THE UNIVERSITY OF TEXAS AT EL PASO
INDUSTRIAL, MANUFACTURING & SYSTEMS ENGINEERING

ARTIFICIAL INTELLIGENCE

APPLICATIONS & IMPLICATIONS

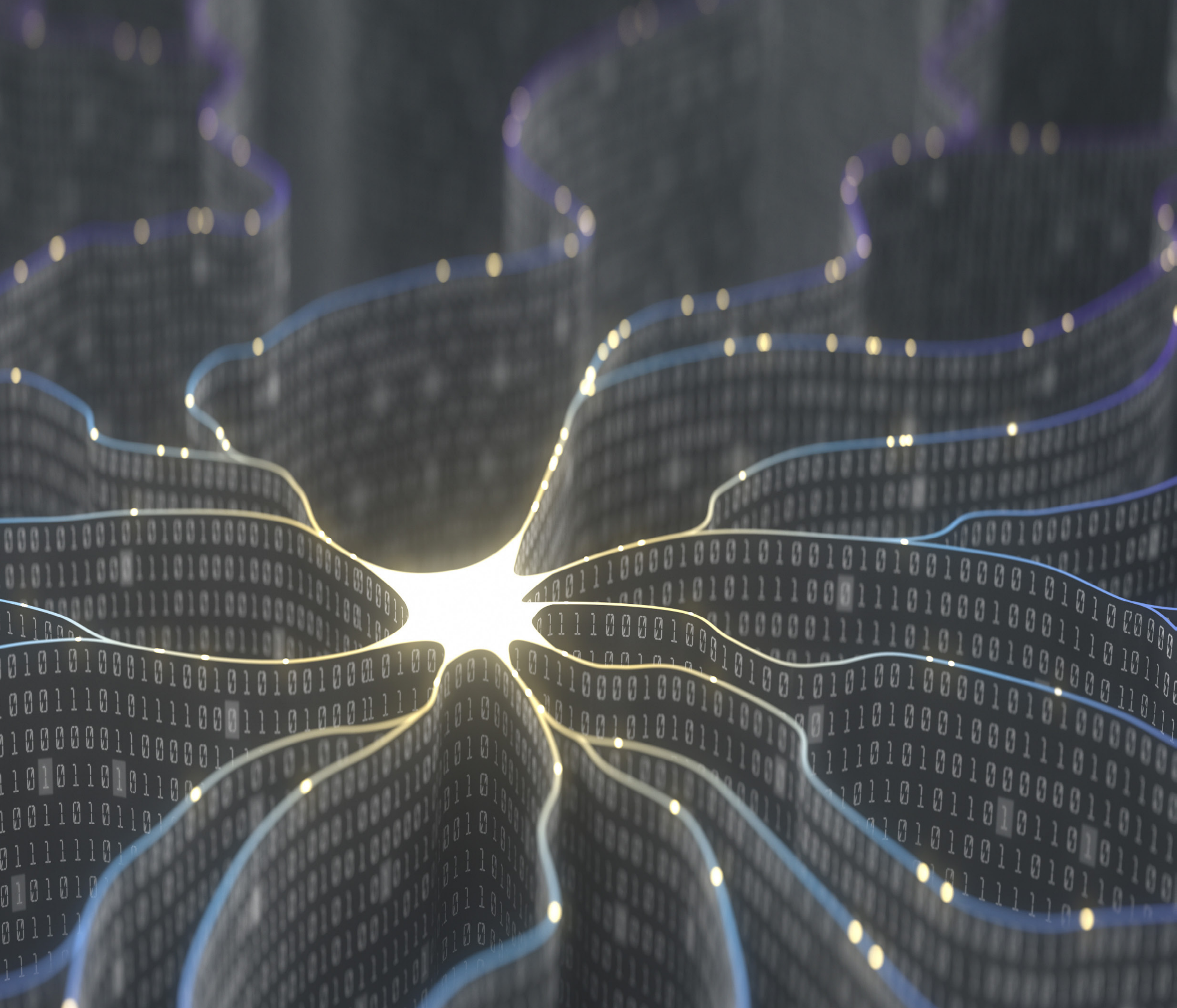
IMSE DAY 2023

EL PASO NATURAL GAS CONFERENCE CENTER

APRIL 19, 2023

8:30 AM TO 5:00 PM

Open to all students and faculty



WELCOME TO THE ARTIFICIAL INTELLIGENCE IMSE DAY CELEBRATED AT UTEP

On behalf of the Industrial, Manufacturing and Systems Engineering (IMSE) department at The University of Texas at El Paso, it is our great pleasure to welcome you to IMSE Day 2023! We are delighted to be celebrating this event with you, and we hope that today's theme of "Artificial Intelligence: Applications and Implications" will spark new ideas and collaborations within the field.

IMSE provides a wide range of academic opportunities, and this event is a testament to our commitment to interdisciplinary research fields. By focusing on the practical applications of Artificial Intelligence, we hope to highlight the potential that these technologies can offer to various industries and organizations.

This event will bring together researchers, practitioners, and industry leaders to exchange insights, share ideas, and collaborate on new projects. Our goal is to develop innovative AI solutions that have a real-world impact and improve the quality of life for individuals and society. We strongly believe in the potential of AI to drive change in fields such as healthcare, simulation, transportation, and manufacturing.

We encourage you to take advantage of this unique opportunity to network, share your insights, and gain a deeper understanding of AI applications within IMSE. Together, let's shape the future of AI and drive innovative solutions!

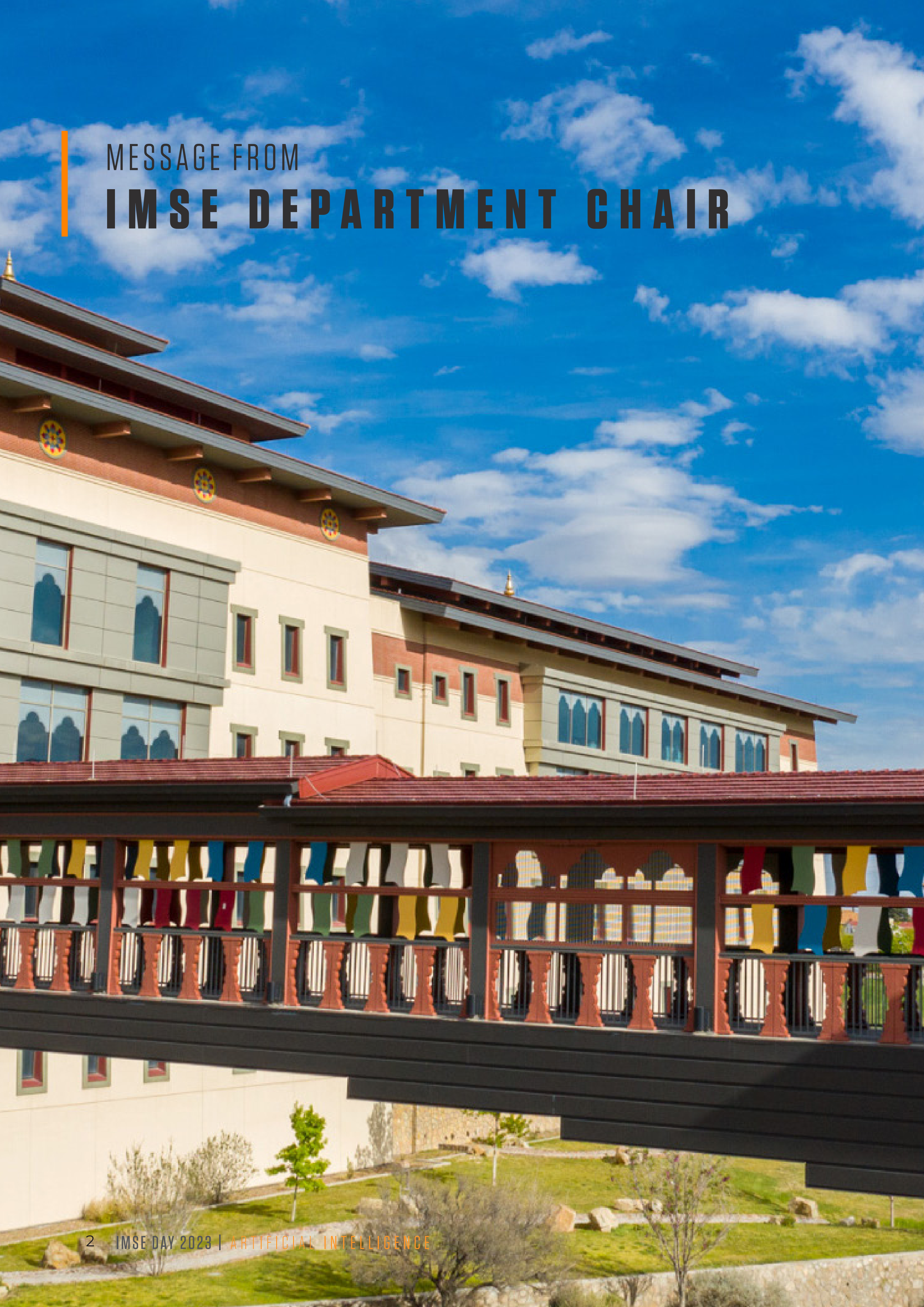
Md Fashiar Rahman, Ph.D.
Assistant Professor, IMSE

IMSE DAY 2023 | ARTIFICIAL INTELLIGENCE

CONTENT

MESSAGE FROM

IMSE DEPARTMENT CHAIR



Welcome to the Industrial, Manufacturing, and Systems Engineering [IMSE] Day in Artificial Intelligence

It is my pleasure to welcome you all to our annual IMSE Day event. The event brings together industry leaders and subject-matter expert panelists to share their valuable insights on Artificial Intelligence technologies, Digital Engineering, Machine Learning, and active collaborations needed among industry leaders, researchers from academia, and workforce development institutes, for broader AI adoption.

As we witness the continuous growth and advancement in AI technologies, we can see that many applications are being enabled in various fields such as healthcare, transportation, surveillance, military, and first responders. The manufacturing industry has seen a lot of advancement over the years, and this calls for even more innovation and development in Artificial Intelligence technologies. At UTEP, our academic work emphasizes experiential learning for students from the El Paso-Cd. Juarez region. Events like IMSE Day provide students with an opportunity to develop leadership and networking abilities, which will be critical in their future careers.

I would like to thank all the speakers and presenters and most importantly, all the students and staff who have participated in making this annual event a success. I encourage all the student community and those attending this event to see this as a networking opportunity and build professional relationships which will enhance your personal, networking, and professional growth. I invite you to also send us your valuable suggestions and feedback on the event to help us organize a better event in the future.

Dr. Tzu-Liang (Bill) Tseng

CHAIR- DEPARTMENT OF INDUSTRIAL, MANUFACTURING & SYSTEMS ENGINEERING (IMSE)
DIRECTOR- RESEARCH INSTITUTE OF MANUFACTURING AND ENGINEERING SYSTEMS (RIMES)

OUR DEPARTMENT

GENERAL OVERVIEW

The Department of Industrial, Manufacturing and Systems Engineering (IMSE) strives to graduate industrial, manufacturing and systems engineers of the highest quality and to conduct state-of-the-art research from an end-to-end enterprise point of view.

The Industrial, Manufacturing and Systems Engineering Department at The University of Texas at El Paso plays a vital role in providing innovative solutions to complex problems across various industries such as manufacturing, transportation, technology, healthcare, agriculture, aerospace, and supply chain management. With a mission to advance the field of engineering and address pressing societal issues, the department offers innovative research and education opportunities to its students.

The IMSE Department offers a bachelor's degree in industrial & Systems Engineering (ISE) and three Master of Science (MS) programs in Industrial Engineering, Manufacturing Engineering, and Systems Engineering. The curriculum of these programs is designed to equip students with a deep understanding of the fundamentals of engineering, including mathematics, science, and technology, as well as practical skills in problem-solving, analysis, and design. The department also offers an online MS program in Systems Engineering to provide greater flexibility to students pursuing higher education.

