

Daniel Carbonero

danny.carbonero@gmail.com
dannycarbonero.github.io

RESEARCH INTERESTS

I enjoy solving challenging biological and mathematical problems by crafting machine learning solutions backed by the implementation of massive data sets. My current research involves developing novel, and adapting existing, machine learning methods for analysis of large neuroscientific data sets to better understand the brain.

EDUCATION

PhD	Biomedical Engineering, Boston University Dissertation: "Machine Learning Framework for Analyzing State-Dependent Neuronal Network Dynamics in Calcium Recordings" Advisors: John A. White, PhD & Mark A. Kramer, PhD	2019 - Present
MS	Biomedical Engineering, Boston University	2019 - 2022
BS	Biomedical Engineering, University of Miami GPA: 3.8/4.0, Cum Laude	2015 - 2019

PROFESSIONAL AND RESEARCH EXPERIENCE

Graduate Research Fellow Neuronal Dynamics Laboratory (NDL), Department of Biomedical Engineering, Boston University Advisor: John White, PhD	March 2020 – Present
<ul style="list-style-type: none">• Developed and adapted linear and non-linear dimensionality reduction (DR) machine learning methods for unsupervised neuronal network analyses recorded with calcium imaging under unique neural contexts.• Built constraining for non-negative matrix factorization DR to allow for semi-supervised analytical approaches to similar neuronal network dynamics.• Constructed software wrapper packages to make complex machine learning methods more easily accessible and implementable to end users.• Collaborated with experimental lab scientists to iteratively adapt and apply machine learning analysis methods to their collected data to answer groundbreaking, novel, and complex neurological questions.• Designed analysis pipeline for rigorously characterizing neuronal network dynamics under: increasing concentrations of anesthetic sedation, natural and artificial memory recall.	
Student Analyst Office of Technology Development, Boston University, Supervisor: Frances Forrester, PhD	November 2023 – Present
<ul style="list-style-type: none">• Carried out comprehensive analyses of academic technologies to assess commercial viability, and subsequently facilitate commercialization of promising ones.• Conducted market and landscape research, outlining where a technology fit within the commercialization pipeline and the industry environment.• Drafted invention assessments, detailing a foundational understanding of a technology, its field, and subsequent commercialization potential.• Composed one-page promotional marketing briefs, describing the technology and its potential to prospective partners (licensing, sponsored research, etc.).	
Venture Fellow Breakout Ventures	March 2023 – Present
<ul style="list-style-type: none">• Refined investment skills and proficiency in navigating the venture capital landscape with Breakout investment team, leveraging case studies to deepen understanding of successful startup investing.• Conducted preliminary assessments and initial diligence of various start-up companies, evaluating their scientific merits and market potential within the biotech landscape, to determine their potential for funding.	

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- Served as strategic partner in biotech hub of Boston, evaluating emerging technologies, startups, and entrepreneurs to connect promising future ventures with Breakout's resources.

Associate Engineer

May 2019 – August 2019

Bio-Vitro Inc, Supervisor: Siddarth Rawal, MD

- Optimized design of previously constructed fluid handling platform for unattended, automated, cell culture and cell signaling analysis under physiological conditions.
- Design was produced and sent to collaborating labs to make organs-on-chips more technically accessible.

Undergraduate Research Assistant

May 2018-August 2018

Research Experience for Undergraduates – Neurological Prosthesis Research Laboratory, Department of Biomedical Engineering, Duke University, Advisor: Warren Grill, PhD

- Modified and completely automated a fully computational, Deep Brain Stimulation, Parkinson's Disease (PD) Neurological model to simulate networks of neurons using experimentally recorded data as inputs.
- Modeled PD brain using experimentally recorded, upstream, neuron firing as inputs to simulate and analyze downstream Thalamus activity, assessing effectiveness of Deep Brain Stimulation as treatment for PD.

Undergraduate Research Assistant

May 2017 – May 2019

Physiometric Microsystems Laboratory (PML), Department of Biomedical Engineering, University of Miami

Advisor: Ashutosh Agarwal, PhD

- Developed automated software pipelines for immunohistochemical fluorescent microscope image data acquisition, processing, and analysis for reproducible quantification of organ-on-chip systems.
- Wrote front-end software packages to allow end users to easily and reproducibly process and analyze image data for various platforms (heart, neuro-muscular junction, metastasis).
- Designed, prototyped, and manufactured an integrated and completely automated platform for continuous cell culture and dynamic cell secretion analysis of these organ-on-chip systems.

Student Analyst

January 2017 – May 2017

Department of Continuing International Education, University of Miami, Supervisor: Magaly Abreu

- Created early iteration of real-time, self-updating student database to consolidate information and ease access.
- Wrote financial reports to visualize large volumes of financial information clearly and intuitively.

