

# Milton O. Candela-Leal

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## EDUCATION

<b>Tecnológico de Monterrey</b> - Monterrey, Mexico BS in Biomedical Engineering (94.5/100 = 3.8/4.0 GPA)	Aug 2020 - Dec 2024
<b>International Baccalaureate</b> - Monterrey, Mexico Math HL, Psychology SL, Physics SL, ... Thesis: <i>Harry Potter and the Prisoner of Azkaban</i> (2004), a Cultural and Ideological Instructor of the Millennial Viewer	Aug 2018 - May 2020

## RESEARCH EXPERIENCE

<b>Boston Children's Hospital</b> - Boston, MA, USA <i>Harvard Medical School</i> Advisor: Kiho Im, Ph.D. Project: <i>High-res Fetal Subplate Segmentation</i> <i>Unsupervised VAE-GAN for Anomaly</i> <i>Non-linear qMRI for CHD Classification</i>	Aug 2023 - Aug 2024
<b>NSF IUCRC BRAIN Center</b> - Monterrey, Mexico TMX BRAIN Site - <i>Tecnológico de Monterrey</i> Advisor: Mauricio A. Ramírez-Moreno, Ph.D. Project: <i>Advanced Learner Assistance System (ALAS)</i> <i>Talent and Passion Detection Through Biometrics</i> <i>Biomechanics for the Digital Twin</i> <i>Neurohumanities Lab</i> <i>Digital Twin of the Workspace</i>	Mar 2021 - Jul 2023
<b>NSF IUCRC BRAIN Center</b> - Houston, TX, USA UH BRAIN Site - <i>University of Houston</i> Advisor: Jose L. Contreras-Vidal, Ph.D. Project: <i>Brain on Acting</i>	Spring 2022

## 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, 1319574 [\[paper\]](#)
- Candela-Leal, M.O.**, Gutiérrez-Flores, E.A., Presbítero-Espinoza, 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-Espinoza, 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-Espinoza, 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.**, ... Ramírez-Mendoza, R.A. (2022). "Current and Future Biometrics: Technology and Applications." In R.A. Ramírez-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

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- 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. *15<sup>th</sup> 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 *6<sup>th</sup> North American Industrial Engineering and Operations Management (IEOM)* (pp. 2959-2970). Monterrey, Mexico: IEOM (**best undergraduate paper award**) [\[paper\]](#) [\[award\]](#)
- 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

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- Candela-Leal, M.O.** (2023, April). Computer Vision and Facial Recognition [Invited talk]. Presented to Senior Undergraduate Computer Science Students in *Computing Seminar* at the Universidad Autónoma de Nuevo León, Monterrey, Mexico [\[certificate\]](#) [\[slides\]](#)

## CONTRIBUTED TALKS

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- Candela-Leal, M.O.** (2021, July). Biomechanics for the Digital Twin of Performance: Study Cases [Contributed talk]. Presented at the *Conscious Technologies for Smart Communities Workshop*, Monterrey, Mexico [\[certificate\]](#) [\[slides\]](#)
- Candela-Leal, M.O.** (2021, February). Harry Potter and the Prisoner of Azkaban (2004), a Cultural and Ideological Instructor of the Millennial Viewer [Contributed talk]. Presented at the *51<sup>th</sup> Research and Development Congress: International Baccalaureate Extended Essay Session*, Monterrey, Mexico [\[certificate\]](#) [\[slides\]](#)

## ABSTRACTS

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- 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
- Tafaya-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 *19<sup>th</sup> 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 43<sup>rd</sup> Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC) (p. 5101). <https://embc.embs.org/2021> [\[abstract\]](#)
- Olivas-Martínez, 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 43<sup>rd</sup> Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC) (p. 5244). <https://embc.embs.org/2021> [\[abstract\]](#)