In addition to its academic and research programs, the ISE Department is committed to providing students with opportunities for experiential learning, including internships, co-op programs, and research projects. The department also hosts seminars, workshops, and conferences that provide students with access to leading experts in the field of engineering.

Overall, IMSE is an essential contributor to the advancement of engineering and the advancement of society. Its commitment to interdisciplinary collaboration, innovative research, and experiential learning prepares students for successful careers in a range of industries and positions them to make a positive impact in the world.

Industrial, Manufacturing, and Systems Engineering

MISSION

- To make a high quality, relevant engineering education available to all residents of the Paso del Norte bi-national region.
- To provide students with a set of skills, knowledge, and attitudes that will permit them to succeed and thrive as engineers and leaders.
- To prepare its graduates to pursue life-long learning, serve the profession and meet intellectual, ethical and career challenges.
- To maintain vital, state-of-the-art research to provide its students and faculty with opportunities to create, interpret, apply and disseminate knowledge for the end-to-end enterprise.

CENTERS AND ACTIVE RESEARCH LABS ASSOCIATED WITH THE DEPARTMENT

RESEARCH INSTITUTE FOR MANUFACTURING & ENGINEERING SYSTEMS (RIMES) - RIMES was created in 1995 as the Institute for Manufacturing and Materials Management (IM3). We have recently renamed the Institute while maintaining its focus on Manufacturing and Materials Management. The institute has also evolved and taken the lead in focusing on the research of new knowledge of systems and its applications to Manufacturing and Engineering Systems. As part of The University of Texas at El Paso, the Institute is committed to education. Members of the RIMES teach classes, sponsor research at the University, and are encouraged to participate in seminars, conferences and lectures The institute has a long history of collaboration with private industry. We are committed to continue and expand this synergy.

TEXAS MANUFACTURING ASSISTANCE CENTER (TMAC) - TMAC's mission is to increase the global competitiveness of the Texas economy by working to grow the extended manufacturing enterprise.TMAC works with you to make your company more efficient, whether it is energy efficiency, quality issues, or supply chain, we will give you the customized solutions to have the competitive edge, discover financial opportunities and grow your business.

PROGRAM COMMITTEE

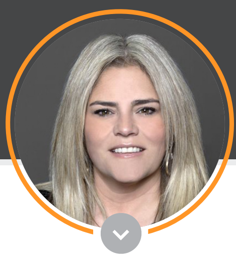
BILL TSENG, PH.D.
IMSE CHAIR | RIMES DIRECTOR

SERGIO A. LUNA, PH.D.
ASSISTANT PROFESSOR

HONGLUN XU H, PH.D.
RESEARCH ASSISTANT PROFESSOR

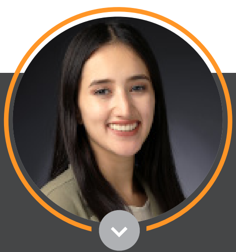
MD FASHIAR RAHMAN, PH.D.
ASSISTANT PROFESSOR

ANAIS ACOSTA
BRANDING MANAGER, COLLEGE OF ENGINEERING

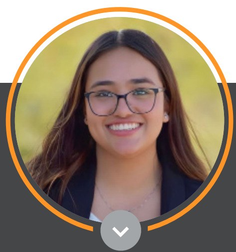


RENE DOMINGUEZ
IMSE PROGRAM MANAGER/ COORDINATOR

DANA ZAMORANO
UTEP CHAPER APM CHAPTER, OFFICER



LAURA C. TOVAR
UTEP STUDENT IISE CHAPTER, PRESIDENT



JESUS A. GUTIERREZ
UTEP STUDENT IISE CHAPTER, OFFICER

SOLAYMAN EMON
UTEP STUDENT, DOCTORAL RA

BRIANA CARDENAS
UTEP STUDENT APM CHAPTER, PRESIDENT

KAREN D. GONZALEZ
UTEP STUDENT IISE CHAPTER, OFFICER

MD. FAZLE RABBI
UTEP STUDENT, MASTERS RA

COLLEGE OF ENGINEERING

INDUSTRIAL, MANUFACTURING & SYSTEMS ENGINEERING

310 STUDENT ENROLLMENT

140 TOTAL DEGREES CONFERRED

8 (T/TT) FACULTY

FALL2022

DEGREES CONFERRED AY 2021-22

(FALL 21, SP22 & SU 22)

Bachelor of Science (B.S.)	**50**
Industrial & Systems Engineering	50
Master of Science (M.S.)	**86**
Industrial Engineering	15
Manufacturing Engineering	14
Systems Engineering	49
Systems Engineering - AT&T	8
Interdisciplinary Master's	**1**
Computational Science	1

i. Students with a Thesis Advisor from Industrial, Manufacturing & Systems Engineering

Interdisciplinary Ph.D.	**3**
Computational Science	1
Environmental Science and Engineering	2

i. Students with a Thesis Advisor from the College of Engineeering

FALL 2020 ENROLLMENT

Undergraduate	**162**
Industrial & Systems Engineering	137
Industrial Engineering	2
Lower Division Industrial Engineering	23
Master's	***148**
Industrial Engineering	26
Manufacturing Engineering	13
Systems Engineering	104
Systems Engineering – AT&T	5

*These numbers do not include certificates, only actual degrees.

FACULTY AS OF FALL 2020

Total	**8**
Tenured	5
Tenure-track	3
Faculty Rank (T/TT)	
Assistant	3
Associate	4
Professor	1
Gender (T/TT Faculty)	
Female	1
Male	7

STUDENTBODYPROFILE-DEGREES CONFERRED AY 2021-22

Ethnicity (UG)	50
Black Non-Hispanic	2.0%
Hispanic	68.0%
Mexican International	10.0%
Other International	16.0%
Two or more races	2.0%
White Non-Hispanic	2.0%
Gender (UG)	
Female = 40% Male = 60%	
Ethnicity (MS)	86
Black Non-Hispanic	3.4%
Hispanic	63.9%
Mexican International	19.8%
Other International	1.2%
Unknown	1.2%
White Non-Hispanic	10.5%
Gender (MS)	
Female = 31% Male = 69%	
Ethnicity(Master's Interdisciplinary)	1
Other International	100%
Gender (Master's Interdisciplinary)	
Female = 0% Male = 100%	
Ethnicity(Ph.D. Interdisciplinary)	
Mexican International	3
Other International	33.3%
Gender (Ph.D. Interdisciplinary)	66.7%
Female = 0% Male = 100%	

STUDENT BODY PROFILE - FALL 2020 ENROLLMENT

Ethnicity (UG)	162
Asian American	0.6%
Black Non-Hispanic	0.6%
Hispanic	77.8%
Mexican International	11.1%
Native American	1.2%
Other International	4.9%
Unknown	1.2%
White Non-Hispanic	2.6%
Gender (UG)	
Female = 37% Male = 63%	
Ethnicity (MS)	148
Asian American	2.0%
Black Non-Hispanic	3.4%
Hispanic	60.1%
Mexican International	16.2%
Other International	4.8%
Unknown	3.4%
White Non-Hispanic	10.1%
Gender (MS)	
Female = 27% Male = 73%	

PROGRAM AGENDA

IMSE DAY ARTIFICIAL INTELLIGENCE 2023

8:30AM - 9:00AM | COFFEE AND REGISTRATION

9:00AM - 9:15AM | OPENING REMARKS: ERIC MACDONALD, PH.D.

Associate Dean for Graduate Studies and Research | Aerospace and Mechanical Engineering Professor, ***The University of Texas at El Paso***

09:15AM - 10:00AM | DAVID LOGAN

Vice President of Quality and Mission Success, ***Lockheed Martin Aeronautics Company***

DISCUSSION TOPIC: Aircraft Quality in a Digitally Enabled Future (AI/ML, Digital Twins, and Flexible Inspection Systems)

10:10AM - 11:00AM | XIA HUANG, PH.D.

Algorithm Scientist, **VIDA Diagnostics Inc.**

DISCUSSION TOPIC: Applying Deep Learning in Lung CT Images: Opportunities and Challenges

11:10AM - 12:00PM | ANTONIO DEMARCO

Principal Data Scientist, ***Lockheed Martin Aeronautics Company***

DISCUSSION TOPIC: An Underdiscussed Topic of Ethics in Artificial Intelligence

12:00PM - 1:00PM | LUNCH / POSTER SESSION / APPLIED RESERACH

1:00PM - 1:50PM | SCOTT MOEN, PH.D.

Director of Health Innovations, ***The University of Texas Medical Branch at Galveston***

DISCUSSION TOPIC: The 5 Ws of Medical Entrepreneurship

2:00PM - 2:50PM | ZHENGTAO GAN, PH.D.

Assistant Professor of Aerospace and Mechanical Engineering Department

The University of Texas at El Paso

DISCUSSION TOPIC: Data-driven discovery of dimensionless numbers and governing laws from scarce measurements

3:00PM - 3:50PM | IMSE ALUMNI EXPERIENCES: HOW DID I GET HERE?

KATHLEEN A. ZURLINDEN, Systems Engineering Lead
Lockheed Martin Company

ABISAI RAMIREZ, Product Engineer
Cardinal Health

Carmen Almeraz, Process Engineer
Dell Technologies

Juan E. Apodaca, Manufacturing Engineer
DISH Network

DANIEL ALVILLAR, Election and Government Mail Services Field Specialist
USPS

JOSE LICON, Manager of In-Plant Support
USPS

4:00PM - 4:45PM | MD FASHIAR RAHMAN, PH.D.

Assistant Professor of Industrial, Manufacturing, and Systems Engineering Department, ***The University of Texas at El Paso***
DISCUSSION TOPIC: A risk-free way to explore complex systems using computer simulation and Artificial Intelligence.

4:50PM - 5:00PM | CLOSING REMARKS: BILL TSENG, PH.D., CMFGE

IMSE Chair & Professor, ***The University of Texas at El Paso***

SEMINAR 1

DAVID LOGAN

Vice President of Quality and Mission Success
Lockheed Martin Aeronautics Company

AIRCRAFT QUALITY IN A DIGITALLY ENABLED FUTURE (AI/ML, DIGITAL TWINS, AND FLEXIBLE INSPECTION SYSTEMS)

One hundred years of aviation design, manufacturing, and inspection tradecraft has built an industry foundation that is dependent on physical artifacts and reactive human-based assessments of quality. This approach is extremely costly and drives aircraft development cycles that are measured in decades. New digital capabilities for design modeling and simulation have now created the possibility for a five-year aircraft development cycle, but old habits and customer expectations die hard in the industry. Growing accessibility to new artificial intelligence and machine learning (AI/ML) techniques, advanced visualization, and the ability to evaluate model-based aircraft performance before a physical artifact is ever made will transform the industry. For Lockheed Martin to keep our customers Ahead of Ready, a conscious acceptance of radically evolving capabilities for people and processes must occur. This presentation will define the opportunity space, applications, and expectations for future aircraft programs to consider.

Mr. David Logan is the Vice President of Quality and Mission Success (Q&MS) for the Aeronautics sector of Lockheed Martin. He is responsible for ensuring adherence to the quality management system, process compliance, and product conformance in accordance with exceeding customer expectations.

Prior to his current role, Mr. Logan was responsible for all the Operations with Special Operations Forces Global Logistics Support Services (SOF GLSS). In this role, he was responsible for leading Production Operations, Quality, Global Supply Chain, and other support functions across the SOF GLSS enterprise. He was also responsible for driving positive customer relations, process innovation, and culture enhancement across the enterprise. Mr. Logan has also led various aspects of the Operations, Affordability Initiatives, and Continuous Improvement across multiple locations. He has held a wide range of operational leadership positions across multiple business areas within Lockheed Martin. Other highlights of Mr. Logan's experience include transforming Internal Supply Chain distribution processes while driving an effective common enterprise solution and applying LEAN principles to ensure a successful reduction of inventory levels while enabling PULL processes. Mr. Logan graduated with a bachelor's degree and a master's degree in Business Management from Dallas Baptist University.

