

Milton O. Candela-Leal

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EDUCATION

- Tecnológico de Monterrey** - Monterrey, Mexico 2020 - Dec 2024
BS in Biomedical Engineering (95/100 = 3.88/4.00 GPA)
Highest honors (*Summa Cum Laude*) and highest award for co-curricular success (*Excellence Diploma*); *Borrego de Oro* in professional development
- 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

- Tecnológico de Monterrey** - Monterrey, Mexico Mar 2021 - Jul 2023, Fall 2024
NSF IUCRC BRAIN Center
Advisor: Prof. Mauricio A. Ramírez-Moreno, PhD
Projects: Biometrics (EEG, ECG, CV) and Machine Learning to predict:
Mental fatigue (2021); engineering interest (2021); emotion (2023).
- Force prediction through pose estimation keypoints and RNN (2022).
- Cognitive load in chess (2023); closed-loop BCI for attention (2024).
- Harvard Medical School** - Boston, MA, USA Aug 2023 - Jul 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; MICCAI FeTA Challenge 2024.
- University of Houston** - Houston, TX, USA Spring 2022
NSF IUCRC BRAIN Center
Advisor: Prof. Jose L. Contreras-Vidal, PhD
Project: EEG functional connectivity and bispectrum analysis between actors.

JOURNAL ARTICLES

(† indicates equal contribution)

- Mandujano-Granillo, J.A., **Candela-Leal, M.O.**, Ortiz-Vazquez, J.J., ... Lozoya-Santos, J.J. (2024). Human-Vehicle Interfaces: A Review for Autonomous Electric Vehicles. *IEEE Access*, 12, 121635–121658. doi:[10.1109/ACCESS.2024.3450439](https://doi.org/10.1109/ACCESS.2024.3450439)
- 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](https://doi.org/10.3389/fnhum.2024.1319574). PubMed PMID:[38545515](https://pubmed.ncbi.nlm.nih.gov/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](https://doi.org/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](https://doi.org/10.3390/ijerph182211891). PubMed PMID:[34831645](https://pubmed.ncbi.nlm.nih.gov/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](https://doi.org/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](https://doi.org/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 *Future of Educational Innovation-Workshop Series: Data in Action* (pp. 142-150). Monterrey, Mexico: IEEE. doi:[10.1109/IEEECONF56852.2023.10104757](https://doi.org/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 North American IEOM* (pp. 2959-2970). Monterrey, Mexico: IEOM (**best undergraduate paper award**). doi:[10.46254/NA06.20210487](https://doi.org/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 *Machine Learning-Driven Digital Technologies for Educational Innovation Workshop* (pp. 33-40). Monterrey, Mexico: IEEE. doi:[10.1109/IEEECONF53024.2021.9733772](https://doi.org/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 *Machine Learning-Driven Digital Technologies for Educational Innovation Workshop* (pp. 26-33). Monterrey, Mexico: IEEE. doi:[10.1109/IEEECONF53024.2021.9733770](https://doi.org/10.1109/IEEECONF53024.2021.9733770)

INVITED TALKS

- | | |
|---|------|
| Decoding Cognitive Performance, | 2024 |
| Cognitive Neuroscience minor, Tecnológico de Monterrey - School of Humanities and Education | |
| Computer Vision and Facial Recognition, | 2023 |
| Computing Seminar course, UANL - School of Physics and Mathematics | |

WORKING PAPERS

- Ramírez-Arceo, G.A., **Candela-Leal, M.O.**, Tudon-Martinez, J.C., ... Ramírez-Moreno, M.A., (*accepted*). Innovative Spaces With Advanced Technologies Such as Research Activity Simulators for Engineering Education. In *16th EDUCON*. London, United Kingdom: IEEE
- Ramírez-Moreno, M.A., Romero-Días, D.C., **Candela-Leal, M.O.**, ... Lozoya-Santos, J.J. (*under review*). Workplace Measures of Mental Fatigue.
- 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
- Candela-Leal, M.O.**, Lozoya-Santos, J.J., Ramírez-Moreno, M.A. (*in prep*). Central Theta for Task Completion Time Estimation during Chess-Based Problem-Solving using Single-Channel EEG
- Candela-Leal, M.O.**, Martínez-Hernández, A., Moreno-Salazar, I.E., ... Ramírez-Moreno, M.A. (*in prep*). EEG-Based Spherical Model for Emotion and Fear Prediction with Biometric Validation
- Candela-Leal, M.O.**, Ramírez-Arceo, G.A., Ramírez-Moreno, M.A., ... Lozoya-Santos, J.J. (*in prep*). Neurohumanities Lab as an Educational Immersive Virtual Reality Space

