Israa Azzam, Ph.D.

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in Israa-Azzam-034290197

Personal Webpage

Education

Ph.D in Technology, Purdue University, West Lafayette, U.S.

August 2025

Thesis Title: Transforming Teleoperation through Immersive Digitial Twin: XR-Enabled Teleoperation Platform for Industrial Operations.

Thesis Advisor: Professor Farid Breidi

Work Funded by the National Science Foundation (NSF).

GPA: 4/4

M.E. in Mechanical Engineering, American University of Beirut, Lebanon

September 2021

Thesis Title: Semi-Definite Programming (SDP) Approach for Robust State PD Control Design for Descriptor Systems.

Thesis Advisor: Professor Dany Abou Jaoude

Work Supported by the University Research Board (URB) at the American University of Beirut.

GPA: 4/4

B.Sc. in Mechanical Engineering, Beirut Arab University, Lebanon

January 2019

Project Title: Design and Implementation of a Smart Industrial Handling Unit (Semi-Automated Forklift). *Project Funded by the Industrial Research Achievement in Lebanon (IRALEB).*

GPA: 3.83/4

Professional Appointment

Milwaukee School of Engineering (MSOE), Milwaukee, WI

August 2025-Ongoing

Assistant Professor at the Department of Mechanical Engineering

Awards, Honors, and Achievements

T Best Paper Award: IISE Annual Conference

2025

Awarded by the IISE for the paper titled "Investigating the Impact of Stress on Shared Mental Models and Team Performance in Collaborative Mixed Reality Environments".

National Science Foundation (NSF) Travel Support Award

2025

Awarded by NSF to attend the 2025 ASEE Conference.

T Best Poster Award: First Place

2024

Awarded by Industrial Engineering Operation Management (IEOM) World Congress for the research titled "Transforming Teleoperations through Immersive Digital Twins: A Collaborative Extended Reality (XR) Environment for Remote Operations".

National Science Foundation (NSF) Travel Support Award Awarded by NSF to attend the IEOM World Congress.

2024

P Best Paper Award: ASEE Manufacturing Division

2024

Awarded by ASEE Manufacturing Division for the paper titled "Teaching Manufacturing Assembly Processes Using Immersive Mixed Reality".

T Best Paper Award: ASEE Industrial Engineering Division

2024

Awarded by ASEE Industrial Engineering Division for the paper titled "Mixed Reality as a Teaching Tool for Improving Spatial Visualization in Engineering Students".

T Bravo Award: Employee Recognition for Departmental Achievements

2024

Awarded by Purdue University Polytechnic Institute in 2024 for outstanding contributions.

Tertificate of Appreciation: Purdue Polytechnic Grad Student Poster Competition

2024

Awarded by Purdue University Polytechnic Institute for outstanding efforts and performance in organizing the 2024 Purdue Polytechnic Graduate Student Poster Competition.

T Best Student Poster Presentation Award: First Place

2023

Awarded by the 2023 Spring Polytechnic Research Impact Area Student Poster Symposium: Realize Digital Enterprise (RDE) for the research titled "Mixed Reality Technology: A Design Validation Tool for Engineering Applications".

Awards, Honors, and Achievements (continued)

P Best Presentation in Onsite Session

2023

Awarded by the $2023~9^{th}$ International Conference on Computer Technology Applications in Vienna, Austria for the presentation titled "An Investigation of Learning Process with Mixed Reality Technology in STEM Education: The case for a computer-based educational".

Graduate Research Experience

Graduate Research Assistant

2022-2025

Polytechnic Institute, Purdue University, West Lafayette, IN, U.S.