LOCKHEED MARTIN

SEMINAR 2

XIA HUANG, PH.D.

Algorithm Scientist
VIDA Diagnostics Inc.

APPLYING DEEP LEARNING IN LUNG CT IMAGES: OPPORTUNITIES AND CHALLENGES

Deep learning (DL) has emerged as a powerful tool for medical image analysis, particularly in the field of lung CT imaging with the advancements in algorithms and computing power. The ability of DL algorithms to extract meaningful features from high-dimensional imaging data has led to significant advances in computer-aided diagnosis, disease pattern detection/segmentation, image generation, etc. However, the application of DL to lung CT images also presents several challenges, including data limitation and heterogeneity, class imbalance, and model generalizability and explain ability.

This talk provides a coarse overview of state-of-the-art DL applications on lung CT image analysis, highlighting the opportunities, challenges, and future directions and potential impacts while leveraging DL in lung CT images.

Dr. Xia Huang, algorithm scientist of R&D department at VIDA Diagnostics Inc, has over 8 years of experience in medical image processing and machine/deep learning targeting on pulmonary CT images. He has contributed to various algorithm designs and implementations to automate VIDA's existing biomarkers and explore new biomarkers with high accuracy, efficiency, and robustness. His automated deep learning-based lung and lobe segmentation algorithms have received 510(k) clearance from FDA. Xia holds a doctorate degree in Biomedical Engineering from the University of Texas at El Paso in 2019.

VIDA

SEMINAR 3

ANTONIO DEMARCO

Principal Data Scientist
Lockheed Martin Aeronautics Company

AN UNDERDISCUSSED TOPIC OF ETHICS IN ARTIFICIAL INTELLIGENCE

There is a vigorous and growing cultural discussion surrounding ethics issues in Artificial Intelligence; but there is one ethical topic critically important to AI practitioners within manufacturing and engineering firms which has been underdiscussed.

In this talk, Tony DeMarco (Data Scientist at Lockheed Martin Aeronautics) will highlight the sometimes blurred distinction between engineering and science in the discipline of data analytics, the exploitation of trust in data science, the exploitation of the wonder/awe surrounding new technologies, and the problems that these mistakes can cause for the AI practitioners and their clients. Through this discussion, we will seek to clarify the role of, and emphasize the importance of, a true scientific mindset in the data science organizations within manufacturing/engineering firms.

Tony DeMarco is a Principal Data Scientist within Lockheed Martin Aeronautics with expertise in advanced data analytics, AI/ML, statistics and operations research. Tony is also a retired Marine Corps attack pilot and has worked in the data analytics field for over 10 years.

LOCKHEED MARTIN

SEMINAR 4

SCOTT T. MOEN, PH.D.

Director of Health Innovations
University of Texas Medical Branch, Galveston TX

THE 5 WS OF MEDICAL ENTREPRENEURSHIP

The skills and mindset that are needed to succeed and thrive in the academic arena are often very different and insufficient for a successful entrepreneurial venture. As these two disparate entities more frequently interact to achieve economic goals, it can be both cost-effective and time-efficient to be mindful of these differences during the planning stages of your research/technology development. The talk will highlight a story of medical innovation to provide an insight into the entrepreneurial mindset."
Conrad has over 20 years of experience in manufacturing systems development and implementation and holds an M.S. in Industrial Engineering from the Georgia Institute of Technology.

He is a lifetime member and contributor of MESA International and a frequent speaker at conferences and his writing includes guidebooks, whitepapers, online courses and articles on Smart Manufacturing, Industrial Internet of Things (IIoT), Digital Thread, Lean, MES, MRO, quality management, regulatory compliance, and ROI analysis.

Scott Moen is the Director of Health Innovations at the University of Texas Medical Branch in Galveston Texas, where he collaborates with UTMB Faculty to conceptualize, construct, and implement diagnostic devices, software (Mobile Device, AI, Web), and medical hardware. He is also Director of the Medical Technology Resource and Education Center, where he assists faculty in adopting new technologies. Previously he studied Biodefense pathogens during his doctoral thesis and developed microfluidic diagnostics as a PI for Sandia National Laboratory.

UTMB®
The University of Texas Medical Branch

IMSE ALUMNI EXPERIENCES: HOW DID I GET HERE?

PANELIST

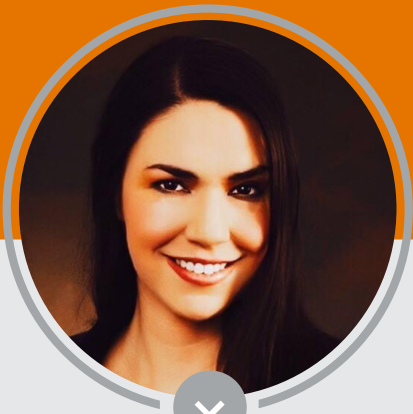
ABISAI RAMIREZ
Product Engineer
Cardinal Health

Abisai Ramirez works as Product Engineer/ Project Leader at Cardinal Health, one of the largest healthcare companies who focus on distribution and is a global manufacturer of pharmaceuticals and medical products.

he currently develops different projects that build on saving cost, continuous and product improvement. collaborating globally with locations such as, Mexico, Dominican Republic and Singapore.

Prior this role, Abisai collaborated with Engine Logistics at DAU5 Amazon, Designing and installing quality control processes to improve operational efficiency and package delivery. Additionally, analyzing production limitations and standard parameters for each driver to improve customer service and experience. Analyzing data to perform root cause analysis on issues that impact inventory performance and implement appropriate corrective actions. Abisai was part of MAES/SHEP serving as Social and Leadership Board.

KATHLEEN A. ZURLINDEN
Systems Engineering Lead
Lockheed Martin Company



Kathleen Zurlinden is from El Paso, TX, and is an alumnus of the University of Texas at El Paso. She graduated with a Bachelor of Science in Electrical Engineering and a Master of Science in Systems Engineering.

She currently works for Lockheed Martin Aeronautics Company supporting the F35 Program where she has been for the last 12 years. Her current role is as systems engineering lead for ACURL Sustainment.

She is very passionate about the company's purpose and strives to bring other passionate students into a company that is Ahead of Ready in serving our nation's brave men and women.Pay for Success Program in support of the biomedical industry, and a member of the ASPIRE Industry and Innovation Board. She is a member of Progress321 and the International Economic Development Council.

JUAN E. APODACA
Manufacturing Engineer
DISH Network

Juan E. Apodaca Aguilar has been a Manufacturing Engineer for the DISH company since last October 2022.

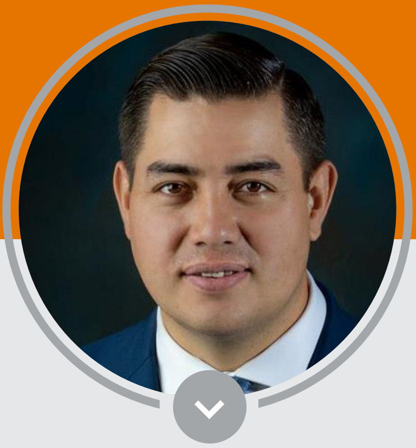
Juan is a successful, dynamic, and inspirational leader who constantly equips others to succeed. In his role, Juan is responsible for supporting production operations in all aspects of engineering functions, including designing, specifying, and implementing engineered solutions for receiving, production, shipping, and warehouse operations. In addition, this position also requires leading and directing technicians that support these functions. The team is responsible for projects from inception through the deployment of new products and equipment implementation. He currently possesses 2 patent submissions per project done in his work. He also facilitated and lead the team awarded as the best kaizen award recipient in 2019 and 2021 in two different locations at Daltile Corporation.

Prior to this role, he started his career working for Daltile in the ceramic industry in El Paso Texas, starting with an Internship Program and receiving his job offer before his graduating with his Bachelor, (Graduated with B.S. in Industrial and Systems Engineering) in Fall 2017. He recently graduated with his Master of Science in Systems Engineering in the Fall of 2022.

DANIEL ALVILLAR

Election and Government Mail Services Field Specialist

USPS



Daniel Alvillar Garcia is an Election and Government Mail Services Field Specialist for the United States Postal Service. His team just received the Public Service Award from the nonpartisan Election Verification Network, an award given each year to a public official or governmental unit for protecting and promoting election integrity and verifiable elections.

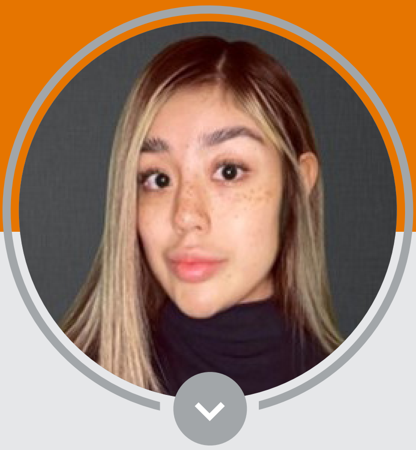
In his role, Daniel manages the Southern Area of the United States compromising the States of Texas, Arkansas, Oklahoma, Louisiana, Tennessee, Alabama, Georgia, South Carolina, Mississippi, Florida and Puerto Rico. He was just recognized as a Product Solutions MVP award recipient at the 2023 USPS Product Solutions meeting in Washington DC.

Prior to this role he started as an IE at the USPS Processing and Distribution Center in El Paso Texas and was later promoted to Manager of Operations where he was responsible for Operations, Staffing, Budget, Quality, Logistics, Planning, and Engineering. His work and vision transformed El Paso P&DC into one of the top performing facilities in the nation which resulted in the selection and promotion to his current role. He graduated from UTEP with a BSIE in 2015 and later completed his MBA in 2021.

CARMEN ALMERAZ

Process Engineer

Dell Technologies



Carmen Almeraz is currently part of the Operations Test Engineering Team at Dell Technologies where she takes on the role of capacity planning and infrastructure development as a Process Engineer.

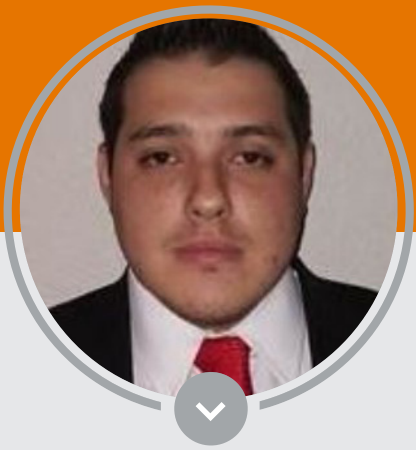
She completed her master of science in Systems Engineering from the University of Texas at El Paso in May of 2022, where she was part of the Industrial Engineering Honor Society and an IMSE Advisory Student Board Member.

Carmen is a first-generation graduate and enjoys being involved in extracurricular activities which allowed her to grow as a student and aspiring professional in the IMSE UTEP Department, where she had the opportunity to publish 2 IEEE conference paper publications on Systems Engineering. Besides IE, she is passionate about learning new things and is always open for a challenge.

JOSE LICON

Manager of In-Plant Support

USPS



Jose Licon is the MIPS (Manager of In-Plant Support) at the processing and distribution center in EL Paso TX working for the United States Postal Service. Jose oversees the implementation of new processes, layout redesign, service standards, and machine implementation among other things.

Jose started with the USPS back in 2017 as an Industrial Engineer at the Processing and distribution center in Albuquerque NM. As an Industrial Engineer, Jose worked on different projects that involved working with outside contractors and also along with the engineering headquarters team to implement new sorting machines and automated tow motors to make operations more efficient and safer for the company.