PRESENTATIONS

Oral Presentations

- | | |
|---|------|
| Digital Twins in Education: Enhancing Student Well-being and Academic Performance with Biometric Insights and Machine Learning. <i>U21 Health Sciences Group 2024 Annual Meeting</i> , Amsterdam University Medical Centers (Amsterdam, Netherlands) (student speaker award) | 2024 |
| High-resolution Fetal Subplate Automatic Segmentation. <i>FNNDSC Research Symposium</i> , Boston Children's Hospital (Boston, MA) | 2024 |
| CHD Fetal Brain Analysis using Combined Quantitative MRI Features and Custom-build Loss Functions. <i>FNNDSC Research Symposium</i> , Boston Children's Hospital (Boston, MA) | 2024 |
| Biomechanics for the Digital Twin of Performance: Study Cases. <i>Conscious Technologies for Smart Communities Workshop</i> (Virtual) | 2021 |
| <i>Harry Potter and the Prisoner of Azkaban</i> (2004), a Cultural and Ideological Instructor of the Millennial Viewer. <i>51th Research and Development Congress</i> (Virtual) | 2021 |

Poster Presentations

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|---|------|
| FALCONS: Fetal Automatic Landmark Computation and Optimization for Neuroimaging Segmentation. <i>27th International Conference on MICCAI</i> (Marrakesh, Morocco) | 2024 |
| Real-time Dual-feature Mental Fatigue State SVM Classification using EEG Delta Bandpower. <i>19th IEEE-EMBS International Conference on BSN</i> , MIT Media Lab (Boston, MA) | 2023 |

Talent Detection Tool for Early Engineering Education. <i>NSF IUCRC BRAIN 2023 Annual Meeting</i> , Arizona State University (Phoenix, AZ)	2023
Human Machine Interface for Fleet Electric Vehicles. <i>NSF IUCRC BRAIN 2023 Annual Meeting</i> , Arizona State University (Phoenix, AZ)	2023
Biometric Cabin for Neurohumanities Lab. <i>NSF IUCRC BRAIN 2023 Annual Meeting</i> , Arizona State University (Phoenix, AZ)	2023
Digital Twin modeling for Human Biomechanics and Office Spaces. <i>NSF IUCRC BRAIN 2022 Annual Meeting</i> , University of Houston (Houston, TX)	2022
Brain on Acting: Neural Dynamics of Actor-Actor Dyads During an Acted Scene. <i>NSF IUCRC BRAIN 2022 Annual Meeting</i> , University of Houston (Houston, TX)	2022
Identifying Engineering Interest in Children through Machine Learning using Biometric Signals. <i>43rd Annual Conference of the IEEE-EMBS</i> (Virtual)	2021
ALAS: Advanced Learner Assistance System for Engineering Education using Wearable Sensors. <i>43rd Annual Conference of the IEEE-EMBS</i> (Virtual)	2021
Digital Twin of Biomechanics: Joint Force Prediction using Video and AI. At the <i>NSF IUCRC BRAIN 2021 Annual Meeting</i> (Virtual)	2021
Detection of Engineering Interest in Children Through an Intelligent System Using Biometric Signals. At the <i>NSF BRAIN 2021 Annual Meeting</i> (Virtual)	2021

NON-INTERNATIONAL PRESENTATIONS

Poster Presentations

Closed-Loop BCI with Haptic Feedback and SINDy Algorithm for Attention Support in ADHD Students. At the <i>24th Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2024
Biometric Cabin with Portable Real-Time Monitoring Technology for Smart Solutions. At the <i>21st Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2023
Neurohumanities Lab. At the <i>21st Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2023
Comparison of Brain Synchronization between Pairs during Collaborative and Competitive Tasks. At the <i>21st Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2023
Real-Time Knee Flexion Angle for Anterior Cruciate Ligament Injury using Computer Vision. At the <i>BMEX: Engineering and Health Sciences Symposium</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2023
Advanced Learner Assistance System (ALAS). At the <i>20th Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2022
Real-Time Knee Flexion Angle for Anterior Cruciate Ligament Injury using Computer Vision. At the <i>20th Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2022
Digital Twin Office for Workspace Throughput Monitoring. At the <i>19th Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2022
Biomechanics For the Digital Twin of Performance. At the <i>19th Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2022
Advanced Learner Assistance System. At the <i>19th Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2022
Detection of Engineering Interest in Children Through an Intelligent System Using Biometric Signals. At the <i>18th Expo Ingenierías</i> (Virtual)	2021
Real-time Biofeedback System for Interactive Learning using Wearables and IoT. At the <i>18th Expo Ingenierías</i> (Virtual)	2021
Biomechanics for the Digital Twin of Performance. At the <i>18th Expo Ingenierías</i> (Virtual)	2021
Advanced Learner Assistance System (ALAS) for Engineering Education using Wearable Sensors. At the <i>17th Expo Ingenierías</i> (Virtual)	2021

HONORS AND AWARDS

Summa Cum Laude (highest academic distinction), Tecnológico de Monterrey	2024
Excellence Diploma (highest co-curricular distinction), Tecnológico de Monterrey	2024
Borrego de Oro (#1 in professional development), Tecnológico de Monterrey	2024
International Diploma (leadership & multilingual proficiency), Tecnológico de Monterrey	2024
Student Speaker Award (\$1600 USD), U21 Health Sciences Group	2024
Outstanding Student Award (1% eng. trajectories) [80/8000], Tecnológico de Monterrey	2023, 2024
1 st Place - Undergraduate Student Paper Competition, 6 th North American IEOM	2021
1 st Place - R&D Improvement Proposals (\$250 USD), 18 th Conexión Tec	2021
Academic Talent Scholarship , Tecnológico de Monterrey	2020

