Milton O. Candela-Leal

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Education

Tecnológico de Monterrey - Monterrey, Mexico — Aug 2020 - Dec 2024
BS in Biomedical Engineering (94.5/100 = 3.8/4.0 GPA)
International Baccalaureate - Monterrey, Mexico — Aug 2018 - May 2020
Math HL, Psychology SL, Physics SL, ...
Thesis: [Film & Psychology] *Harry Potter and the Prisoner of Azkaban* (2004), a Cultural and Ideological Instructor of the Millennial Viewer

Research Experience

Boston Children's Hospital - Boston, MA, USA — Aug 2023 - Jul 2024
Harvard Medical School
Advisor: Kiho Im, PhD
Projects: Fetal MRI subplate segmentation (attention U-Net), non-linear qMRI for congenital heart disease classification, VAE-GAN for anomaly detection.

NSF IUCRC BRAIN Center - Monterrey, Mexico — Mar 2021 - Jul 2023
TMX BRAIN Site - *Tecnológico de Monterrey*
Advisor: Mauricio A. Ramírez-Moreno, PhD
Projects: Cognitive state prediction via biometrics (EEG, ECG, Computer Vision) and machine learning: Mental fatigue, interest in STEM, emotion.
Force prediction via OpenPose human predicted keypoints and RNN.

NSF IUCRC BRAIN Center - Houston, TX, USA — Spring 2022
UH BRAIN Site - *University of Houston*
Advisor: Jose L. Contreras-Vidal, PhD
Projects: EEG Functional Connectivity and bisprectrum analysis between actors.

Journal Articles

(† indicates equal contribution)

Blanco-Ríos, M.A.†, **Candela-Leal, M.O.**†, Orozco-Romo, C., Remis-Serna, P., ... Ramírez-Moreno, M.A. (2024). Real-time EEG-based Emotion Recognition for Neurohumanities: Perspectives from Principal Component Analysis and Tree-based Algorithms. *Frontiers in Human Neuroscience*, 18, 1319574. PMID: 38545515. doi:10.3389/fnhum.2024.1319574

Candela-Leal, M.O., Gutiérrez-Flores, E.A., Presbítero-Espinosa, G., Sujatha-Ravindran, A., ... Ramírez-Moreno, M.A. (2022). Multi-Output Sequential Deep Learning Model for Athlete Force Prediction on a Treadmill Using 3D Markers. *Applied Sciences*, 12(11), 5424. doi:10.3390/app12115424

Ramírez-Moreno, M.A., Carrillo-Tijerina, P., **Candela-Leal, M.O.**, Alanis-Espinosa, M., ... Lozoya-Santos, J.J. (2021). Evaluation of a Fast Test Based on Biometric Signals to Assess Mental Fatigue at the Workplace—A Pilot Study. *International Journal of Environmental Research and Public Health*, 18(22), 11891. PMID: 34831645. doi:10.3390/ijerph182211891

Candela-Leal, M.O., Alanis-Espinosa, M., Murrieta-González, J., Lozoya-Santos, J.J, & Ramírez-Moreno, M.A. *(submitted)*. Neurocognitive Insights into STEM Learning: An Integrated Analysis of Bandpower and Functional Connectivity among Youth. *Thinking Skills and Creativity*

Book Chapters

Lozoya-Santos, J.J., Ramírez-Moreno, M.A., Diaz-Armas, G.G., **Candela-Leal, M.O.**, ... Ramirez-Mendoza, R.A. (2022). "Current and Future Biometrics: Technology and Applications." In R.A. Ramirez-Mendoza, J.J. Lozoya-Santos, R. Zavala-Yoé, L.M. Alonso-Valerdi, ... H.G. Gonzalez-Hernandez (Eds.), *Biometry: Technology, Trends and Applications* (1st ed., pp. 1–30). Boca Raton, FL: CRC Press. doi:10.1201/9781003145240-1. ISBN: 9781003145240.

