Milton O. Candela-Leal

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Education

Tecnológico de Monterrey - Monterrey, Mexico 2020 - Dec 2024
BSc in Biomedical Engineering (95/100 = 3.8/4.0 GPA)

International Baccalaureate - Monterrey, Mexico 2018 - 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

MIT Media Lab - Boston, MA, USA Summer 2024
Massachusetts Institute of Technology
Advisor: Samantha Chan, PhD
Project: EEG slow wave brain analysis for sleep quality improvement.

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

Tecnológico de Monterrey - Monterrey, Mexico 2021 - 2023
NSF IUCRC BRAIN Center
Advisor: Prof. 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 employing Computer Vision's keypoints and RNN.

University of Houston - Houston, TX, USA Spring 2022
NSF IUCRC BRAIN Center
Advisor: Prof. Jose L. Contreras-Vidal, PhD
Project: EEG functional connectivity and bisprectrum analysis between actors.

Journal Articles

(† indicates equal contribution)

Blanco-Ríos, M.A.†, **Candela-Leal, M.O.**†, Orozco-Romo, C., ... 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. doi:10.3389/fnhum.2024.1319574. PubMed PMID:38545515

Candela-Leal, M.O., Gutiérrez-Flores, E.A., Presbítero-Espinosa, G., ... 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.**, ... 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. doi:10.3390/ijerph182211891. PubMed PMID:34831645

Book Chapters

Lozoya-Santos, J.J., Ramírez-Moreno, M.A., **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, ... 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.

Conference Proceedings

Candela-Leal, M.O., Aguilar-Herrera, A.J., Ramírez-Moreno, M.A., ... Lozoya-Santos, J.J. (2024). Conscious Technologies Projects as a Hub for Real Life Challenges in Engineering Education. In 15th EDUCON (pp. 665-675). Kos, Greece: IEEE. doi:10.1109/EDUCON60312.2024.10578738

Candela-Leal, M.O., Martínez-Díaz, D., Orozco-Romo, C., ... Ramírez-Moreno, M.A. (2023). Biomechanics Digital Twin: Markerless Joint Acceleration Prediction Using Machine Learning and

Computer Vision. In FEI-WS 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., ... Lozoya-Santos, J.J. (2021). Real-time Biofeedback System for Interactive Learning using Wearables and IoT. In 6th NA-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., ... Ramírez-Moreno, M.A. (2021). Detecting Change in Engineering Interest in Children through Machine Learning using Biometric Signals. In ML-DT Edu. 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.**, ... Ramirez-Mendoza, R.A. (2021). Advanced Learner Assistance System's (ALAS) recent results. In ML-DT Edu. Innovation Workshop (pp. 26-33). Monterrey, Mexico: IEEE. doi:10.1109/IEEECONF53024.2021.9733770

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) [one of Mexico's top eight universities], Monterrey, Mexico [slides]

Under Review

Candela-Leal, M.O., Alanis-Espinosa, M., Murrieta-González, 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

Candela-Leal, M.O., Lozoya-Santos, J.J., Ramírez-Moreno, M.A. (*under review*). Task Completion Time Estimation via EEG Theta Bandpower during Chess-Based Problem-Solving. In IEEE-EMBS BHI. Houston, TX: IEEE

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

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

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 BSN, Boston, MA

Alvarez-Espinoza, G.J, **Candela-Leal, M.O.**, Abrego-Ramos, R., ... Lozoya-Santos, J.J. (2021, October). ALAS: Advanced Learner Assistance System for Engineering Education using Wearable Sensors. **Poster presentation** at the 43rd IEEE-EMBS (p. 5101). https://embc.embs.org/2021

Olivas-Martinez, G., Acosta-Soto, L., **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 IEEE-EMBS (p. 5244). https://embc.embs.org/2021

Conference Presentations

Oral Presentations

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

Poster Presentations

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

HONORS AND AWARDS

Student Speaker Travel Award ($1600 USD) - *U21 Health Sciences Group* 2024
Outstanding Student Award (top 1% engineering trajectories) - *Tecnológico de Monterrey* 2023
1st Place - Undergraduate Student Paper Competition - *6th North American IEOM* 2021
1st Place - R&D Improvement Proposals ($250 USD) - *18th Conexión Tec* 2021
Academic Talent Scholarship - *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, G*Power, Overleaf, LaTeX
Platforms Linux, ROS, Windows, Arduino, Raspberry

PROJECTS

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

Non-linear qMRI for CHD Classification - *Harvard Medical School* 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* 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 - *Tecnológico de Monterrey* 2022-2023
(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 - *Tecnológico de Monterrey* 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 - *University of Houston* 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

Biomechanical Force Prediction - *Tecnológico de Monterrey* 2021-2022
(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

Mental Fatigue Prediction - *Tecnológico de Monterrey* 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%)

Interest in STEM Prediction - *Tecnológico de Monterrey* 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

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

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

PROFESSIONAL DEVELOPMENT

MIT - Department of Brain and Cognitive Sciences (BCS)
(Workshop) Exploring New Horizons: Strategies for Success in new Scientific Field 2024
(Symposium) McGovern Institute: Transformational Strategies in Mental Health 2024
(Symposium) McGovern-MEGIN: MEGnificent brain discoveries 2024

Tecnológico de Monterrey
(Course) Data Science - *Crystal System* (150 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