Advisor: Professor Farid Breidi

Collaborators: Professors Jose Garcia, Gaurav Nanda, and Faisal Aqlan

NSF RIEF: Developing Spatial Visualization and Understanding of Complex Systems via Interactive MR Modules

- Designed, developed, and implemented interactive Mixed Reality (MR) Modules to enhance spatial visualization skills and learning of complex engineering concepts within engineering technology courses.
- Incorporated MR modules into engineering technology courses (MET: 230 and MET: 432)
- Conducted research studies and collected and analyzed data to evaluate the effectiveness of MR modules in enhancing learning outcomes.
- Authored four manuscripts as the first author, two of which received **Best Paper Awards**.
- Software Stack: 3ds Max, SolidWorks, Blender, Unity, MRTK2

► Internal Engineering Education Project: Improving Engineering Instruction through XR Technologies

- Collaborated with faculty members and industry mentors.
- Designed, developed, and incorporated XR applications in engineering technology courses.
- Conducted natural language processing (NLP) and statistical descriptive data analysis.
- Authored two journals and five conference papers as the first author.
- **Software Stack:** 3ds Max, SolidWorks, Unity, MRTK2, OVR, Text Analysis Toolbox on Matlab.

Graduate Research Experience (continued)

Research Scholar (Visiting Scholar)

2021-2022

Polytechnic Institute, Purdue University, West Lafayette, IN, U.S.

Advisor: Professor Farid Breidi

Collaborators: Professors Jose Garcia and Jiansong Zhang

► Hydraulic End-Effector Design for Construction Robotics and Automation

- Developed conceptual designs for a hydraulic gripper end-effector.
- Designed, modeled, and simulated the hydraulic gripper end-effector.
- Authored one conference proceeding as the first author.
- Software Stack: 3ds Max, Solidworks, MATLAB/ Simulink & Simscape-SimMechanics.

Improving Hydraulic Hybrid Systems Performance through Digital Hydraulics

- Modeled, simulated, and controlled a series hydraulic hybrid transmission that aims to improve fluid power systems' performance and efficiency through the incorporation of digital hydraulics.
- Integrated experimental data into a Matlab/Simscape simulation model.
- Improved the total efficiency of the series hydraulic hybrid drivetrain by up to 25%.
- Authored one journal paper as the first author.
- **Software Stack:** MATLAB/ Simulink & Simscape-SimMechanics.

Fluid Power Club in the National Fluid Power Vehicle Challenge

- Assisted the Fluid Power Club in the design of a hydraulically actuated bike by conducting mechanical and hydraulic simulation models for the hydraulic bike on Matlab/simscape Multibody.
- Participated in the National Fluid Power Vehicle Challenge, hosted by the National Fluid Power Association (NFPA).
- Traveled with the Fluid Power Club at a National level in Colorado.
- Co-authored a conference proceeding paper.

Graduate Research Assistant

2019-2021

Mechanical Engineering Department, American University of Beirut, Lebanon

Advisor: Professor Dany Abou Joaudy **Co-Advisor:** Professor Elie Shammas

Developing Numerical Methods for Designing Control Laws for Descriptor Systems

- Proposed new methods for synthesizing state-space controllers to tackle the stabilization problem of linear time-invariant (LTI) descriptor systems, with a particular focus on leveraging convex optimization techniques framed within linear matrix inequalities (LMIs).
- Designed, implemented, and validated state-space PD, D, PID, and LQR-LQG controllers utilizing the proposed methods, tackling the stability problem of mechanical and electrical descriptor systems.
- **Software Stack:** C++, MATLAB-Yalmip, MATLAB-Simscape Multibody.

Graduate Teaching Experience

Graduate Teaching Assistant

2022-2025

Polytechnic Institute, Purdue University, West Lafayette, IN, U.S.

Course Instructor: Professor Farid Breidi

MET: 230 Fluid Power (Fall 2022 & Spring 2023)

- Re-designed all the labs.
- Taught and graded the re-designed lab modules for 100 students registered in seven sections.

► MET: 432 Hydraulic Motion Control Systems (Spring 2024)

- Taught two labs per week for 35 students registered in the course.
- Graded the lab assignment, reports, and final project for the 35 student.
- Designed a new laboratory session focusing on pneumatic gripper control and operation. This involved developing the gripper model, designing the pneumatic circuit, creating a simulation model, and 3D printing the gripper kits.

'Visiting Teaching Assisting

2021-2022

Polytechnic Institute, Purdue University, West Lafayette, IN, U.S.