Invited Talks

Candela-Leal, M.O. (2023, April). Computer Vision and Facial Recognition. Presented to Senior Undergraduate Computer Science Students in *Computing Seminar* at the Universidad Autónoma de Nuevo León (UANL), Monterrey, Mexico

Candela-Leal, M.O. (2021, July). Biomechanics for the Digital Twin of Performance: Study Cases. Presented at the *Conscious Technologies for Smart Communities Workshop*, Monterrey, Mexico

Conference Proceedings

Candela-Leal, M.O., Aguilar-Herrera, A.J., Ramírez-Moreno, M.A., Félix-Herrán L.C., ... Lozoya-Santos, J.J. (2024). Conscious Technologies Projects as a Hub for Real Life Challenges in Engineering Education. *15th Global Engineering Education Conference (EDUCON)*. Kos, Greece: IEEE

Candela-Leal, M.O., Martínez-Díaz, D., Orozco-Romo, C., Aguilar-Herrera, A.J., ... Ramírez-Moreno, M.A. (2023). Biomechanics Digital Twin: Markerless Joint Acceleration Prediction Using Machine Learning and Computer Vision. In *2023 Future of Educational Innovation-Workshop Series Data in Action* (pp. 142-150). Monterrey, Mexico: IEEE. doi:10.1109/IEEECONF56852.2023.10104757

Candela-Leal, M.O., García-Briones, J.M., Olivas-Martínez, G., Abrego-Ramos, R., ... Lozoya-Santos, J.J. (2021). Real-time Biofeedback System for Interactive Learning using Wearables and IoT. In *6th North American Industrial Engineering and Operations Management (IEOM)* (pp. 2959-2970). Monterrey, Mexico: IEOM **(best undergrad paper)**. doi:10.46254/NA06.20210487

Olivas-Martínez, G., **Candela-Leal, M.O.**, Ocampo-Alvarado, J.C., Acosta-Soto, L.F., ... Ramírez-Moreno, M.A. (2021). Detecting Change in Engineering Interest in Children through Machine Learning using Biometric Signals. In *2021 Machine Learning-Driven Digital Technologies for Educational Innovation Workshop* (pp. 33-40). Monterrey, Mexico: IEEE. doi:10.1109/IEEECONF53024.2021.9733772

Aguilar-Herrera, A.J., Delgado-Jimenez, E.A., **Candela-Leal, M.O.**, Olivas-Martinez, G., ... Ramirez-Mendoza, R.A. (2021). Advanced Learner Assistance System's (ALAS) recent results. In *2021 Machine Learning-Driven Digital Technologies for Educational Innovation Workshop* (pp. 26-33). Monterrey, Mexico: IEEE. doi:10.1109/IEEECONF53024.2021.9733770

Conference Presentations

Candela-Leal, M.O., Lemus-Aguilar, M., Mondragon-Estrada, E., Hereida-Marin, I.B., ... Im, K. (2024, March). High-resolution Fetal Subplate Automatic Segmentation. **Oral presentation** at the *Fetal Neonatal Neuroimaging and Developmental Science Center (FNNDSC) Research Symposium*, Boston, MA

Esparza-Esparza, S.A., **Candela-Leal, M.O.**, Yun, H.J., Grant, P.E., Im, K. (2024, March). CHD Fetal Brain Analysis using Combined Quantitative MRI Features and Custom-build Loss Functions. **Oral presentation** at the *Fetal Neonatal Neuroimaging and Developmental Science Center (FNNDSC) Research Symposium*, Boston, MA

Tafoya-Milo, G., Amador-Izaguirre, S.A., **Candela-Leal, M.O.**, You, S., ... Im, K. (2024, March). Gestational Age-Informed VAE-GAN Anomaly Detection for Fetal Brain MRI. **Oral presentation** at the *Fetal Neonatal Neuroimaging and Developmental Science Center (FNNDSC) Research Symposium*, Boston, MA