AWARDS/HONORS

F31 Ruth L. Kirschstein Predoctoral Individual National Research Service Award	2023
NSF Research Traineeship Program Understanding the Brain: Neurophotonics Trainee	2020
NIH Translational Research in Biomaterials Grant Funded Trainee	2019
Boston University Biomedical Engineering Distinguished Fellowship	2019
University of Miami College of Engineering Senior Design Industry Impact Award	2019
Alpha Eta Mu Beta - National biomedical engineering honor society	2019
Omicron Delta Kappa Honor Society - National leadership honor society	2019
Tau Beta Pi Honor Society -National engineering honor society	2018
University of Miami President's Scholarship	2015

SKILLS

Machine Learning and Data Science: Linear Dimensionality Reduction, Matrix Decomposition, Manifold Learning, Clustering, Unsupervised/Semi-Supervised/Supervised Learning, Deep Learning (Artificial Neural-Networks)

Time Series Analysis, Image Analysis

Data Science Software: Scikit-Learn, Scipy, Statsmodels, Pandas, Tensorflow, Numba

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Programming: Highly Proficient in: Python, MATLAB
Comfortable with: HTML, CSS, R
Familiar with: C++, Java

High Performance Computing: Unix, Linux, Remote Super Computing Clusters, Code Parallelization (Python, MATLAB), GPU Computing, git Version Control

Engineering Design: CAD, SOLIDWORKS, Rapid Prototyping

Software: Arduino IDE, COMSOL Multiphysics, ImageJ

Document Preparation and Graphic Desing: Microsoft Office, Adobe Illustrator, Figma

Certifications: Six Sigma Green Belt

Languages: Native in Spanish, fluent in English

LEADERSHIP & MENTORING

Nucleate, Boston Chapter

Director of Communications

June 2023 – Present

- Directed all communications and managed the Communications team of the Boston chapter of Nucleate, a student-led organization aiming to facilitate venture creation of pioneering life science companies.
- Overhauled and implemented entirely novel pipeline to standardize communications from Boston chapter leadership to target audiences.
- Served as liaison between Nucleate headquarters, local Nucleate program participants, and the Boston leadership team, solving logistical issues as they presented, or delegating them to the appropriate personnel.
- Wrote all promotional and professional materials advertising Nucleate programming to the Boston biotech community.
- Collaborated with other directors to set weekly communication and agenda and improve current communications workflow.

Vice President of Communications

November 2022 – May 2023

- Built automated email pipelines to ensure both chapter leadership, and program participants were up to date on all organizational information.
- Worked with the communications team, and directors of other teams, to write and publish weekly newsletter.

Neuronal Dynamics Lab - 2021-2022 Senior Design Team Advisor

August 2021 – May 2022

- Advised and mentored senior design team through development of random forest and support vector machine (SVM) depth of anesthesia classifiers using standard neural recordings.

JOURNAL PUBLICATIONS

D Carbonero, J Noueihed, MA Kramer, JA White, “Non-Negative Matrix Factorization for Analyzing Neuronal Network Dynamics in Calcium Recordings” ([under review](#))

ED Schlafly, **D Carbonero**, CJ Chu, MA Kramer, "A data augmentation procedure to improve detection of spike ripples in brain voltage recordings" (under review)

J Noueihed, **D Carbonero**, FR Fernandez, JA White, “Balance of Excitation and Inhibition in the Primary Somatosensory Cortex Layer 2/3 Under Isoflurane Anesthesia” (in preparation)

J Noueihed, **D Carbonero**, FR Fernandez, JA White, “Multisession Processing of Multiphoton Calcium Imaging” (under review)

RR Besser, A C Bowles, A Alassaf, **D Carbonero**, R Maciel, M Saporta, A Agarwal, “A Chemically Defined Media for Culture of C2C12 Skeletal Muscle and Human Induced Pluripotent Stem Cell Derived Spinal Spheroids” [Cellular and Molecular Bioengineering](#), 13 (6), 605-619

RR Besser, R Maciel, **D Carbonero**, A Alassaf, I Claire, E Jones, J Reda, A Bowles, W Bachelor, N Ziebarth, R Rodriguez, A Khan, M Saporta, A Agarwal: “Enzymatically Crosslinked Gelatin-Laminin Hydrogels for Applications in Neuromuscular Tissue Engineering”, [Biomaterials Science](#), 8(2), 591-606 HIGHLIGHTED AS COVER ARTICLE

A Alassaf, G Tansik, V Mayo, L Wubker, **D Carbonero**, A Agarwal: “Engineering Anisotropic Cardiac Monolayers on Microelectrode Arrays for Non-invasive Analyses of Electrophysiological Properties” [Analyst](#), 145(1), 139-140 *included in themed collection on bioanalytical tools for enabling precision medicine*

