

# Milton O. Candela-Leal

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[miltoncandela.github.io](https://miltoncandela.github.io)

## EDUCATION

- Tecnológico de Monterrey** - Monterrey, Mexico 2020 - Dec 2024  
BS in Biomedical Engineering (95/100 = 3.88/4.00 GPA)  
*Summa Cum Laude, Excellence Diploma, Borrego de Oro, International Diploma*
- 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  
*15<sup>th</sup> 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 *6<sup>th</sup> 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-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
- Ramírez-Arceo, G.A., **Candela-Leal, M.O.**, Tudon-Martínez, J.C., ... Ramírez-Moreno, M.A., (*under review*). Innovative Spaces With Advanced Technologies Such as Research Activity Simulators for Engineering Education
- Candela-Leal, M.O.**, Ramírez-Arceo, G.A., Ramírez-Moreno, M.A., ... Lozoya-Santos, J.J. (*under review*). Neurohumanities Lab as an Educational Immersive Virtual Reality Space
- 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

## 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) ( <b>student speaker award</b> ) | 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>51<sup>th</sup> Research and Development Congress</i> (Virtual)  | 2021 |

### Poster Presentations

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|---|------|
| FALCONS: Fetal Automatic Landmark Computation and Optimization for Neuroimaging Segmentation. <i>27<sup>th</sup> International Conference on MICCAI</i> (Marrakesh, Morocco)            | 2024 |
| Real-time Dual-feature Mental Fatigue State SVM Classification using EEG Delta Bandpower. <i>19<sup>th</sup> 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>43<sup>rd</sup> Annual Conference of the IEEE-EMBS</i> (Virtual)	2021
ALAS: Advanced Learner Assistance System for Engineering Education using Wearable Sensors. <i>43<sup>rd</sup> 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>24<sup>th</sup> Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2024
Biometric Cabin with Portable Real-Time Monitoring Technology for Smart Solutions. At the <i>21<sup>st</sup> Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2023
Neurohumanities Lab. At the <i>21<sup>st</sup> Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2023
Comparison of Brain Synchronization between Pairs during Collaborative and Competitive Tasks. At the <i>21<sup>st</sup> 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>20<sup>th</sup> 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>20<sup>th</sup> Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2022
Digital Twin Office for Workspace Throughput Monitoring. At the <i>19<sup>th</sup> Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2022
Biomechanics For the Digital Twin of Performance. At the <i>19<sup>th</sup> Expo Ingenierías</i> , Tecnológico de Monterrey (Monterrey, Mexico)	2022
Advanced Learner Assistance System. At the <i>19<sup>th</sup> 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>18<sup>th</sup> Expo Ingenierías</i> (Virtual)	2021
Real-time Biofeedback System for Interactive Learning using Wearables and IoT. At the <i>18<sup>th</sup> Expo Ingenierías</i> (Virtual)	2021
Biomechanics for the Digital Twin of Performance. At the <i>18<sup>th</sup> Expo Ingenierías</i> (Virtual)	2021
Advanced Learner Assistance System (ALAS) for Engineering Education using Wearable Sensors. At the <i>17<sup>th</sup> Expo Ingenierías</i> (Virtual)	2021

## HONORS AND AWARDS

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

## TEACHING

German A2 Teacher, Mentoor 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: <a href="#">They receive recognition for their AI learning project and take it to Amsterdam!</a>	2024
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## SKILLS SUMMARY