TEACHING

German A2 Teacher, Mentoora MX	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

PRESS

(Spanish) Conecta: Of Gold! Monterrey Campus Graduates Acknowledged for Holistic Formation	2024
(Spanish) Conecta: They receive recognition for their AI learning project and take it to Amsterdam!	2024

SKILLS SUMMARY

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

PROJECTS

Closed-loop BCI for Attention - <i>Tecnológico de Monterrey</i>	2024
<ul style="list-style-type: none">- Real-time analog haptic neurofeedback when the model predicts low attention- Collected 4-channel EEG CPT-II data, further validated using a 12-min video- Trained a 3-feature MLR model that predicted attention continuously (0.72 R^2)	
FeTA Challenge @ MICCAI - <i>Harvard Medical School</i>	2024
<ul style="list-style-type: none">- 7-label dataset (CSF, GM, WM, Ventricles, Cerebellum, Deep GM, Brainstem)- Pre-processed multi-site data; evaluated model zoo performance on in-house data- Trained a MRI U-Net model with spatial and resolution augmentation (0.76 Dice)	
High-res Fetal Subplate Segmentation - <i>Harvard Medical School</i>	2024
<ul style="list-style-type: none">- Upsampled, aligned, and corrected subplate segmentation in a higher resolution- Implemented Bivariate Gaussian Smoothing (BGS) for step-like borders- Trained a MRI U-Net leveraged by transfer-learning for segmentation (0.98 Dice)	
Non-linear qMRI for CHD Classification - <i>Harvard Medical School</i>	2024
<ul style="list-style-type: none">- Designed Recursive RF importance (RRFi) for feature selection (20,453)- Discovered and proposed new biomarkers in fetal CHD brain identification- Created a 5-feature kNN model with 0.88 F1-score (0.10 better than baseline)	
Real-time Emotion Recognition - <i>Tecnológico de Monterrey</i> (<i>Neurohumanities Lab</i>)	2022-2023
<ul style="list-style-type: none">- Reduced 32-channel DEAP dataset dimensionality into optimal config- Designed a channel selection pipeline using lobe-based PCA and RF- Created an 8-channel EEG VAD 15 emotion recognition model (94% accuracy)	
Cognitive Load Dynamics in Chess - <i>Tecnológico de Monterrey</i>	2023
<ul style="list-style-type: none">- Designed, led, and processed 37 chess players under ambient/white noise- Calculated Task Completion Time (TCT) based on EEG biomarker theta C4- Validated TCT with Cognitive Load Theory (CLT), stratifying by chess level	
Digital Twin of the Workspace - <i>Tecnológico de Monterrey</i>	2022
<ul style="list-style-type: none">- 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 - <i>University of Houston</i>	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 - <i>Tecnológico de Monterrey</i>	2021-2022
(<i>Biomechanics for the Digital Twin</i>)	
- Used OpenPose API and DLT to markerless track an individual's joints	
- Predicted the force exerted by using raw human pose keypoints	
- Designed and trained an RNN using Tensorflow and Keras in Python (0.92 R^2)	
Mental Fatigue Prediction - <i>Tecnológico de Monterrey</i>	2021
(<i>Advanced Learner Assistance System [ALAS]</i>)	
- Feature engineered 4-electrode EEG & ECG wearables features using R	
- Developed and tuned a ML algorithm that predicted mental fatigue via Python	
- Optimized to use the least amount of non-linear combined features (2) (93% accuracy)	
Interest in STEM Prediction - <i>Tecnológico de Monterrey</i>	2021
(<i>Talent and Passion Detection Through Biometrics</i>)	
- Trained ML regression models with biometrics (EEG, ECG, and CV emotions)	
- Predicted change in vocational interest after a STEM lecture using Python	
- Validated the algorithm with STEM-CIS ground-truth psychometric test (80% accuracy)	

MEMBERSHIPS

SACNAS	Mar 2024 - Mar 2025
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AUDITED COURSES

Harvard - Department of Psychology	
PSY 3340 Research Seminar in Cognition, Brain, and Behavior - <i>T. Ullman</i>	Spring 2024
PSY 1322 The Cognitive Science of Making Up Your Mind - <i>T. Ullman</i>	Spring 2024
MIT - Department of Brain and Cognitive Sciences (BCS)	
9.014 Quantitative Methods and Computational Models in Neuroscience - <i>M. Jazayeri</i>	Fall 2023
9.66 Computational Cognitive Science - <i>J. Tenenbaum</i>	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 - <i>Crystal System</i>	(150 h) 2022
(Workshop) Biosignal processing in Python - <i>Neuroengineering and Neuroacoustics</i>	2021
(Hackathon) HackMTY	2021
(Hackathon) B-Hack - <i>43th National Biomedical Engineering Congress</i>	2020
(Course) Systemic Change - <i>Ashoka</i>	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