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. *(under review)*. Neurocognitive Insights into STEM Learning: An Integrated Analysis of Bandpower and Functional Connectivity among Youth. *Thinking Skills and Creativity*

Mandujano-Granillo, J.A., **Candela-Leal, M.O.**, Ortiz-Vazquez, J.J., Ramírez-Moreno, M.A., ... Lozoya-Santos, J.J. (*under review*). Human-Vehicle Interfaces: A Review for Autonomous Electric Vehicles. *Sensors*

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.

Ramírez-Moreno, M.A., Romero-Días, D.C., **Candela-Leal, M.O.**, Hernández-Mustieles, M.A., & Lozoya-Santos, J.J. (*under review*). "Workplace measures of mental fatigue." In *The Scientific Basis of Fatigue*. Academic Press-Elsevier

Invited Talks

Candela-Leal, M.O., & Valdivia-Padilla, A. (2024, August). Digital Twins in Education: Enhancing Student Well-being and Academic Performance with Biometric Insights and Machine Learning. *U21 Health Sciences Group 2024 Annual Meeting*, Amsterdam University Medical Centers, Amsterdam, Netherlands. (Theme: Data Driven Health Care and Teaching) **(student speaker travel award)**

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

International Conference Presentations

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 (EMBS)* (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 (EMBS)* (p. 5244). https://embc.embs.org/2021

Additional Conference Presentations

Oral Presentations

FNNDSC Research Symposium	(Boston, MA)	Mar 2024
Conscious Technologies for Smart Communities Workshop	(Virtual)	July 2021
51th Research and Development Congress	(Virtual)	Feb 2021

Poster Presentations

NSF BRAIN Summer Annual IAB Meeting	(Phoenix, AZ)	Jul 2023
21st Expo Ingenierías at Conexión Tec	(Monterrey, Mexico)	Jun 2023
BMEX: Engineering and Health Sciences Symposium	(Monterrey, Mexico)	May 2023
19th & 20th Expo Ingenierías at Conexión Tec	(Monterrey, Mexico)	Jun, Nov 2022
NSF BRAIN Summer Annual IAB Meeting	(Houston, TX)	Aug 2022
17th & 18th Expo Ingenierías at Conexión Tec	(Virtual)	Jun, Nov 2021

Honors and Awards

Student Speaker Travel Award ($1600 USD) - *U21 Health Sciences*	2024
1st Place - Undergraduate Student Paper Competition - *6th NA IEOM*	2021

Tecnológico de Monterrey
Outstanding Student Award (top 1% best engineering trajectories) 2023
1st Place - R&D Improvement Proposals ($250 USD) - *18th Conexión Tec* Fall 2021
Academic Talent Scholarship 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

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

MEMBERSHIPS

SACNAS March 2024 - March 2025

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 Apr - Jul 2024
(Symposium) McGovern Institute: Transformational Strategies in Mental Health May 2024
(Symposium) McGovern-MEGIN: MEGnificent brain discoveries Mar 2024

Tecnológico de Monterrey
(Course) Data Science - *Crystal System* (150 h) Jan - Mar 2022
(Workshop) Biosignal processing in Python - *Neuroengineering and Neuroacoustics* Mar 2021
(Hackathon) HackMTY Aug 2021
(Hackathon) B-Hack - *43th National Biomedical Engineering Congress* Oct 2020
(Course) Systemic Change - *Ashoka* Dec 2020

COURSERA SPECIALIZATIONS

Johns Hopkins University
Data Science (288 h) Feb 2021
Neuroscience and Neuroimaging (42 h) Oct 2020
Health Informatics (56 h) Aug 2020
Patient Safety (54 h) Aug 2020
Healthcare IT Support (20 h) Jan 2021

University of Michigan
Applied Data Science with Python (145 h) Jul 2021

DeepLearning.AI
AI for Medicine (72 h) Mar 2021

Imperial College London
Infectious Disease Modelling (65 h) Jan 2021

Alberta Machine Intelligence Institute
Machine Learning: Algorithms in the Real World (41 h) Nov 2020

IBM - *edX*
Fundamentals of AI (80 h) Aug 2020

Rice University
Fundamentals of Immunology (69 h) Sep 2020

University of Colorado System
Applied Cryptography (34 h) Jul 2020

University System of Georgia
Six Sigma Green Belt (49 h) Oct 2020

Duke University
Excel to MySQL: Analytic Techniques for Business (109 h) Apr 2021