## PROJECTS

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|--|------------------------|
| <b>High-res Fetal Subplate Segmentation</b> - ( <i>Harvard Medical School</i> )  | Spring 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 boundaries</li> <li>- Trained an U-Net leveraged by transfer-learning for automatic segmentation</li> </ul>  |                        |
| <b>Non-linear qMRI for CHD Classification</b> - ( <i>Harvard Medical School</i> )  | Spring 2024            |
| <ul style="list-style-type: none"> <li>- Designed Recursive RF importance (RRFi) for feature selection (20,453)</li> <li>- Created a 5-feature kNN model with 0.88 F1-score (0.10 better than baseline)</li> <li>- Discovered and proposed new biomarkers in fetal CHD brain identification</li> </ul>   |                        |
| <b>Unsupervised VAE-GAN for Anomaly</b> - ( <i>Harvard Medical School</i> )  | Spring 2024            |
| <ul style="list-style-type: none"> <li>- Trained an age-informed GAN model in typically developed fetal brains</li> <li>- Detected abnormalities in Ventriculomegaly (VM) fetal subjects (AUC = 90%)</li> <li>- Designed a novel age encoding: Bidirectional Ordinary Encoding (BOE)</li> </ul>  |                        |
| <b>Real-time Emotion Recognition</b> - ( <i>TMX BRAIN Site</i> ) <a href="#">[journal]</a>   | Fall 2022, Spring 2023 |
| <i>(Neurohumanities Lab)</i> <ul style="list-style-type: none"> <li>- Created an 8-channel EEG-based VAD 15 emotion recognition model</li> <li>- Designed a channel selection pipeline using lobe-based PCA and RF</li> <li>- Reduced 32-channel DEAP dataset dimensionality into optimal OpenBCI config</li> </ul>  |                        |
| <b>Digital Twin of the Workspace</b> - ( <i>TMX BRAIN Site</i> ) <a href="#">[internal poster]</a>   | Spring 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>UH BRAIN Site</i> ) <a href="#">[internal poster]</a>  | Spring 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>Mental Fatigue Prediction</b> - ( <i>TMX BRAIN Site</i> ) <a href="#">[journal]</a> <a href="#">[proceeding]</a> <a href="#">[poster]</a>   | Spring, Fall 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>- Used the least amount of combined features (2) to achieve high accuracy (93%)</li> </ul>       |                        |
| <b>Biomechanical Force Prediction</b> - ( <i>TMX BRAIN Site</i> ) <a href="#">[journal]</a> <a href="#">[proceeding]</a>   | Spring, Fall 2021      |
| <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>- Designed and trained an RNN using Tensorflow and Keras in Python</li> <li>- Predicted the force exerted by using raw human pose keypoints</li> </ul>   |                        |
| <b>Interest in STEM Prediction</b> - ( <i>TMX BRAIN Site</i> ) <a href="#">[proceeding]</a>  | Fall 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 with STEM-CIS psychometric test, the algorithm achieved 80% accuracy</li> </ul> |                        |

## HONORS AND AWARDS

Outstanding Student Award (top 1% best engineering trajectories)	2023
1 <sup>st</sup> Place - Research and Improvement Proposals at 18 <sup>th</sup> Conexión Tec	Fall 2021
1 <sup>st</sup> Place - Undergraduate Paper Competition at 6 <sup>th</sup> NA IEOM	2021
Outstanding IB Extended Essay - 51 <sup>th</sup> Research and Development Congress	2021
Scholarship for Academic Talent - <i>Tecnológico de Monterrey</i>	2020
2 <sup>nd</sup> Place - Nuevo León State Chess Tournament (Youth Category)	2020

## TEACHING

German A2 Teacher - <i>Mentoor</i>	2022-2023
Middle School Math and Spanish Teacher - <i>Aprendamos Juntos</i>	2021-2022
Independent High School Physics Teacher	Fall 2019
FIRST® LEGO® League Mentor - <i>Little Minds</i>	Spring 2019

## SKILLS SUMMARY

<b>Languages</b>	Python (3 years), MATLAB (2 years), R (1 year), SQL (3 months) English (C1), German (B1), Spanish
<b>Frameworks</b>	Numpy, Scipy, Matplotlib, Pandas, Scikit-learn, TensorFlow, Keras, BrainFlow, Flask Lattice, Dplyr, TidyR, Caret, GA, Ggplot, Shiny
<b>Tools</b>	FSL, FreeSurfer, MRtrix3, ANTs, NiBabel, PyDicom, IRTK GitHub, Anaconda, CUDA, cuDNN, Tableau, Microsoft Excel, Overleaf, $\text{\LaTeX}$
<b>Platforms</b>	Linux, ROS, Windows, Arduino, Raspberry
<b>Soft Skills</b>	Leadership, Problem Solving, Teamwork, Self-Learning, Time Management

## COURSERA SPECIALIZATIONS

Data Science - <i>Johns Hopkins University</i> (288 h)	2021
Applied Data Science with Python - <i>University of Michigan</i> (145 h)	2021
AI for Medicine - <i>DeepLearning.AI</i> (72 h)	2021
Infectious Disease Modelling - <i>Imperial College London</i> (62 h)	2021
Neuroscience and Neuroimaging - <i>Johns Hopkins University</i> (42 h)	2020
Machine Learning: Algorithms in the Real World - <i>Alberta Machine Intelligence Institute</i> (41 h)	2020

## AUDITED COURSES

### 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

### Harvard - Psychology Department

PSY 3340 Research Seminar in Cognition, Brain, and Behavior - <i>T. Ullman</i>	Spring 2024
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