Also, Jose is Green Belt certified at the USPS. He worked on a project that involves 3rd parties and by working together with them and using the engineering tools that involved the lean six sigma philosophy, time studies, layout redesign, and data analysis, the company was able to streamline that specific process which resulted in faster time delivery and capture more revenue for the company.

SEMINARS & PRESENTERS

DATA-DRIVEN DISCOVERY OF DIMENSIONLESS NUMBERS AND GOVERNING LAWS FROM SCARCE MEASUREMENTS

ZHENGTAO GAN, PH.D.
Assistant Professor of Aerospace and Mechanical Engineering
The University of Texas at El Paso

Dimensionless numbers and scaling laws provide elegant insights into the characteristic properties of physical systems. Classical dimensional analysis and similitude theory fail to identify a set of unique dimensionless numbers for a highly multi-variable system with incomplete governing equations.

This talk introduces a mechanistic data-driven approach that embeds the principle of dimensional invariance into a two-level machine learning scheme to automatically discover dominant dimensionless numbers and governing laws (including scaling laws and differential equations) from scarce measurement data. The proposed methodology, called dimensionless learning, is a physics-based dimension reduction technique. It can reduce high-dimensional parameter spaces to descriptions involving only a few physically interpretable dimensionless parameters, greatly simplifying complex process design and system optimization.

He will demonstrate the algorithm by solving several challenging engineering problems with noisy experimental measurements (not synthetic data) collected from the literature. Examples include turbulent Rayleigh-Bénard convection, vapor depression dynamics in laser melting of metals, and porosity formation in 3D printing. Lastly, he will show that the proposed approach can identify dimensionally homogeneous differential equations with dimensionless number(s) by leveraging sparsity-promoting techniques.

Zhengtao Gan received his Ph.D. degree in Mechanics from the Chinese Academy of Sciences in 2017. He joined Northwestern University as a postdoc after his graduation, then was promoted to Research Associate in 2019 and Research Assistant Professor in 2020. He joined the University of Texas at El Paso as an Assistant Professor in 2022. He also holds an Adjunct Assistant Professor at Northwestern University. Dr. Gan's expertise involves additive and advanced manufacturing, multiscale and multiphysics modeling, and scientific machine learning. Dr. Gan was identified as Top Performer in Air Force Research Laboratory (AFRL) Additive Manufacturing (AM) Modeling Challenge Series and awarded several 1st places by the National Institute of Standards and Technology (NIST) in AM-Bench 2018 and 2022. Dr. Gan has published more than 30 high-quality articles in peer-reviewed journals. Several papers have been recognized as "Top 1% highly cited papers in the field of Engineering" by the Web of Science. Dr. Gan has published one textbook "Mechanistic Data Science for STEM Education and Applications", Springer.

A RISK-FREE WAY TO EXPLORE COMPLEX SYSTEMS USING COMPUTER SIMULATION AND ARTIFICIAL INTELLIGENCE.

MD FASHIAR RAHMAN. PH.D.
Assistant Professor of Industrial, Manufacturing, and Systems Engineering Department
The University of Texas at El Paso

The paradigm of scientific discovery has been shifted from empirical observation of natural phenomena to computational science, in which complex phenomena are simulated numerically. Today, we observe lots of discoveries based on the synthesis of theory and computation through simulation. This opens the door to the next scientific paradigm that may enable computationally accelerated simulation and empirical observation at the time, different dimensions, and special scales.

This seminar will focus on the intersection of simulation and artificial intelligence (AI) from the systems perspective. Simulation and AI can be combined to become the counterpart of each other. For example, simulation models can be used as a source to generate an unlimited amount of synthetic, structured, and labeled data analogous to the real system and can be used to train an AI model. One of the major barriers to the AI model is the reliability, verification, and validation when the is exposed to the real environment. The simulation models can be used as a virtual environment to test the implications of incorporating AI into existing systems. Thus, it is a powerful tool for understanding complex systems/processes.

This talk will demonstrate how industries or organizations can develop and leverage the digital representation of a real system to experiment and explore their system in a risk-free way.

Md Fashiar Rahman is an Assistant Professor with the Industrial, Manufacturing, and Systems Engineering (IMSE) Department at The University of Texas at El Paso. He received his Ph.D. and M.S. degrees in Computational Science in 2021 and 2018, respectively. He has an extensive research background in the field of image data mining, machine learning, deep learning, and computer simulation for industrial and healthcare applications. His research area covers advanced quality technology, AI application in health care, smart manufacturing, computational intelligence/data analytics, and computer modeling/simulations. Dr. Rahman has publications in various top peer-reviewed journals such as the Journal of Visual Communication and Image Representation, CIRP Journal of Manufacturing Science and Technology, Artificial Intelligence for Engineering Design, Analysis, and Manufacturing Journal, Measurements, Journal of X-Ray Science and Technology, and Machine Learning with Applications.

ARTIFICIAL INTELLIGENCE
APPLIED RESEARCH

AI APPLICATIONS FOR IN-SITU PROCESS MONITORING

Artificial intelligence is being deployed more intensively for in-situ process monitoring to optimize the production process, productivity, and quality control. In most manufacturing operations, in-situ process monitoring includes online monitoring and reporting on the processing parameters to identify the corrective actions. These modifications must be carried out promptly if some deviation from the intended operating parameters is detected. This process may incorporate AI-assisted computer vision and algorithms for image/video processing to inspect images and detect errors in real time.

AI has been employed in in-situ process monitoring across various industries, but significantly in manufacturing, healthcare, and agriculture. Additive manufacturing (AM) is one such sector where AI has the potential for in-situ process monitoring. Layer-wise monitoring in AM is one of the key aspects for ensuring the quality of final products. Depending on the AM technology, the product quality in 3D printing could deteriorate due to changes in optional parameters such as temperature, print speed, positional distortion, photodiode signals, etc., resulting the defects like warping, delamination, or dimensional inaccuracies.

Continuous observation of these parameters provides an effective way to prevent any kind of product distortion. However, the task is not trivial due to the complex pattern and unforeseen changes in operational parameters. Moreover, the layer-wise printing setup generates a voluminous amount of data, which needs to be analyzed properly to extract hidden patterns and findings. Here, AI can perform quality printing by monitoring key performance indicators like temperature, pressure, and other process variants. Such an end-to-end process usually utilizes computer vision and an Internet of Things (IoT) setup backed by AI techniques. This ensures faster intervention to rectify any flaws and ensure that the print is satisfied. Moreover, AI can also be utilized to enhance the overall printing process and optimize the printing parameters. Machine learning algorithms can identify the most effective settings for a certain material or object by evaluating information from previous prints and investigating various sorts of parameters. A similar IoT-based in-situ process monitoring framework is currently being developed in UTEP's "Intelligent Systems Engineering Laboratory (ISEL)" under the supervision of Dr. Rahman and Dr. Tseng, as shown in Figure 1.

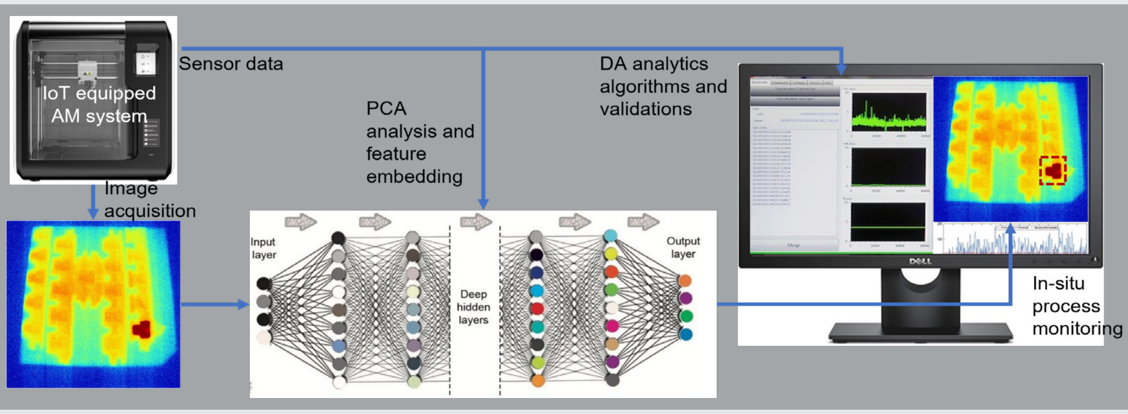


Figure 1. The conceptual framework of AI-based In-Situ process monitoring

Recently, Dr. Tseng and his research group accomplished another project on AI-based non-destructive testing and evaluation (NDT/E) – detection and classification of the composite component using a digital twin approach. This integrates the results from NDT/E devices and digital twin recreations to the cutting-edge quality-control framework called quality information framework (QIF). With the QIF, the project formalizes the NDT/E inspection results driven by deep learning detection into a format allowing specialists to obtain the composite material's quality aspects. The capabilities offered by the deep-leaning driven NDT/E and the integration of the digital twin generate novel automated inspection methodologies that speed up the evaluation of material at an industrial scale. The conceptual framework is shown in Figure 2.

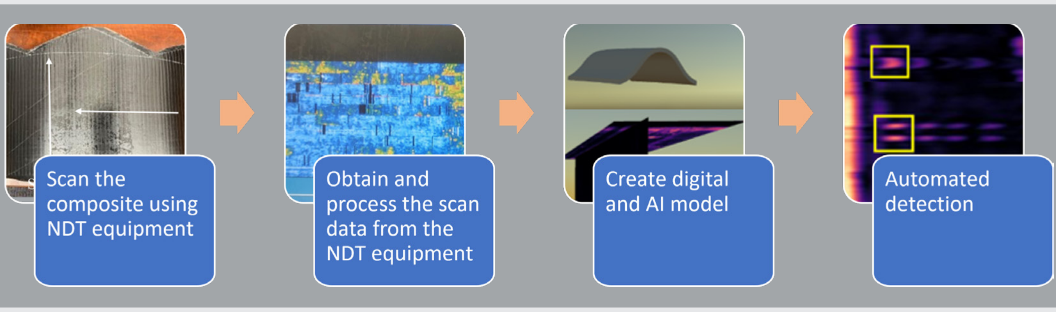


Figure 2. The conceptual framework of AI-based NDT/E using digital twin

HEALTHCARE SYSTEM

APPLIED RESEARCH

UNFOLD YOUR PROCESSES WITH COMPUTER SIMULATION – AN EXAMPLE OF A HEALTHCARE SYSTEM.

The US healthcare system is currently in need of an efficient emergency department (ED) due to its uncertain and stochastic behavior. During past years the ED demand has been increasing at an alarming rate, especially in the event of the COVID-19 pandemic situation . Due to increasing demand within the hospital system, management must uncover alternative solutions for the methods already in use. Each patient visits the ED with a specific condition that must be treated accordingly, and all situations vary significantly. The interactions among physicians, nurses, staff, and visitors make the hospital systems complex. In addition, any existing ED systems face conflicts due to the event of a new disease wave. For example, the wave of COVID-19 forces ED systems to alter their strategies, causing trouble in the regular processes. However, the systems must respond promptly to any unprecedented situation with utmost priority. Thus, the effective management of ED in all US hospitals becomes a key issue.

The ED has a vast space for improvement through effective bed management, reducing patients' delay in the queue and thus reducing the length of stay (LOS), timely response, proper scheduling of doctors and nurses, resource utilization, proper maintenance of equipment and other facilities, etc. Improper management of all these factors creates a negative impact on patients' experience and endangers their health. Overcoming these challenges is important because growing demand within the ED can cause high dissatisfaction among patients as they must wait longer, even in emergencies. Once a room has been assigned, it can take a long period of time for doctors, nurses, or staff members to handle the case. A tolerable LOS is key to avoiding long waiting times for both incoming and in-room patients, which results in enhanced patient satisfaction and improved quality of services. Hence, there is a need for effective management of the system design through analysis of all factors involved and the areas where waiting time can be reduced and explore different solutions. A noble approach could be the key to maintaining a balance between the hospital and patient needs to make a positive difference.

