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: *Harry Potter and the Prisoner of Azkaban* (2004), a Cultural and Ideological Instructor of the Millennial Viewer

Research Experience

Boston Children's Hospital - Cambridge, MA, USA — Aug 2023 - Aug 2024
Harvard Medical School
Advisor: Kiho Im, Ph.D.
Project: *High-res Fetal Subplate Segmentation*
Unsupervised VAE-GAN for Anomaly
Non-linear qMRI for CHD Classification

NSF IUCRC BRAIN Center - Monterrey, Mexico — Mar 2021 - Jul 2023
TMX BRAIN Site - *Tecnológico de Monterrey*
Advisor: Mauricio A. Ramírez-Moreno, Ph.D.
Project: *Advanced Learner Assistance System (ALAS)*
Talent and Passion Detection Through Biometrics
Biomechanics for the Digital Twin
Neurohumanities Lab
Digital Twin of the Workspace

NSF IUCRC BRAIN Center - Houston, TX, USA — Spring 2022
UH BRAIN Site - *University of Houston*
Advisor: Jose L. Contreras-Vidal, Ph.D.
Project: *Brain on Acting*

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() [paper] [preprint]

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 [paper]

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 [paper]

Candela-Leal, M.O., Alanis-Espinosa, M., Murrieta-González, J., Lozoya-Santos, J.J, & Ramírez-Moreno, M.A. *(in press)*. 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. ISBN: 9781003145240 [paper]

Conference Proceedings

(† indicates equal contribution)

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 [paper]

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)** [paper]

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 [paper]

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 [paper]

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, Monterrey, Mexico [certificate] [slides]

Abstracts

Candela-Leal, M.O., Lemus-Aguilar, M., Mondragon-Estrada, E., Hereida-Marin, I.B., ... Im, K. (2024, March). High-resolution Fetal Subplate Automatic Segmentation [Abstract: Oral presentation]. Presented 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 [Abstract: Oral presentation]. Presented 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 [Abstract: Oral presentation]. Presented 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 [Abstract: Poster presentation, Poster #35]. In *19th IEEE-EMBS International Conference on Body Sensor Networks*, Boston, MA [poster] [abstract]

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 [Abstract: Poster presentation]. Presented at the *43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)* (p. 5101). https://embc.embs.org/2021 [abstract]

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 [Abstract: Poster presentation]. Presented at the *43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)* (p. 5244). https://embc.embs.org/2021 [abstract]

PROJECTS

High-res Fetal Subplate Segmentation - *(Harvard Medical School)* Spring 2024
- Upsampled, aligned, and corrected subplate segmentation in higher resolution
- Implemented Bivariate Gaussian Smoothing (BGS) to reduce sharp borders
- Trained an U-Net leveraged by transfer-learning to automatically segment

Non-linear qMRI for CHD Classification - *(Harvard Medical School)* Spring 2024
- Implemented a Genetic Algorithm (GA) pipeline for feature selection (513)
- Created a 2-feature kNN model with 88% accuracy (7% better than PCA)
- Discovered and proposed new biomakers in fetal CHD brain identification

Unsupervised VAE-GAN for Anomaly - *(Harvard Medical School)* Spring 2024
- Designed and trained an age-informed GAN model in healthy 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)* [journal article] 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)* [internal poster] Spring 2022
- Designed a throughput monitoring system via Human Action Recognition (HAR)
- Integrated Velodyne LiDAR pointcloud with CV tracking using CCTV footage

Brain on Acting - *(UH BRAIN Site)* [internal poster] 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)* [journal article] 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)* [journal article] 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)* [conference proceeding] 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
Outstanding IB Extended Essay - 51th Research and Development Congress 2021
Scholarship for Academic Talent (40%) 2020

TEACHING

German A2 Teacher - *Mentoor* 2022-2023
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), SQL (3 months) English (C1), German (B1), Spanish
Frameworks	Numpy, Scipy, Matplotlib, Pandas, Scikit-learn, TensorFlow, Keras, BrainFlow, Flask Lattice, Dplyr, Tidyr, Caret, Ggplot, Shiny FSL, FreeSurfer, MRtrix3, ANTs, NiBabel, PyDicom
Tools	GitHub, Anaconda, CUDA, cuDNN, Tableau, Microsoft Excel, Overleaf, LaTeX
Platforms	Linux, ROS, Windows, Arduino, Raspberry
Soft Skills	Leadership, Problem Solving, Teamwork, Self-Learning, Time Management