodes for selective activation of the fascicles inside the nerve, which could improve the success rate in removing the upper airway obstructions in patients given the fact that the site of obstruction may be different in each patient. I worked on this project as a post-doc, and a junior faculty.
   a. Jingtao Huang and M. Sahin, “Dilation of the Oropharynx via Selective Stimulation of the Hypoglossal Nerve”, J. of Neural Eng., No 2, pp. 73-80, 2005.
   b. Paul Yoo, M. Sahin, and D.M. Durand, “Selective Stimulation of the Canine Hypoglossal Nerve Using a Multi-Contact Cuff Electrode”, Ann. of Biomed. Eng. Vol. 32, No. 4, pp. 511-519, April 2004.
   c. Mesut Sahin, Dominique M. Durand, and Musa A. Haxhiu, "Closed-loop stimulations of hypoglossal nerve using its spontaneous activity as the feedback signal", IEEE Tran. on Biomed. Eng., Vol. 47, No. 7, pp. 919-925, July, 2000.
   d. Mesut Sahin, Dominique M. Durand, and Musa A. Haxhiu, "Chronic recordings of hypoglossal nerve in a dog model of upper airway obstruction" J. Apply. Physiol. Vol. 87, No. 6, pp. 2197-2206, 1999.
   e. Mesut Sahin, Musa A. Haxhiu, Dominique M. Durand, and Ismail A. Dreshaj, "Spiral nerve cuff electrode for recordings of respiratory output", J. Apply. Physiol., Vol. 83, No. 1, pp. 317-322, July 1997.

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/1zgkbzZshRPAC/bibliography/42367897/public/?sort=date&direction=ascending

D. Research Support

Ongoing Research Support

- NIH/NINDS, RF1NS122741, Multi-PI (Sahin, Lang, and Oralkan), , “Modulation of Cerebellar Activity by Electrical and Focused Ultrasound Stimulation,” 05/01/2022 - 04/30/2025.
- NIH/NINDS/R21, PI (Sahin), “Electrical and Ultrasonic Modulation of Lateral Cerebellar Nucleus, 09/30/2021 - 08/31/2022.

Recently Completed Grants

- NIH/NIA/R21, Multi PI (Sahin and Oralkan from NCSU), “A whole-brain ultrasonic neural stimulation and photoacoustic recording system in behaving animals” 09/01/2017 – 08/31/2019.
- NIH/NIMH/R21, PI: Sahin (Collaboration with Eric Lang from NYU) “Underlying Mechanisms of Cerebellar tDCS,” 11/01/2017 – 10/31/2019.