Figure 1. The conceptual framework of modeling and simulation (source: The Big Book of Simulation Modeling by Andrei Borshchev and Ilya Grigoryev)

The usual practices for managing challenges in the ED include responsibility assigned to leaders and managers within the ED to obtain organization and effective decision-making. Sometimes the ED improvement project is addressed based on experiences, intuitions, and quality principles. Besides, some analytical approaches, such as queuing theory, linear and on-liner optimization techniques, and time-to-event modeling, are popularly used to optimize ED processes. However, such approaches are developed based on static assumptions and fail to describe the real-time intuition of ED systems. Nowadays, computer simulation techniques, especially discrete event simulation (DES), have become popular for solving complex systems like emergency departments. The computer simulation techniques can simulate all possible scenarios with different solutions and compare based on the key performance indicators (KPIs) such as patients' LOS, resource utilization, systems throughput, etc.

For example, an ED may want to investigate the effect on patient waiting time when they use reserved beds for severe patients (coming through ambulance) and walk-in patients. Similarly, ED managers may be interested to know the effect of deploying floating beds on patients' waiting time.

Moreover, any system desires to operate in optimal conditions with maximum gain. In the ED process, one of the primary objectives is to minimize the patients' LOS while allocating optimal resources. However, considering the budget limitations, the ED may want to limit the number of doctors/nurses while ensuring their tolerable workload. Competitive pressure or meeting the national/state standard are other critical criteria for every organization. Hence, ED systems may want to reduce patients' waiting time below their peer organizations. In such cases, the ED authorities may be interested in knowing what they should change in their systems to reach their desired goal. These are a few common examples from the point of strategic decision and optimization experiments. However, all these experiments require real-time resource allocation, physical changes, data collection, and observations, which is time-consuming, risky, tedious, and sometimes infeasible. Here, the DES can simulate all the scenarios in a digital platform, run the systems for a substantial amount of time, and observe and explore the effect of changes without any potential risk. An example of a simulation dashboard for a hypothetical ED system is shown in Figure 2, where the user can explore the KPIs for ED systems.

In summary, the concept of computer simulation can be used in a wide range of applications, such as manufacturing, healthcare systems, transportation and logistics, system design, environmental studies, and many more. It is a powerful tool that enables engineers, scientists, and decision-makers to study the behavior of complex systems, make informed decisions, and improve the overall performance of a wide range of applications.

Figure 2. Simulation dashboard showing the KPIs for an ED system, *above*.

Utilizing Machine Learning Techniques for COVID-19 Screening Based on Clinical Data

Honglun Xu[1], Andrews T. Anum[2], Michael Pokojovy[2], Md Fashiar Rahman[1] and Tzu-Liang (Bill) Tseng[1,2]
[1] Department of Industrial, Manufacturing & Systems Engineering (IMSE)
[2]Computational Science Program

Research/Project Objective

In this study, we investigated six different machine learning models for COVID-19 diagnosis using the UTMB dataset. The random forest methodology was used as variable selection method to reduce the full data dimension based on the variable importance of models, which can help researchers rapidly find relevant variables. Predictive modeling with and without feature selection/model reduction was separately performed.

Background

The COVID-19 pandemic has led to an increased need for rapid clinical decision making to facilitate efficient usage of healthcare resources. Over the past decade, Machine learning (ML) has caused a tectonic shift in healthcare allowing for data-driven prediction and decision-making. Recent research demonstrates how ML can be used to respond to the COVID-19 pandemic. This paper puts forth new computer-aided COVID-19 disease screening techniques using six classes of ML algorithms (including penalized logistic regression, random forest, artificial neural networks, support vector machines) and benchmarks their performance when applied to a real-world clinical dataset containing patients' demographic information and vital indices (such as sex, ethnicity, age, pulse, pulse oximetry, respirations, temperature, BP systolic, BP diastolic and BMI) as well as ICD-10 codes of existing comorbidities as attributes to predict the risk of having COVID-19 for given patient(s).

Research /Project Design

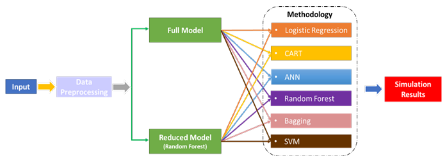


Illustration of COVID-19 non-image-based diagnosis procedure

Data Gathering/Analysis

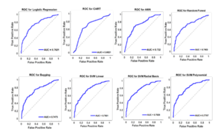
The University of Texas Medical Branch (UTMB) proprietary clinical COVID-19 dataset contains demographic data, vital measurements as well as multiple ICD-10 codes of respective commodities for each of 1987 patients. We performed imputation using the Multivariate Imputation by Chained Equations (MICE) method available from the mice package in R using random forest (RF)

Variables	Description	Type
sex	Sex (male or female)	Binary
ethnicity	Whether a patient is Hispanic or Latino	Binary
age	Patient's age	Numerical
pulse	Number of pulse beats per minute	Numerical
pulse oximetry	Blood oxygen level (oxygen saturation)	Numerical
respirations	Number of breaths per minute	Numerical
temperature	Body temperature	Numerical
BP systolic	Systolic blood pressure (top number) – the force heart exerts on the walls of arteries each time it beats	Numerical
BP diastolic	Diastolic blood pressure (bottom number) – the force heart exerts on the walls of arteries in between beats	Numerical
BMI	Measure of under/overweight	Numerical
ICD-10 codes	Binary indicator (yes/no) for each ICD*-10 code (for diseases, signs and symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or diseases)	Binary

*International Statistical Classification of Diseases and Related Health Problems

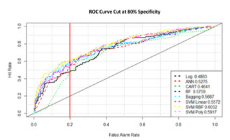
Simulation Results & Discussion

• Full Dataset/Model



Test AUC values for the full models

Method	Accuracy	Sensitivity	Specificity	ROC AUC
random forest	0.718	0.656	0.746	0.7529
bagging	0.710	0.632	0.751	0.7473
SVM linear	0.715	0.837	0.517	0.7651
SVM radial basis	0.743	0.862	0.550	0.7828
SVM polynomial	0.746	0.850	0.576	0.7797
ANN	0.708	0.748	0.642	0.7295
CART	0.680	0.586	0.732	0.6821
logistic regression	0.725	0.797	0.609	0.7621

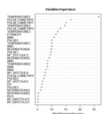


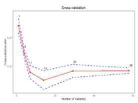
Test ROC curves compared with 80% specificity for the full model

SVM radial basis also produced better classification results based on the AUC values of 0.7828 as compared to other methods

• Reduced Dataset/Model

1. Variable Selection





Select variables with cross-validation

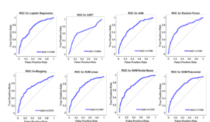
Cross-validation error with different number of variables

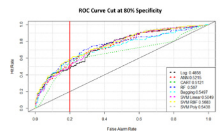
Number of selected variables	Cross-validation error: Mean	Mean+1 × ste	Mean-1 × ste
1	0.371	0.383	0.358
4	0.322	0.330	0.315
7	0.290	0.301	0.278
14	0.276	0.292	0.259
29	0.292	0.303	0.280
58	0.292	0.297	0.287

random forests were applied for variable selection for our study

Simulation Results & Discussion

2. Results for the Reduced Model





AUC values for the reduced test dataset

Method	Accuracy	Sensitivity	Specificity	ROC AUC
Random forest	0.710	0.632	0.751	0.7421
Bagging	0.698	0.610	0.746	0.7219
SVM linear	0.683	0.813	0.470	0.7427
SVM radial basis	0.723	0.846	0.523	0.7579
SVM polynomial	0.708	0.846	0.483	0.7548
ANN	0.703	0.772	0.589	0.7368
CART	0.693	0.607	0.737	0.6533
Logistic regression	0.673	0.760	0.530	0.7405

The SVM radial basis model has the best classification performance in terms of the test AUC values of 0.7579 that is larger than that of other methods. The same SVM radial basis results are displayed in Figure with AUC value of 0.5683

Summary of all methods for test dataset

Methods	Full model: Accuracy	Full model: Sensitivity (Specificity=0.8)	Full model: ROC AUC	Reduced model: Accuracy	Reduced model: Sensitivity (Specificity=0.8)	Reduced model: ROC AUC
Random forest	0.718	0.5759	0.7529	0.710	0.5670	0.7421
Bagging	0.710	0.5687	0.7473	0.698	0.5497	0.7219
SVM linear	0.715	0.5572	0.7651	0.683	0.5049	0.7427
SVM radial basis	0.743	0.6032	0.7828	0.723	0.5683	0.7579
SVM polynomial	0.746	0.5917	0.7797	0.708	0.5438	0.7548
ANN	0.708	0.5275	0.7295	0.703	0.5215	0.7368
CART	0.680	0.4641	0.6821	0.693	0.5121	0.6533
Logistic regression	0.725	0.4863	0.7621	0.673	0.4858	0.7405

Conclusions & Future Work

The results of our case study show that the selected SVM radial basis model exhibited a high degree of robustness in prediction performance depending on the model evaluation criteria, which, in addition to being a simple cost-neutral screening technique, may help guide treatment planning for clinics. Even though our paper provides an automated procedure to screen for COVID-19 using non-image data, the accuracy and AUC are not very high due to a limited amount of data available for our study. In the future, we intend to collect more data to further validate and improve the proposed method.

References

[1]X. Mei et al., "Artificial intelligence–enabled rapid diagnosis of patients with COVID-19," Nature Medicine, vol. 26, no. 8, pp. 1224-1228, 2020.
[2]H. Ihle-Hansen et al., "COVID-19: Symptoms, course of illness and use of clinical scoring systems for the first 42 patients admitted to a Norwegian local hospital," Tidsskrift for Den Norske Legeforening, 2020.
[3]E. J. Chow et al., "Symptom screening at illness onset of health care personnel with SARS-CoV-2 infection in King County, Washington," JAMA, vol. 323, no. 20, pp. 2087-2089, 2020.
[4]M. D. Firouzabadi et al., "Olfactory and gustatory dysfunction in coronavirus disease 19 (COVID-19)," 2021.
[5]R. K. Zimmerman et al., "Proposed clinical indicators for efficient screening and testing for COVID-19 infection using Classification and Regression Trees (CART) analysis," Human Vaccines & Immunotherapeutics, vol. 17, no. 4, pp. 1109-1112, 2021.

Acknowledgements

This section must be included in your poster. "This research was funded through the US Department of Education Award # P031S120131."

THE UNIVERSITY OF TEXAS AT EL PASO

A simulation-based optimization approach to improve the performance of the healthcare systems - A case study on the emergency department

Briana Cardenas [1] and Dr. Md Fashiar Rahman Faculty Mentor[2]
[1] Department of Industrial, Manufacturing & Systems Engineering (IMSE)
[2]Research Institute for Manufacturing & Engineering Systems (RIMES)
The University of Texas at El Paso

BACKGROUND

Healthcare facilities are responsible of delivering efficient and qualitative patient care. However, hospital systems for the emergency department (ED) are currently struggling with resources, visitors' capacity, and scheduling. Patient arrival rate and resource unavailability are key factors to understand the system behavior, explore system improvement strategies, and optimize experiments.