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M Ishahak, L Birman, **D Carbonero**, J Hill, A Hernandez, S Rawal, A Agarwal: “Integrated platform for operating and interrogating organs-on-chips”, *Analytical Methods*, 11(43), 5645-5651 *highlighted in the Emerging Investigator Series*
RR Besser, M Ishahak, V Mayo, **D Carbonero**, I Claire, A Agarwal: “Engineered Microenvironments for Maturation of Stem Cell Derived Cardiac Myocytes”, *Theranostics*, 8(1), 124-140

CONFERENCE PRESENTATIONS

- D Carbonero**, J Noueihed, MA Kramer, JA White, “Non-Negative Matrix Factorization for Analysis of Latent Neuronal Network and Sub-Network Dynamics”, Biomedical Engineering Society 2023 Annual Meeting, Seattle WA, October 2023
- D Carbonero**, J Noueihed, MA Kramer, JA White, “Linear Dimensionality Reduction for Neuronal Network Analysis Under Isoflurane Sedation in Mice”, Society for Neuroscientists 2022 Annual Meeting, San Diego CA, November 2022
- D Carbonero**, J Noueihed, MA Kramer, JA White, “Linear Dimensionality Reduction for Analyzing Calcium Recordings”, Biomedical Engineering Society 2022 Annual Meeting, San Antonio TX, October 2022 (**Platform Oral Presentation**)
- D Carbonero**, J Noueihed, JA White, “Principal Component Analysis for Neuronal Network Analysis Under Isoflurane Sedation in Mice”, Society for Neuroscientists 2021 Annual Meeting, November 2021
- D Carbonero**, J Noueihed, JA White, “Principal Component Analysis for Neuronal Network Analysis Under Isoflurane Sedation in Mice”, Biomedical Engineering Society 2021 Annual Meeting, Orlando FL, October 2021
- R Besser, R Maciel, A Alassaf, **D Carbonero**, M Saporta, A Agarwal, “In Vitro Recapitulation of The Dysfunctional Neuromuscular Junction In Charcot-Marie-Tooth Disease”, TERMIS 2019 Annual Conference & Exhibition, Orlando FL, December 2019
- R Besser, **D Carbonero**, I Claire, A Alassaf, A Bowles, E Jones, J Reda, W Bachelor, R Rodriguez, A Khan, R Maciel, M Saporta, A Agarwal, “Enzymatically Crosslinked Gelatin-Laminin Hydrogels for Disease on Chip Applications”, Society for Biomaterials 2019 Annual Meeting, Seattle WA, April 2019
- D Carbonero**, K Kumaravelu, W M Grill, “Computational Analysis of Neural Activity Recorded during Subthalamic Nucleus Deep Brain Stimulation in a Rat Model of Parkinson’s Disease”, Biomedical Engineering Society 2018 Annual Meeting, Atlanta GA, October 2018
- R Besser, R Maciel, A Alassaf, **D Carbonero**, M Dvornik, I Claire, M Saporta, A Agarwal, “In Vitro Recapitulation of the dysfunctional neuromuscular junction in Charcot-Mari-Tooth disease”, Biomedical Engineering Society 2018 Annual Meeting, Atlanta GA, October 2018
- M Ishahak, L Alameda-Sabate, **D Carbonero**, S Rawal, A Agarwal, “Organ-on-Chip Platform with Integrated, Non-Invasive Oxygen Monitoring”, Pittcon 2018, Orlando FL., February 2018.
- D Carbonero**, R Besser, A Agarwal, “TwitchRead: Analyzing Contraction in Engineered Skeletal Muscle Tissue Co-Cultured with Neurospheres”, Biomedical Engineering Society 2017 Annual Meeting, Phoenix AZ., October 2017

INVITED TALKS

- Boston University Stochastic Processes in Neuroscience Seminar Series** Boston MA, December 2022
Principal Component Analysis as a Change of Basis for Neural Signals
• Seminar series to discuss physical feasibility of stochastic models for neuroscientific data analysis.
- Boston University Neurophotonics Center Tech Talk Tutorial Series** Boston MA, September 2022
Linear Dimensionality Reduction for Analyzing Calcium Recordings (a toolbox)
• Seminar series to spread awareness on technologies under development to foster collaboration between labs.

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TEACHING EXPERIENCE

Graduate Teaching Fellow

EK 381 – Probability, Statistics and Data Science for Engineers
Department of Mechanical Engineering, Boston University

September 2021- December 2021

Graduate Teaching Fellow

EK 125 – Introduction to Programming for Engineers
Department of Mechanical Engineering, Boston University

September 2020- December 2020