Milton O. Candela-Leal

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Education

Tecnológico de Monterrey - Monterrey, Mexico 2020 - Dec 2024
BS in Biomedical Engineering (96/100 = 3.9/4.0 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

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 bisprectrum 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

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 3rd IFE-WS (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 North American 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., ... Ramírez-Moreno, M.A. (2021). Detecting Change in Engineering Interest in Children through Machine Learning using Biometric Signals. In 1st IFE-WS (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 1st IFE-WS (pp. 26-33). Monterrey, Mexico: IEEE. doi:10.1109/IEEECONF53024.2021.9733770

Invited Talks

Candela-Leal, M.O. (2024, September). Decoding Cognitive Performance: From Chess Puzzles to STEM Classrooms. Presented to senior undergraduate students at Cognitive Neuroscience minor, Tecnológico de Monterrey, Monterrey, Mexico [slides]

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]

Working Papers

Ramírez-Moreno, M.A., Romero-Días, D.C., **Candela-Leal, M.O.**, ... Lozoya-Santos, J.J. (*submitted*). Workplace Measures of Mental Fatigue.

Candela-Leal, M.O., Alanis-Espinosa, M., Murrieta-González, J., ... Ramírez-Moreno, M.A. *(submitted)*. Neurocognitive Insights into STEM Learning: An Integrated Analysis of Bandpower and Functional Connectivity among Youth

Ramírez-Arceo, G.A., **Candela-Leal, M.O.**, Tudon-Martinez, J.C., . . . Ramírez-Moreno, M.A., (*submitted*). Innovative Spaces With Advanced Technologies Such as Research Activity Simulators for Engineering Education

Candela-Leal, M.O., Lozoya-Santos, J.J., Ramírez-Moreno, M.A. (*in prep*). Task Completion Time Estimation via EEG Theta Bandpower during Chess-Based Problem-Solving

Presentations

Oral Presentations

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) **(student speaker award)** 2024

High-resolution Fetal Subplate Automatic Segmentation. *FNNDSC Research Symposium*, Boston Children's Hospital (Boston, MA) 2024

CHD Fetal Brain Analysis using Combined Quantitative MRI Features and Custom-build Loss Functions. *FNNDSC Research Symposium*, Boston Children's Hospital (Boston, MA) 2024

Biomechanics for the Digital Twin of Performance: Study Cases. *Conscious Technologies for Smart Communities Workshop* (Virtual) 2021

Harry Potter and the Prisoner of Azkaban (2004), a Cultural and Ideological Instructor of the Millennial Viewer. *51th Research and Development Congress* (Virtual) 2021

Poster Presentations

FALCONS: Fetal Automatic Landmark Computation and Optimization for Neuroimaging Segmentation. *27th Conference on MICCAI* (Marrakesh, Morocco) 2024

Real-time Dual-feature Mental Fatigue State SVM Classification using EEG Delta Bandpower. *19th IEEE-EMBS Conference on BSN*, MIT Media Lab (Boston, MA) 2023

Talent Detection Tool for Early Engineering Education. *NSF IUCRC BRAIN 2023 Annual Meeting*, Arizona State University (Phoenix, AZ) 2023

Human Machine Interface for Fleet Electric Vehicles. *NSF IUCRC BRAIN 2023 Annual Meeting*, Arizona State University (Phoenix, AZ) 2023

Biometric Cabin for Neurohumanities Lab. *NSF IUCRC BRAIN 2023 Annual Meeting*, Arizona State University (Phoenix, AZ) 2023

Digital Twin modeling for Human Biomechanics and Office Spaces. *NSF IUCRC BRAIN 2022 Annual Meeting*, University of Houston (Houston, TX) 2022

Brain on Acting: Neural Dynamics of Actor-Actor Dyads During an Acted Scene. *NSF IUCRC BRAIN 2022 Annual Meeting*, University of Houston (Houston, TX) 2022

Identifying Engineering Interest in Children through Machine Learning using Biometric Signals. *43rd Annual Conference of the IEEE-EMBS* (Virtual) 2021

ALAS: Advanced Learner Assistance System for Engineering Education using Wearable Sensors. *43rd Annual Conference of the IEEE-EMBS* (Virtual) 2021

Digital Twin of Biomechanics: Joint Force Prediction using Video and AI. At the *NSF IUCRC BRAIN 2021 Annual Meeting* (Virtual) 2021

NON-INTERNATIONAL PRESENTATIONS

Poster Presentations

Closed-Loop BCI with Haptic Feedback and SINDy Algorithm for Attention Support in ADHD Students. At the *24th Expo Ingenierías*, Tecnológico de Monterrey (Monterrey, Mexico) 2024

Biometric Cabin with Portable Real-Time Monitoring Technology for Smart Solutions. At the *21st Expo Ingenierías*, Tecnológico de Monterrey (Monterrey, Mexico) 2023

Neurohumanities Lab. At the *21st Expo Ingenierías*, Tecnológico de Monterrey (Monterrey, Mexico) 2023

Comparison of Brain Synchronization between Pairs during Collaborative and Competitive Tasks. At the *21st Expo Ingenierías*, Tecnológico de Monterrey (Monterrey, Mexico) 2023

Real-Time Knee Flexion Angle for Anterior Cruciate Ligament Injury using Computer Vision. At the *BMEX: Engineering and Health Sciences Symposium*, Tecnológico de Monterrey (Monterrey, Mexico) 2023

Advanced Learner Assistance System (ALAS). At the *20th Expo Ingenierías*, Tecnológico de Monterrey (Monterrey, Mexico) 2022

Real-Time Knee Flexion Angle for Anterior Cruciate Ligament Injury using Computer Vision. At the *20th Expo Ingenierías*, Tecnológico de Monterrey (Monterrey, Mexico) 2022

Digital Twin Office for Workspace Throughput Monitoring. At the *19th Expo Ingenierías*, Tecnológico de Monterrey (Monterrey, Mexico) 2022

Biomechanics For the Digital Twin of Performance. At the *19th Expo Ingenierías*, Tecnológico de Monterrey (Monterrey, Mexico) 2022

Advanced Learner Assistance System. At the *19th Expo Ingenierías*, Tecnológico de Monterrey (Monterrey, Mexico) 2022

Detection of Engineering Interest in Children Through an Intelligent System Using Biometric Signals. At the *18th Expo Ingenierías* (Virtual) 2021

Real-time Biofeedback System for Interactive Learning using Wearables and IoT. At the *18th Expo Ingenierías* (Virtual) 2021

Biomechanics for the Digital Twin of Performance. At the *18th Expo Ingenierías* (Virtual) 2021

Advanced Learner Assistance System (ALAS) for Engineering Education using Wearable Sensors. At the *17th Expo Ingenierías* (Virtual) 2021

HONORS AND AWARDS

Diploma of Excellence Award (5% 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
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 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

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, TochIO, 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

FeTA Challenge @ MICCAI - *Harvard Medical School* 2024
- 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, intensity and resolution augmentation

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 a MRI 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

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

Cognitive Load Dynamics in Chess - *Tecnológico de Monterrey* 2023
- 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 - *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