RESEARCH OBJECTIVES

- Understand existing hospital systems and practices to optimize performance
- Observe and analyze models for comparison between current hospital methodology and proposed practices
- Reduce patient's length of stay (LOS)

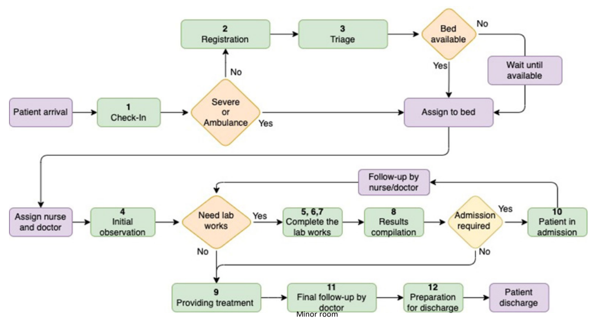
PROBLEM STATEMENT

- This research aims to explore hypothetical emergency department performance utilizing pre-bed assignment, patient treatment procedure and discharge processes through simulation techniques for optimization

TP ID	Distribution	TP ID	Distribution	TP ID	Distribution
1	$Uniform\ (3,6)$	5	$traingular(10,15,12)$	9	$traingular(10,20,15)$
2	$traingular(5,10,7)$	6	$traingular(7,13,10)$	10	$traingular(4,6,5)$
3	$traingular(6,13,8)$	7	$traingular(10,20,15)$	11	$traingular(7,12,9)$
4	$traingular(8,15,12)$	8	$traingular(3,6,4)$	12	$traingular(5,8,6)$

Doctor shift	Curr.	MinR	MaxA	Nurse shift	Curr.	MinR	MaxA
12.00 AM – 6.00 AM	2	2	4	12.00 AM – 6.00 AM	3	2	5
6.00 AM – 12.00 PM	4	2	6	6.00 AM – 12.00 PM	5	2	8
12.00 PM – 6.00 PM	5	2	8	12.00 PM – 6.00 PM	6	2	10
6.00 PM – 12.00 AM	2	2	5	6.00 PM – 12.00 AM	3	2	6

PROBLEM DESCRIPTION



METHODOLOGY

Case 1 – Strategic Decision: Conserve the two major rooms for severe patients and walk-in patients only if there are no severe patients in queue to analyze system's performance when major and minor rooms are merged

Case 2 – Optimization Experiment: Minimize LOS for patients, allocating optimal resources. Daily allocation of the hospital staff maximum of 15 or 20. Maintain staff utilization below 75%

Case 3 – Optimization Experiment: Maintain LOS below 7 hours. Determine optimal staff and equipment quantities to meet targeted LOS time regulations. Maintain staff utilization below 75%

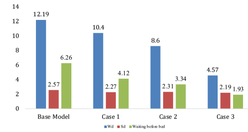
EXPERIMENT DESIGN

Case 2	Case 3
$Minimize\ \sum_i^m LOS_i + \sum_j^n LOS_j$	$Minimize\ \sum_k^{\{0,6,12,18\}} x_{k,k+6} + \sum_k^{\{0,6,12,18\}} y_{k,k+6}$
$Constraints$	$Constraints$
$\sum_k^{\{0,6,12,18\}} x_{k,k+6} \le 15$	$\sum_i^m LOS_i \le 7$
$\sum_k^{\{0,6,12,18\}} y_{k,k+6} \le 20$	$\sum_j^n LOS_j \le 5$
$U_d \le 0.75$	$U_d \le 0.75$
$U_n \le 0.75$	$U_n \le 0.75$
$x_{0,6} \ge 1, x_{6,12} \ge 2, x_{12,18} \ge 2, and\ x_{18,24} \ge 2$	$x_{0,6} \ge 1, x_{6,12} \ge 2, x_{12,18} \ge 2, and\ x_{18,24} \ge 2$
$y_{0,6} \ge 2, y_{6,12} \ge 3, y_{12,18} \ge 3, and\ y_{18,24} \ge 3$	$y_{0,6} \ge 2, y_{6,12} \ge 3, y_{12,18} \ge 3, and\ y_{18,24} \ge 3$

RESULTS

Results were obtained from simulation experiments over a frame of seven days. ED performance is evaluated considering

- Mean LOS
- Waiting time ratio
- Resource utilization
- System throughputs



	Mean LOS	W/S Ratio	Resource Utilization				System Throughput		
			Major room	Minor room	Doctors	Nurses	Enter	waiting	Exit
Base model	14.76	4.74	0.37	0.94	0.82	0.69	255	62	185
Case 1	12.67	4.58	0.92		0.80	0.73	246	39	199
Case 2	10.91	3.72	0.85		0.66	0.72	243	23	212
Case 3	6.76	2.09	0.75		0.73	0.74	229	0	222

	Case 2			Case 3		
	Doctors	Nurses	Emergency room	Doctors	Nurse	Emergency room
Shift1	1	2	8	1	2	10
Shift2	5	6		5	6	
Shift3	5	6		5	6	
Shift4	2	3		2	3	
Mean LOS	10.71 hours			6.76 hours		

CONCLUSION

Simulation-base approach improves hospital ED performance. DES simulation ran for 7 days developing an existing ED representation to identify improvement opportunities. Research provides proof-of-concept simulation-based approach effectiveness in decision support systems.

FUTURE WORK

Extend work using real-world hospital systems and any other complex systems.

THE UNIVERSITY OF TEXAS AT EL PASO

Intracranial Hemorrhage (ICH) Segmentation from Brain CT Scans Using Deep Learning

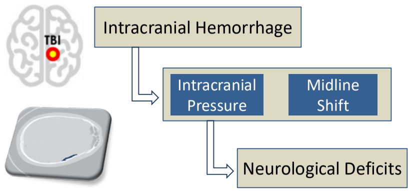
Solayman Hossain[1], Bill Tseng[2], Ph.D. and Md Fashiar Rahman[3], Ph.D.
[1,2,3] Department of Industrial, Manufacturing & Systems Engineering (IMSE)
[2,3] Research Institute for Manufacturing & Engineering Systems (RIMES)
The University of Texas at El Paso

Research Objective

A deep learning-based approach is proposed for the localization of brain hemorrhage regions on CT scans in a fully automated manner. The developed model can detect & segment the brain hemorrhage location by applying pixel-level predictions.

Background

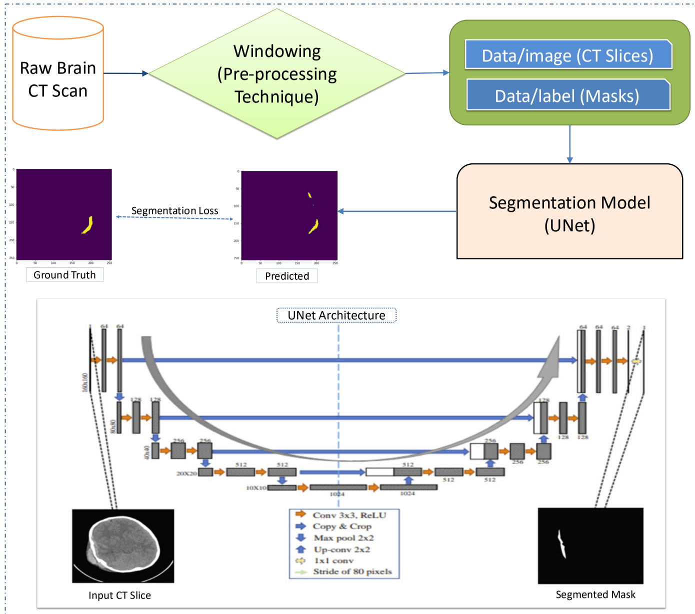
Traumatic brain injury (TBI) is a major cause of death and disability in the United States. It estimated that 1.7 million people suffer TBI every year, with total lifetime TBI medical expenses that are expected to be approximately $76.5 billion. Intracranial Hemorrhage (ICH) is the most common and serious consequence of brain injury. Timely diagnosis of hemorrhage is extremely critical to avoid any unexpected situations due to the diagnosis delay.



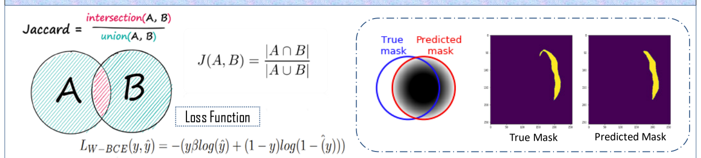
Computational Tools

jupyter, OpenCV, NumPy, PyTorch

Methodology



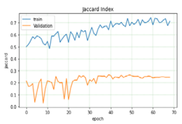
Evaluation Strategy



$$J(A,B) = \frac{|A \cap B|}{|A \cup B|}$$

$$L_{W-BCE}(y,\hat{y}) = -(y\beta log(\hat{y}) + (1-y)log(1-\hat{(y)}))$$

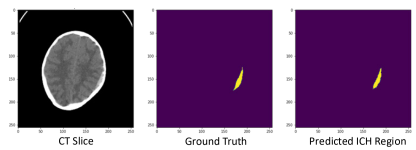
Results



Result Table

	Jaccard Index	Dice Coefficient	Sensitivity	Specificity
Max	0.821	0.89	100	100
Min	0.0	0.0	45	0
Avg	0.639	0.724	89.23	51.34

Visualize Model's Output



Conclusions & Future Work

The automated hemorrhage (ICH) segmentation approach could be further integrated into a computer-aided diagnosis (CAD) system with the composed pipeline. Future efforts will include more sophisticated deep learning architecture and intensive dataset to enhance the segmentation accuracy and robustness for clinical practices.

References

- Ronneberger, Olaf, Philipp Fischer, and Thomas Brox. "U-Net: Convolutional networks for biomedical image segmentation. arXiv 2015." *arXiv preprint arXiv:1505.04597* 2 (2019).
- Lee, H., Kim, M., & Do, S. (2018). Practical window setting optimization for medical image deep learning. *arXiv preprint arXiv:1812.00572.*

Acknowledgements

- The University of Texas Medical Branch (UTMB)
- Research Institute for Manufacturing & Engineering Systems (RIMES)

THE UNIVERSITY OF TEXAS AT EL PASO | IMSE DAY 2023 | ARTIFICIAL INTELLIGENCE

Exploring social media data to understand public perception towards Electric Vehicles: An analysis of Indianapolis, Indiana as ASPIRE City

Jesus Alejandro Gutierrez Araiza, Sergio A. Luna Fong, Ph.D., Ivonne Santiago, Ph.D. & P.E.
The University of Texas at El Paso

ASPIRE
NSF Engineering Research Center
Advancing Sustainability through Powered Infrastructure for Roadway Electrification

Introduction

- The current environmental impacts are affecting our ecosystems.[1]
- The transition to Electric Vehicles (EVs) as transportation way is critical to reduce GHG emissions.
- There are factors among the populations that are not allowing this adoption and slowing down the transition.[2]
- The NSF Engineering Research Center ASPIRE mission is to eliminate barriers that slow down the EV transition, having centers in cities such as Indianapolis, Indiana. [3]

Background

- **Surveys, questionaries, and interviews** have been performed in order to understand the people perception about the topic [4], however, one of their disadvantages are that **they focus only on limited focus groups.[5]**
- We considered that the collection of social media data from Twitter limited to a specific search area could be helpful to understand the public perception regarding EVs

Research Question

- What is social media public perception towards Electric Vehicles on Indianapolis city, Indiana where the NSF Engineering Research Center ASPIRE is located?