Candela-Leal, M.O., Lozoya-Santos, J.J., & Ramírez-Moreno, M.A. (2023, October). Real-time Dual-feature Mental Fatigue State SVM Classification using EEG Delta Bandpower [Poster #35]. **Poster presentation** at the *19th IEEE-EMBS International Conference on Body Sensor Networks (BSN)*, Boston, MA

Alvarez-Espinoza, G.J, **Candela-Leal, M.O.**, Abrego-Ramos, R., Olivas-Martínez, G., ... Lozoya-Santos, J.J. (2021, October). ALAS: Advanced Learner Assistance System for Engineering Education using Wearable Sensors. **Poster presentation** at the *43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)* (p. 5101). https://embc.embs.org/2021

Olivas-Martinez, G., Acosta-Soto, L., Ocampo-Alvarado, J., **Candela-Leal, M.O.**, ... Lozoya-Santos, J.J. (2021, October). Identifying Engineering Interest in Children through Machine Learning using Biometric Signals. **Poster presentation** at the *43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)* (p. 5244). https://embc.embs.org/2021

Candela-Leal, M.O., Prado-Maillard, E.C., Avendaño-Arredondo, B.J., Otálora-Millán, M.P., & Jasso-Ayala, J.C. (2021, February). *Harry Potter and the Prisoner of Azkaban* (2004), a Cultural and Ideological Instructor of the Millennial Viewer. **Oral presentation** at the *51th Research and Development Congress: International Baccalaureate Extended Essay*, Monterrey, Mexico

PROJECTS

High-res Fetal Subplate Segmentation - *(Harvard Medical School)* Spring 2024
- Upsampled, aligned, and corrected subplate segmentation in a higher resolution
- Implemented Bivariate Gaussian Smoothing (BGS) for step-like boundaries
- Trained an U-Net leveraged by transfer-learning for automatic segmentation

Non-linear qMRI for CHD Classification - *(Harvard Medical School)* Spring 2024
- Designed Recursive RF importance (RRFi) for feature selection (20,453)
- Created a 5-feature kNN model with 0.88 F1-score (0.10 better than baseline)
- Discovered and proposed new biomakers in fetal CHD brain identification

Unsupervised VAE-GAN for Anomaly - *(Harvard Medical School)* Spring 2024
- Trained an age-informed GAN model in typically developed fetal brains
- Detected abnormalities in Ventriculomegaly (VM) fetal subjects (AUC = 90%)
- Designed a novel age encoding: Bidirectional Ordinary Encoding (BOE)

Real-time Emotion Recognition - *(TMX BRAIN Site)* Fall 2022, Spring 2023
(Neurohumanities Lab)
- Created an 8-channel EEG-based VAD 15 emotion recognition model
- Designed a channel selection pipeline using lobe-based PCA and RF
- Reduced 32-channel DEAP dataset dimensionality into optimal OpenBCI config

Digital Twin of the Workspace - *(TMX BRAIN Site)* Spring 2022
- Designed a throughput monitoring system via Human Action Recognition (HAR)
- Integrated Velodyne LiDAR pointcloud with CV tracking using CCTV footage
- Fitted a RNN HAR model (Walking, Running, Jumping) using CV human keypoints

Brain on Acting - *(UH BRAIN Site)* Spring 2022
- Recorded a play using 32-electrode EEG on two actors and the director
- Calculated bispectrum signal for the combination of pairs using MATLAB
- Assessed the difference in moments of gaze via Wilcoxon Rank-Sum Test

Mental Fatigue Prediction - *(TMX BRAIN Site)* Spring, Fall 2021
(Advanced Learner Assistance System [ALAS])
- Feature engineered 4-electrode EEG & ECG wearables features using R
- Developed and tuned a ML algorithm that predicted mental fatigue via Python
- Used the least amount of combined features (2) to achieve high accuracy (93%)