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

## PROJECTS

<b>Closed-loop BCI for Attention</b> - <i>Tecnológico de Monterrey</i>	2024
<ul style="list-style-type: none"><li>- Real-time analog haptic neurofeedback when the model predicts low attention</li><li>- Collected 4-channel EEG CPT-II data, further validated using a 12-min video</li><li>- Trained a 3-feature MLR model that predicted attention continuously (0.72 <math>R^2</math>)</li></ul>	
<b>FeTA Challenge @ MICCAI</b> - <i>Harvard Medical School</i>	2024
<ul style="list-style-type: none"><li>- 7-label dataset (CSF, GM, WM, Ventricles, Cerebellum, Deep GM, Brainstem)</li><li>- Pre-processed multi-site data; evaluated model zoo performance on in-house data</li><li>- Trained a MRI U-Net model with spatial and resolution augmentation (0.76 Dice)</li></ul>	
<b>High-res Fetal Subplate Segmentation</b> - <i>Harvard Medical School</i>	2024
<ul style="list-style-type: none"><li>- Upsampled, aligned, and corrected subplate segmentation in a higher resolution</li><li>- Implemented Bivariate Gaussian Smoothing (BGS) for step-like borders</li><li>- Trained a MRI U-Net leveraged by transfer-learning for segmentation (0.98 Dice)</li></ul>	
<b>Non-linear qMRI for CHD Classification</b> - <i>Harvard Medical School</i>	2024
<ul style="list-style-type: none"><li>- Designed Recursive RF importance (RRFi) for feature selection (20,453)</li><li>- Discovered and proposed new biomarkers in fetal CHD brain identification</li><li>- Created a 5-feature kNN model with 0.88 F1-score (0.10 better than baseline)</li></ul>	
<b>Real-time Emotion Recognition</b> - <i>Tecnológico de Monterrey</i> ( <i>Neurohumanities Lab</i> )	2022-2023
<ul style="list-style-type: none"><li>- Reduced 32-channel DEAP dataset dimensionality into optimal config</li><li>- Designed a channel selection pipeline using lobe-based PCA and RF</li><li>- Created an 8-channel EEG VAD 15 emotion recognition model (94% accuracy)</li></ul>	
<b>Cognitive Load Dynamics in Chess</b> - <i>Tecnológico de Monterrey</i>	2023
<ul style="list-style-type: none"><li>- Designed, led, and processed 37 chess players under ambient/white noise</li><li>- Calculated Task Completion Time (TCT) based on EEG biomarker theta C4</li><li>- Validated TCT with Cognitive Load Theory (CLT), stratifying by chess level</li></ul>	
<b>Digital Twin of the Workspace</b> - <i>Tecnológico de Monterrey</i>	2022
<ul style="list-style-type: none"><li>- Designed a throughput monitoring system via Human Action Recognition (HAR)</li><li>- Integrated Velodyne LiDAR pointcloud with CV tracking using CCTV footage</li><li>- Fitted a RNN HAR model (Walking, Running, Jumping) using CV human keypoints</li></ul>	

<b>Brain on Acting</b> - <i>University of Houston</i>	2022
<ul style="list-style-type: none"> <li>- Recorded a play using 32-electrode EEG on two actors and the director</li> <li>- Calculated bispectrum signal for the combination of pairs using MATLAB</li> <li>- Assessed the difference in moments of gaze via Wilcoxon Rank-Sum Test</li> </ul>	
<b>Biomechanical Force Prediction</b> - <i>Tecnológico de Monterrey</i>	2021-2022
<i>(Biomechanics for the Digital Twin)</i>	
<ul style="list-style-type: none"> <li>- Used OpenPose API and DLT to markerless track an individual's joints</li> <li>- Predicted the force exerted by using raw human pose keypoints</li> <li>- Designed and trained an RNN using Tensorflow and Keras in Python (0.92 <math>R^2</math>)</li> </ul>	
<b>Mental Fatigue Prediction</b> - <i>Tecnológico de Monterrey</i>	2021
<i>(Advanced Learner Assistance System [ALAS])</i>	
<ul style="list-style-type: none"> <li>- Feature engineered 4-electrode EEG &amp; ECG wearables features using R</li> <li>- Developed and tuned a ML algorithm that predicted mental fatigue via Python</li> <li>- Optimized to use the least amount of non-linear combined features (2) (93% accuracy)</li> </ul>	
<b>Interest in STEM Prediction</b> - <i>Tecnológico de Monterrey</i>	2021
<i>(Talent and Passion Detection Through Biometrics)</i>	
<ul style="list-style-type: none"> <li>- Trained ML regression models with biometrics (EEG, ECG, and CV emotions)</li> <li>- Predicted change in vocational interest after a STEM lecture using Python</li> <li>- Validated the algorithm with STEM-CIS ground-truth psychometric test (80% accuracy)</li> </ul>	

## MEMBERSHIPS

SACNAS	Mar 2024 - Mar 2025
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## AUDITED COURSES

<b>Harvard - Department of Psychology</b>	
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
<b>MIT - Department of Brain and Cognitive Sciences (BCS)</b>	
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

<b>MIT - Department of Brain and Cognitive Sciences (BCS)</b>	
(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
<b>Tecnológico de Monterrey</b>	
(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>43<sup>th</sup> National Biomedical Engineering Congress</i>	2020
(Course) Systemic Change - <i>Ashoka</i>	2020

## COURSERA SPECIALIZATIONS

<b>Johns Hopkins University</b>	
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
<b>University of Michigan</b>	
Applied Data Science with Python	(145 h) 2021
<b>DeepLearning.AI</b>	
AI for Medicine	(72 h) 2021
<b>Imperial College London</b>	
Infectious Disease Modelling	(65 h) 2021
<b>Alberta Machine Intelligence Institute</b>	
Machine Learning: Algorithms in the Real World	(41 h) 2020
<b>IBM - edX</b>	

Fundamentals of AI	(80 h) 2020
<b>Rice University</b>	
Fundamentals of Immunology	(69 h) 2020
<b>University of Colorado System</b>	
Applied Cryptography	(34 h) 2020
<b>University System of Georgia</b>	
Six Sigma Green Belt	(49 h) 2020
<b>Duke University</b>	
Excel to MySQL: Analytic Techniques for Business	(109 h) 2021