Methodology Inspiration

- Cross-Industry Standard Process for Data Mining (CRISP-DM) is used as inspiration to develop our Modeling Framework

Software Used

- RStudio (R)
- Minitab (Statistical Software)
- Spyder (Python)
- Microsoft Excel (VBA)

Methodology

Datasets to be Analyzed and Visualized

- U.S. Census Data: 2020 ACS 5-Year Estimates
- Twitter Social Media Posts Data
- U.S. Charging Stations from U.S. Department of Energy

Modeling Framework

1. Data Collection
   - Datasets
   - Query Design
   - Tweet search areas selection
2. Data Cleaning and Preprocessing
   - Filter by location
   - Tokenization
   - Stop-word
   - Parts-of-speech
   - Tagging
   - Lemmatization
3. Text Analytics
   - Sentiment Analysis (through the VADER tool)
4. Visualization
   - Control Chart
   - Word Cloud
   - Topic Modeling (using LDA)

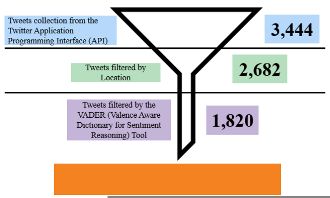
Feedback Loop

Indianapolis city, IN Profile

Geographic Location	Population	Working Age proportion	College Degree or higher achieved	Median Income per household	Number of Charging Stations
39.7684° N, 86.1581° W	869,387	66.90%	60.39%	50,813 USD	151

Results

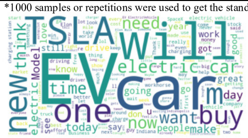
Filtering Process



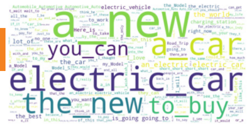
City	Original Mean	Original Standard Deviation	After Bootstrap Method is applied* Mean	After Bootstrap Method is applied* Standard Deviation
Indianapolis, Indiana	0.1306	0.3677	0.13433	0.01855

*1000 samples or repetitions were used to get the standardized means

Unigram Word Cloud



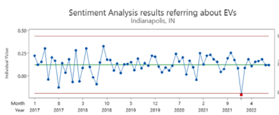
Bigram Word Cloud



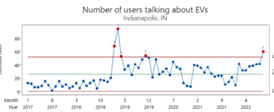
Topic Modeling

Charging Stations	EV Equity Awareness	Use of Gas and EV
Like: 0.014	Electric: 0.034	Car:0.017
Charging:0.012	Car: 0.031	Electric:0.016
Money: 0.011	Model: 0.018	Day:0.013
Station: 0.008	Idea: 0.008	Gas:0.011

Sentiment Control Chart



Users Control Chart



Analysis

- The average sentiment regarding Electric Vehicles is positive (0.1343).
- There was an event before January 2022 that may have caused the average sentiment to be negative.[6]
- The topic modeling results reflect that topics such as Equity Awareness on the economic aspect, need to be treated locally to enable the transition from ICEVs to EVs

Conclusions

This study was useful to understand the **positive sentiment** regarding EVs on Indianapolis. The **methodology was critical** to us to understand the main concerns of the social media users regarding the topic, **showing main insights through multiple visualization tools**. However, it indicated that there is **still some rejection regarding to the EV transition idea**, which roots need to be studied deeply in order to treat them properly. Finally, it is recommended to **keep a monitoring on the sentiment** to understand future events that could be replicated in other potential ASPIRE cities if they favor the sentiment.

Future Work

- Analyze the main socio-economic factors that could be significant on the transition to EVs in Indianapolis.
- Improve the analysis methodology with other cities where an NSF ASPIRE Research center is in USA
- Perform a regression analysis using USA Census data as independent variables having the number of charging station as response variable.

Acknowledgements

This work was funded by the NSF Engineering Research Center for Advancing Sustainability through Powered Infrastructures for Roadway Electrification (ASPIRE) ERC under Grant No. 1941524 .

References

[1] U.S. Environmental Protection Agency. (2022, May). Fast Facts: U.S. Transportation Sector GHG Emissions 1990-2020. *U.S. Environmental Protection Agency*. Retrieved November 29, 2022, from https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P10153PC.pdf

[2] Viola, F. (2021). Electric vehicles and psychology. *Sustainability*, 13(2) doi:10.3390/su13020719

[3] https://aspire.usu.edu/about/overview/

[4] Krause, R. M., Carley, S. R., Lane, B. W., & Graham, J. D. (2013). Perception and reality: Public knowledge of plug-in electric vehicles in 21 U.S. cities. *Energy Policy*, 63, 433-440. doi:https://doi.org/10.1016/j.enpol.2013.09.018

[5] Ruan, T., & Lv, Q. (2022). Public perception of electric vehicles on reddit over the past decade. *Communications in Transportation Research*, 2, 100070. doi:10.1016/j.commtr.2022.100070

[6] Milman, O. (2021, Dec 3,). US lags in electric vehicle sales despite biden administration's push. *The Guardian* Retrieved from https://www.theguardian.com/us-news/2021/dec/03/us-electric-vehicle-car-sales-biden

Artificial Intelligence: Applications & Implications
IMSE Day 2023
El Paso, TX
April 19, 2023

TMAC-PASO DEL NORTE

RESOURCES FOR LOCAL SMALL & MEDIUM MANUFACTURERS

TMAC Paso del Norte is a public-private partnership located at UTEP to serve a wide range of businesses including manufacturing, healthcare, and government. TMAC's mission is to increase the global competitiveness of the Texas economy by working to grow and sustain the extended manufacturing enterprise. TMAC works with companies to help them advance and make operations more agile by using Lean, Quality, Supply Chain, and Workforce Development practices. TMAC PdN provides lean and efficient customized solutions that deliver a competitive edge, identify growth opportunities, and foster regional economic development.

TMAC delivers hands-on business management, technology and operations solutions to a wide range of businesses, including manufacturing, distribution, logistics, construction, health care and government. We have a wide array of services that accelerate profitable growth by developing and improving products, processes and people. Focus areas include Strategic Management, Technology and Operations.

PUBLIC PRIVATE PARTNERSHIP

TMAC is an affiliate of the Manufacturing Extension Partnership (MEP) program of National Institute of Standards and Technology (NIST).

The National Institute of Standards and Technology's Hollings Manufacturing Extension Partnership (MEP) works with small and mid-sized U.S. manufacturers to help them create and retain jobs, increase profits, and save time and money. The nationwide network provides a variety of services, from innovation strategies to process improvements to green manufacturing. MEP also works with partners at the state and federal levels on programs that put manufacturers in position to develop new customers, expand into new markets and create new products.

MEP field staff has over 1,300 technical experts – located in all 50 states and Puerto Rico – serving as trusted business advisors, focused on solving manufacturers' challenges and identifying opportunities for growth. As a program of the U.S. Department of Commerce, MEP offers its clients a wealth of unique and effective resources centered on five critical areas: technology acceleration, supplier development, sustainability, workforce and continuous improvement.

TMAC offices are strategically located across Texas.

OUR APPROACH MAKES US DIFFERENT

Our TMAC advisors have several decades of combined industry experience. Their knowledge and expertise encompasses vast technical, innovative, operational and support areas within an organization. Because of TMAC's hands-on approach, our advisors understand the issues customers face on a daily basis.

TMAC doesn't leave a to-do list for you to navigate alone. We work with you to achieve dramatic results. Our objective is not to implement these methodologies to you or for you, but rather with you to develop your in-house expertise so that improvements are sustainable.

WORK SMART, GROW SMART

TMAC's mission is to increase the global competitiveness of the Texas economy by working to grow the extended manufacturing enterprise.

TMAC works with you to make your company more efficient, whether it is energy efficiency, quality issues, or supply chain, we will give you the customized solutions to have the competitive edge, discover financial opportunities and grow your business.

In today's super competitive environment, growing a business requires planning, efficient processes, customer focused innovation, new customers and markets and smart financial decisions. Whether you desire assistance in one area or a comprehensive approach, TMAC provides actionable steps to get you to the next level and beyond.

TMAC SOLUTIONS

- Executive Leadership
- Supply Chain & Logistics
- Product Development
- Operations
- Maintenance & Facilities
- HR
- Finance & Accounting
- Administration

THE **5** PILLARS OF TMAC

PROFIT
PRODUCT
PROCESSES
TECHNOLOGIES
PEOPLE

ECONOMIC IMPACT

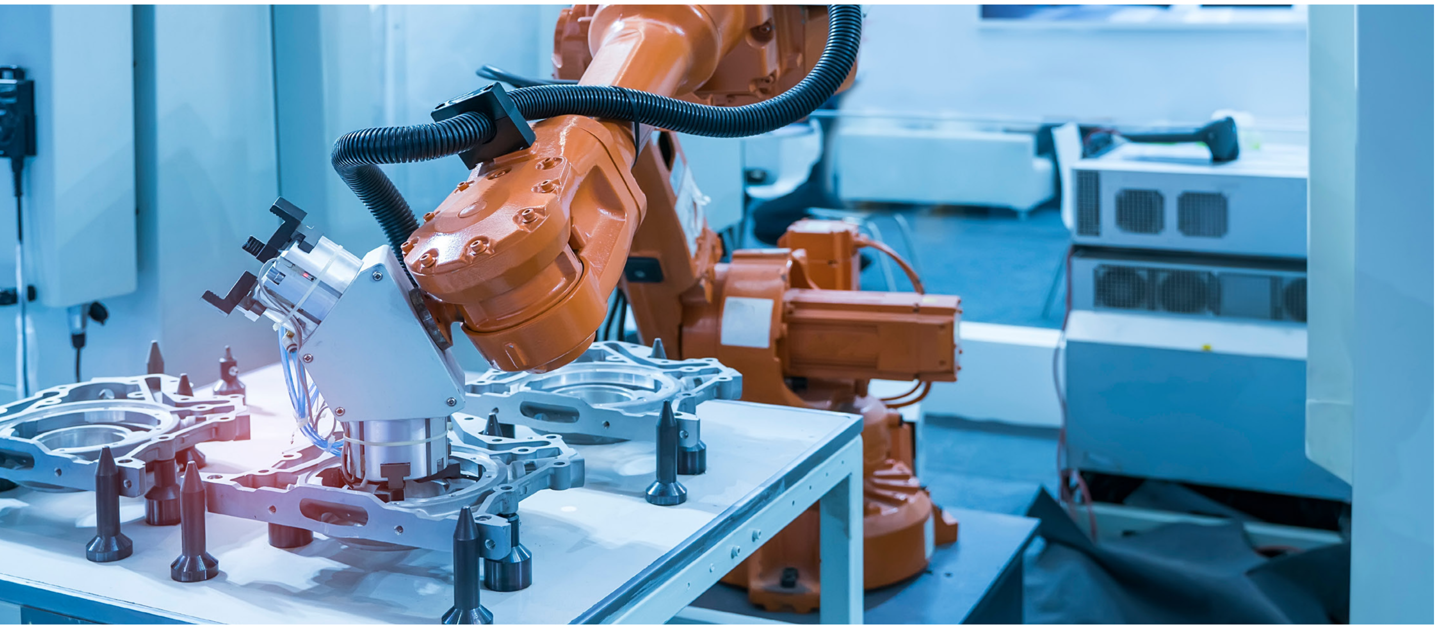
MEP Center impacts are based on clients surveyed in FY2020