Biomechanical Force Prediction - *(TMX BRAIN Site)* Spring, Fall 2021
(Biomechanics for the Digital Twin)
- Used OpenPose API and DLT to markerless track an individual's joints
- Designed and trained an RNN using Tensorflow and Keras in Python
- Predicted the force exerted by using raw human pose keypoints

Interest in STEM Prediction - *(TMX BRAIN Site)* Fall 2021
(Talent and Passion Detection Through Biometrics)
- Trained ML regression models with biometrics (EEG, ECG, and CV emotions)
- Predicted change in vocational interest after a STEM lecture using Python
- Validated with STEM-CIS psychometric test, the algorithm achieved 80% accuracy

HONORS AND AWARDS

Outstanding Student Award (top 1% best engineering trajectories) 2023
1st Place - Research and Improvement Proposals at 18th Conexión Tec Fall 2021
1st Place - Undergraduate Paper Competition at 6th NA IEOM 2021
Scholarship for Academic Talent - *Tecnológico de Monterrey* 2020

TEACHING

German A2 Teacher - *Mentoor* 2022-2024
Middle School Math and Spanish Teacher - *Aprendamos Juntos* 2021-2022
Independent High School Physics Teacher Fall 2019
FIRST® LEGO® League Mentor - *Little Minds* Spring 2019

Skills Summary

Languages	Python (3 years), MATLAB (2 years), R (1 year), Shell (3 months), SQL (3 months) English (C1), German (B1), Spanish
Frameworks	Numpy, Scipy, Pandas, Matplotlib, Scikit-learn, OpenCV, TensorFlow, Keras, BrainFlow Lattice, Dplyr, Tidyr, Caret, GA, Ggplot, Shiny FSL, FreeSurfer, MRtrix3, ANTs, NiBabel, PyDicom, IRTK
Tools	Git, Anaconda, CUDA, cuDNN, Tableau, Microsoft Excel, Overleaf, LaTeX
Platforms	Linux, ROS, Windows, Arduino, Raspberry

Audited Courses

MIT - Department of Brain and Cognitive Sciences (BCS)

9.014 Quantitative Methods and Computational Models in Neuroscience - *M. Jazayeri* — Fall 2023

9.66 Computational Cognitive Science - *J. Tenenbaum* — Fall 2023

Harvard - Department of Psychology

PSY 3340 Research Seminar in Cognition, Brain, and Behavior - *T. Ullman* — Spring 2024

PSY 1322 The Cognitive Science of Making Up Your Mind - *T. Ullman* — Spring 2024

Professional Development

MIT - Department of Brain and Cognitive Sciences (BCS)

(Workshop) Exploring New Horizons: Strategies for Success in new Scientific Field — 2024

Tecnológico de Monterrey

(Course) Data Science - *Crystal System* — (49 h) 2022

(Workshop) Biosignal processing in Python - *Neuroengineering and Neuroacoustics* — 2021

(Hackathon) HackMTY — 2021

(Hackathon) B-Hack - *43th National Biomedical Engineering Congress* — 2020

(Course) Systemic Change - *Ashoka* — 2020

Coursera Specializations

Johns Hopkins University

Data Science — (288 h) 2021

Neuroscience and Neuroimaging — (42 h) 2020

Health Informatics — (56 h) 2020

Patient Safety — (54 h) 2020

Healthcare IT Support — (20 h) 2021

University of Michigan

Applied Data Science with Python — (145 h) 2021

DeepLearning.AI

AI for Medicine — (72 h) 2021

Imperial College London

Infectious Disease Modelling — (65 h) 2021

Alberta Machine Intelligence Institute

Machine Learning: Algorithms in the Real World — (41 h) 2020

IBM - *edX*

Fundamentals of AI — (80 h) 2020

Rice University

Fundamentals of Immunology — (69 h) 2020

University of Colorado System

Applied Cryptography — (34 h) 2020

University System of Georgia

Six Sigma Green Belt — (49 h) 2020

Duke University

Excel to MySQL: Analytic Techniques for Business — (109 h) 2021