Course Instructor: Professor Farid Breidi

The labs of the MET: 230 Fluid Power

- Supported the collaborative development of new CFD simulation labs in partnership with Simerics Mp+ company.
- Assisted the teaching assistant in teaching and grading seven laboratory sessions per week for over 90 students registered in the course.

► The labs of the MET: 432 Hydraulic Motion Control Systems

- Taught and graded the entire lab assignments along with the projects for 30 students registered in the course.
- Designed the final lab project by developing, modeling, and simulating a Simulink-Simscape model for a Hydraulic Actuator with Analog Position Controller.

Graduate Teaching Assistant

2019-2021

Mechanical Engineering Department, American University of Beirut, Lebanon

Course Instructors: Professor Naseem Daher and Eng. Jihad Kasaman

► Graduate level course MECH: 653 Control System Analysis and Design

- Graded weekly assignments, laboratory reports, quizzes, and project submissions.
- Designed tutorial sessions and extra problems.
- Conducted weekly problem-solving sessions and tutorials, and supervised exam administration.

► Undergraduate level course MECH: 436 Control Systems

- Graded weekly assignments, laboratory reports, quizzes, and project submissions.
- Oversaw the evaluation process for the 100 students enrolled in the course.

► Undergraduate level course MECH: 230 Dynamics

- Graded weekly assignments and quizzes for around 150 registered in the course.
- Proctored exams and graded mid and final exams.

Graduate Grant Writing Experience

Federal Grants National Science Foundation (NSF)

Q Research Initiation in Engineering Formation (RIEF) Program

Grant Awarded in Full

- **Project Title:** Developing Spatial Visualization and Understanding of Complex Systems via Interactive Mixed Reality Modules.
- Principle Investigator: Professor Farid Breidi
- Co-Principle Investigator: Professor Paul Asunda
- Award Number: 2204919Contributing Tasks:
 - Wrote significant sections of the proposal (Project Rationale/Vision, Background, and Research plan) and developed figures and diagrams for the proposal document.
 - Assisted with addressing the reviewers' comments and concerns regarding the technical aspect of the work and the experimental design.
 - Co-led the technical planning and implementation aspects of the project.
- Grant Amount: \$224, 996

Q Ideas Lab

Grant Awarded in Full

- **Project Title:** PEL Engineering Playground: Intelligent Augmented Reality for Personalized Learning Informed by Environmental Identity Development
- Principle Investigator: Professor Farid Breidi
- Award Number: 2431980
- **Contributing Tasks:** Contributed to the literature review, background research, and the development of figures and diagrams for the proposal document.
- **Grant Amount:** \$300,000

Q EHR Core Research

Not Awarded Grant

- **Project Title:** Transforming STEM Education: Integrating Emerging Technologies into Middle and High School Classrooms through Purdue's RET Site
- Principle Investigator: Professor Farid Breidi
- **Contributing Tasks:** Contributed to the writing of the proposal (Project Vision, Background, and Study Framework) and developed figures and diagrams for the proposal document.
- Grant Amount: \$499, 448

Internal Grants

Q Course-based Educational Innovations at Scale Purdue Innovation Hub

Not Awarded Grant

- Project Title: Democratizing the use of Digital Reality Experiences in the classroom
- Principle Investigator: Professor Farid Breidi
- Co-Principle Investigator: Professor Garcia Bravo
- **Contributing Tasks:** Contributed to the writing of the proposal (Introduction & Background and Study Framework) and developed diagrams for the proposal document.
- Grant Amount: \$40,000