$528.6 Million
Total Increased/Retained Sales

5,259
Total Increased/Retained Jobs

$207.3 Million
New Client Investments

$170.6 Million
Cost Savings

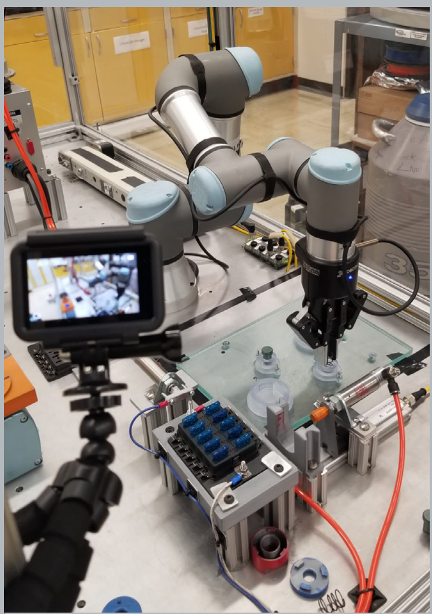


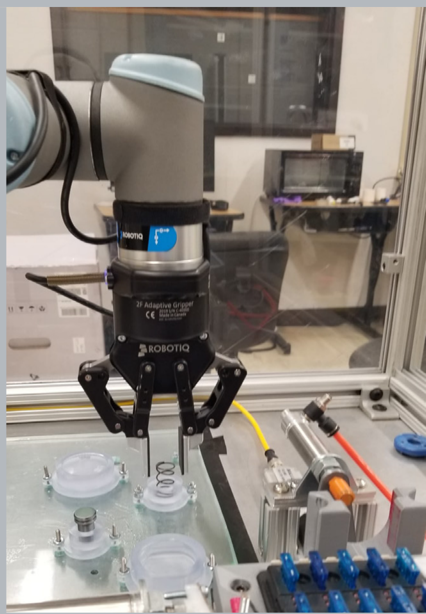
SMART MANUFACTURING LAB

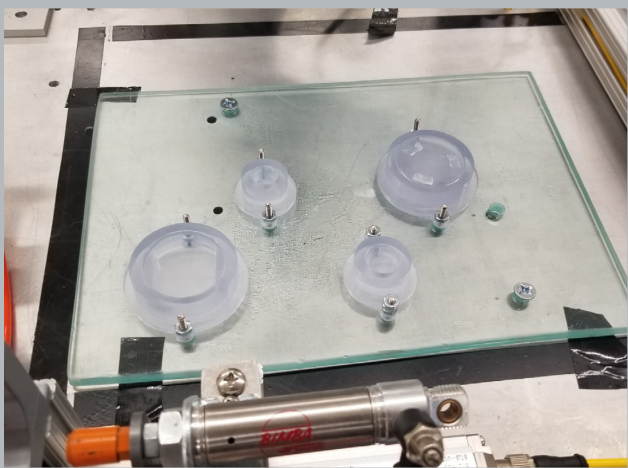
INNOVATION LAB

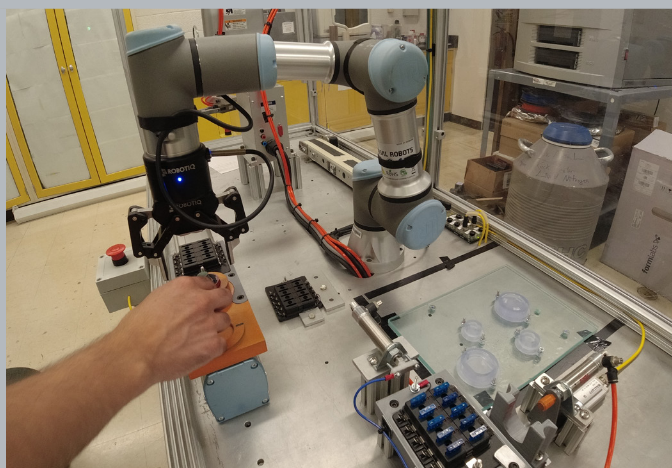
The U.S. manufacturers face many challenges and one of the most impactful is the limited number of skilled workers to support machine automation and robotics in their factories. Hence, this Smart Manufacturing setup is intended to be used to teach the fundamental of industrial robots and automation.

The main objective is to teach a novice an introduction to Programmable Logic Controllers (PLCs), Human Machine Interfaces (HMIs), and collaborative robots programming. Simatic step 7 and Simatic WinCC are used to teach the fundamentals of ladders diagram and HMI programming, respectively. Moreover, the integration of different technologies is covered. For instance, students will learn Human Machine Interface development and integration with ladder diagrams. Lastly, students will be introduced to the industrial applications of collaborative robots and its programming.









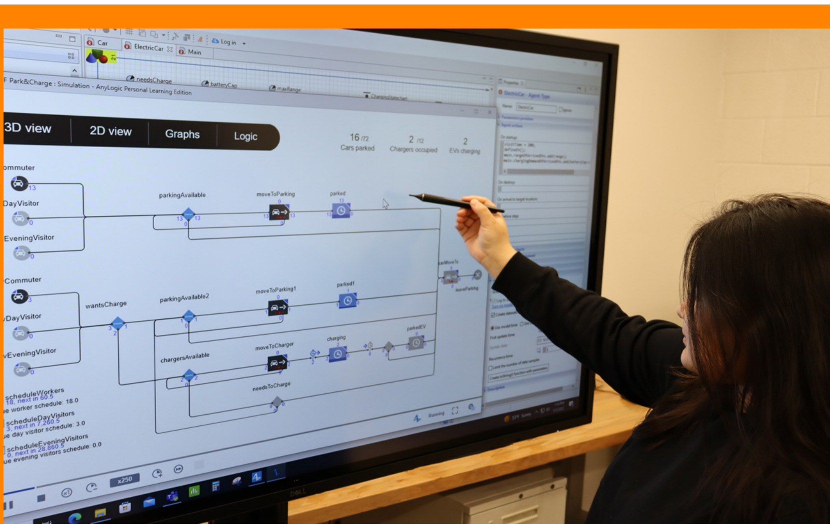
SYSTEMS INNOVATION WITH MODELING AND SIMULATION (SIMS) LABORATORY

The Systems Innovation with Modeling and Simulation (SIMS) laboratory is a specialized facility at UTEP's IMSE Department to develop models of real-world systems and processes and simulate their behavior under various conditions. The primary goal of the SIMS laboratory is to provide state-of-the-art research exposure to students and professionals in developing innovative solutions for complex systems and processes. This can be particularly useful for designing complex systems, optimizing processes, predicting the effects of changes to existing systems, developing new products/services, etc.

The SIMS laboratory is committed to training the next-generation workforce and extending collaboration with local and national industries to overcome their challenges involving the application of mathematical modeling, simulation, optimization, control, and prediction. The laboratory includes high computing performance resources, as well as specialized software tools for creating, analyzing, and visualizing complex systems and processes.

RESOURSES & SOFTWARE

- AnyLogic, University Researcher Version
  - DES, AB, SD and Event-Based Simulation with 2D & 3D Animation
- CAD Software
  - 3D design & modeling
- Alienware
- Stratasys F370 3D Printer
- Interactive, moving Screen
  - 65' Inches
  - Display 3D Rendering



SYSTEMS MODELING & SIMULATION (SMS) CONCENTRATION

Modeling and Simulation (M&S) is an important tool as it helps engineers to design and optimize complex systems and processes. A system can be simple as a single machine or complex as an entire production line. Here, M&S can be used to explore how the systems work and to identify areas where improvements can be made. For example, engineers can use simulation to identify potential bottlenecks in a production line and to test different strategies for increasing throughput and reducing downtime.
Most importantly, it allows engineers to test different "if-then" scenarios without having to make expensive or time-consuming physical modifications to the systems. It is a risk-free way, where engineers can create a virtual model of a system and simulate under different process variants to evaluate the impact of changes. Due to pervasive usefulness, M&S is widely used across many sectors, including manufacturing, healthcare, transportation, supply chain and logistics, warehouse operations, etc. The engineering workforce must gain expertise in M&S to meet critical skill shifts for the industries of today and future.
To make the future leaders, the Department of Industrial, Manufacturing and Systems Engineering (IMSE) at The University of Texas at El Paso (UTEP) is establishing a new concentration in Systems Modeling and Simulation (SMS) in support of the U.S. Department of Education.
This new concentration will allow graduate engineering students to enhance their knowledge in data analytics, computer simulation, machine learning for systems emulation, and augmented and virtual reality (AR/VR) technology. In addition, the newly established laboratory on Systems Innovation with Modeling and Simulation (SIMS) will provide hands-on training on developing simulation models, big data analytics, and AR/VR applications.
In this rapidly evolving environment, Industries face lots of challenges in terms of market growth, efficiency, productivity, and profitability. These challenges cannot be fully addressed using only analytical knowledge. Students who graduate from this concentration will gain the necessary expertise to make significant contribution in searching innovative solutions. This project is cultivating next-generation leaders, especially the minority and female engineering students from the west Texas region.
The concentration is offered the IMSE graduate students. Students who want to pursue the SMS certificate need to complete any of the three courses from the following list:

1 INDUSTRIAL DATA ANALYTICS

Industries, nowadays, are mostly data-driven in taking many strategic decisions. Data analytics can help industries in improving efficiency and productivity, predictive maintenance, quality control, cost savings, taking competitive advantages, and many more. The industrial data analytic course introduces the concepts, algorithms, and techniques to handle big data for data-driven solutions. In this course, students will learn- 1) data preprocessing, 2) descriptive data analytics, 3) mining frequent patterns and correlation, 4) data classification clustering, and (5) data visualization and interpretation. Students will learn and apply all these data analytics techniques using Python programming.

2

COMPUTER SIMULATION APPLICATIONS

In this course, students will be introduced to the different concepts and methods of computer including discrete-event simulation (DES), process-centric modeling, and agent-based simulation to solve mathematically intractable problems in stochastic modeling. The course includes topics such as 1) Queuing theory, 2) Introductory Java programming, 3) Several case studies for DES, 4) Pedestrian modeling, 5) Agent-based modeling, 6) Statistical distribution, 7) Statistical result analysis of simulation output, 8) Presenting simulation using a dashboard, and 9) Model verification and validation. Students will learn these simulation techniques using AnyLogic simulation software.

3

AUGMENTED AND VIRTUAL REALITY (AR/VR) BASED SIMULATION

This course module covers the field of Augmented Reality (AR) and Virtual Reality (VR). AR allows merging of real world with virtual objects superimposed to enable Marker-based tracking and/or Marker-less tracking. VR is a simulation generated with the help of interactive software and hardware, which utilizes the controller and the Head Mounted Devices (HMDs) to replicate real-world scenarios for workforce training and design verification purposes. In this course students will learn to simulate an environment using software like Maya 3D Design and Unity game engine.

4

MACHINE LEARNING FOR SYSTEM EMULATION

This course emphasizes machine learning (ML) and artificial intelligence in system emulation. Students will closely work with different types of ML and AI models. They will further be introduced foundations of simulation and computer experiments in Python, R, Matlab, and/or Julia paired with extensive training in high-performance computing (HPC) such as OpenMP, OpenACC and OpenMPD. Students will have access to these computational resources and receive hands-on experience with statistical emulation based on real-world problems in industrial manufacturing and systems engineering.

ALPHA PI MU

INDUSTRIAL & SYSTEMS ENGINEERING HONOR SOCIETY

The best opportunities to develop skills in effective communication, collaborative leadership, & presentation

Only Top 30% Seniors, Top 20% Juniors, & Grad Students qualify

Mentorships & connections to better prepare for pre-professional opportunities & jobs upon graduation

Socials, certification, sponsorships, leadership retreats, technical and career workshops, & more!

Our members have obtained opportunities with:

- Lockheed Martin
- The Boeing Co.
- Toyota
- Cummins
- Microsoft
- Amazon

Research Areas:

- Renewable Energy
- Model-Based Systems Engineering
- Data Analytics
- Optimization Systems

Studied Abroad:

- Czech Republic
- Spain
- Mexico
- Peru
- Costa Rica

For more info e-mail: alphapimu@utep.edu

Institute of Industrial & Systems Engineers

Vision

We aspire to be recognized as the reference point for Industrial, Manufacturing and Systems Engineering students to request support and as the main way to obtain leadership skills for success beyond college.

Mission

We are devoted to supplement and enhance the ISE curriculum through activities, services, or tools to improve the milestones of engineering students on their college path on their academic and professional areas.

IISE
Operational Excellence Division

Thank you

TO THIS YEAR SUPPORTING PARTNERS AND PRESENTERS

Follow Us!

THE UNIVERSITY OF TEXAS AT EL PASO
College of Engineering,
Industrial, Manufacturing & Systems Engineering,
500 West University Avenue
El Paso, Texas 79968 - 0742
(915) 747-5752
imse.utep.edu