Publications

Iournal Articles

- H. M. A. Mageed, I. **Azzam**, and F. Breidi, "State of electrical metrology and possible advancements utilizing extended reality," *MAPAN*, pp. 1–13, 2025. ODOI: 10.1007/s12647-024-00795-6.
- I. **Azzam**, S. Das, G. Nanda, J. Garcia-Bravo, and F. Breidi, "Investigating Safety Awareness in Assembly Operations via Mixed Reality Technology," *IISE Transactions on Occupational Ergonomics and Human Factors*, pp. 1–17, 2024. ODI: 10.1080/24725838.2024.2431112.
- I. **Azzam**, K. El Breidi, F. Breidi, and C. Mousas, "Virtual reality in fluid power education: Impact on students' perceived learning experience and engagement," *Education Sciences*, vol. 14, no. 7, 2024, ISSN: 2227-7102. ODI: 10.3390/educsci14070764.
- I. Azzam, J. Hwang, F. Breidi, J. Lumkes, and T. Salem, "Automated method for selecting optimal digital pump operating strategy," *Expert Systems with Applications*, vol. 232, p. 120 509, Dec. 2023, ISSN: 0957-4174. ODOI: 10.1016/J.ESWA.2023.120509.
- I. Azzam, K. Pate, F. Breidi, M. Choi, Y. Jiang, and C. Mousas, "Mixed reality: A tool for investigating the complex design and mechanisms of a mechanically actuated digital pump," *Actuators*, vol. 12, no. 11, p. 419, 2023. ODI: 10.3390/act12110419.
- K. Pate, I. **Azzam**, F. Breidi, J. R. Marschand, and J. H. Lumkes, "Digitalization of radial piston pumps through internal mechanically actuated designs," *Actuators*, vol. 12, no. 11, 2023, ISSN: 2076-0825. ODOI: 10.3390/act12110425.
- I. Azzam, K. Pate, J. Garcia-Bravo, and F. Breidi, "Energy Savings in Hydraulic Hybrid Transmissions through Digital Hydraulics Technology," *Energies*, vol. 15, no. 4, p. 1348, Feb. 2022, ISSN: 1996-1073.

 DOI: 10.3390/EN15041348.

Conference Proceedings

- I. **Azzam**, K. Bello, F. Breidi, and F. Aqlan, "Analysis of User Experience in Digital Reality: A Comparative Study of VR and MR for Manufacturing Training," in *The 2025 ASEE Annual Conference and Exposition*, Montreal, Canada, 2025. [Accepted for Publication].
- I. Azzam, K. Bello, F. Breidi, and F. Aqlan, "Collaborative Problem-Solving in Mixed Reality Environments for Manufacturing Assembly Tasks," in *The 2025 ASEE Annual Conference and Exposition*, Montreal, Canada, 2025. [Accepted for Publication].
- I. **Azzam**, F. Breidi, and F. Aqlan, "From Single-User to Multi-User Mixed Reality: How Collaborative MR Enhances Teamwork and Problem-Solving in STEM Education," in *The 2025 ASEE Annual Conference and Exposition*, Montreal, Canada, 2025. [Accepted for Publication].
- K. Bello, I. Azzam, F. Aqlan, and F. Breidi, "Investigating the Impact of Stress on Shared Mental Models and Team Performance in Collaborative Mixed Reality Environments," in *Proceedings of the 2025 IISE Annual Conference and Expo*, Finalist in the Best Paper Award Competition HF/E Track, Orlando, Florida, USA, 2025, [Accepted for Publication].
- I. **Azzam**, F. Breidi, and F. Aqlan, "Teaching Manufacturing Assembly Processes Using Immersive Mixed Reality," in *The 2024 ASEE Annual Conference and Exposition*, Portland, Oregon, 2024. **O**URL: https://peer.asee.org/48063.
- I. Azzam, F. Breidi, F. Aqlan, J. Garcia-Bravo, and P. Asunda, "Mixed Reality as a Teaching Tool for Improving Spatial Visualization in Engineering Students," in *The 2024 ASEE Annual Conference and Exposition*, Portland, Oregon, 2024. URL: https://peer.asee.org/47781.
- H. Jabbour, I. **Azzam**, J. Garcia-Bravo, and F. Breidi, "Development of design, control, and data acquisition modules for fluid power education," in *The 2024 ASEE Annual Conference and Exposition*, Portland, Oregon, 2024. **9** URL: https://peer.asee.org/47182.

- K. Zaidan, I. **Azzam**, D. A. Jaoude, and E. Shammas, "Design of robust pd state feedback controllers for descriptor systems," in *The 2024 European Control Conference (ECC)*, 2024, pp. 3854–3859. DOI: 10.23919/ECC64448.2024.10590920.
- 9 I. **Azzam**, F. Breidi, M. Akedre, and C. Mousas, "Design Validation of a Mechanically Actuated Digital Pump Using Mixed Reality Technology," in *The 18th Scandinavian International Conference on Fluid Power (SICFP23)*, Tampere, Finland, 2023.
- I. Azzam, K. Pate, and F. Breidi, "Mixed reality technology: A virtual training tool in fluid power engineering," in *The 2023 ASME/BATH Symposium on Fluid Power and Motion Control*, Sarasota, Florida, 2023. ODI: 10.1115/FPMC2023-111715.
- I. **Azzam**, P. Soudah, and F. Breidi, "Virtual Reality: A Learning Tool for Promoting Learners' Engagement in Engineering Technology," in *The 2023 ASEE Annual Conference and Exposition.*, Baltimore, Maryland, 2023. OURL: https://peer.asee.org/virtual-reality-a-learning-tool-for-promoting-learners-engagement-in-engineering-technology.
- Y. Jiang, M. Akdere, M. s. Choi, I. **Azzam**, F. Breidi, and C. Mousas, "An Investigation of Learning Process with Mixed Reality Technology in STEM Education: The Case for a computer-based educational Technology," in *9th International Conference on Computer Technology Applications (ICCTA 2023)*, Vienna, Austria, 2023.
- K. Pate, I. **Azzam**, F. Breidi, J. R. Marschand, and J. Lumkes, "Digital Radial Piston Pump/Motor Designs using Variable Geometry Camshafts," in *The Scandinavian International Conference on Fluid Power (SICFP22)*, Tampere, Finland, 2023.
- I. Azzam, F. Breidi, S. Dhar, D. Maiti, J. G. Bravo, and P. Asunda, "Gerotor Pump Simulation Modules for Enhancing Fluid Power Education," in *Proceedings of the BATH/ASME 2022 Symposium on Fluid Power and Motion Control (FPMC2022)*, Bath, UK, 2022. URL: https://asmedigitalcollection.asme.org/FPST/proceedings-abstract/FPMC2022/1150217.
- I. **Azzam**, F. E. Breidi, and J. Zhang, "Hydraulic Gripper Designs for Enhancing Construction Robotics and Automation," in *2022 Polytechnic Summit*, Hochschule Darmstadt, Germany, 2022. OURL: https://arrow.tudublin.ie/cgi/viewcontent.cgi?article=1001&context=eutpresscon.
- I. **Azzam**, K. Pate, F. Breidi, and J. Garcia, "Modular Hydrostatic Vehicle used for Engineering Technology," in *The 2022 ASEE Annual Conference and Exposition*, Minneapolis, Minnesota, 2022.

 Our URL: https://peer.asee.org/modular-hydrostatic-vehicle-used-for-engineering-technology.
- K. Pate, I. **Azzam**, J. Lumkes, and F. Breidi, "Comparison of Variable Cam Profiles in Mechanically Actuated Digital Fluid Power Systems," in *The 13th International Fluid Power Conference. IFK March 21-23, 2022, Aachen, Germany, 2022.*

Presentations and Poster Sessions

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Extended Reality-Enabled Teleoperation Platform for Industrial Robotic Operations
4/11/2025
School of Engineering Technology (SOET) Research Day, Purdue University, IN, U.S. [Poster]
Transforming Teleoperations through Immersive Digital Twins: A Collaborative Extended Reality
(XR) Environment for Remote Operations
i 10/09/2024 - 10/11/2024
■ Industrial Engineering and Operations Management (IEOM) World Congress, Detroit, Michigan, U.S
[Poster]

- Developing Spatial Visualization and Understanding of Complex Systems via Interactive Mixed Reality Modules
 - **=** 09/11/2024 09/12/2024
 - Meeting of the 2024 NSF EEC Grantees Conference, Virginia, Washington, DC, U.S. [Poster]

Presentations and Poster Sessions (continued)

Synchronized Digital Reality (DR) Remote Environments for Seamless Control of Fluid Power Manipulators **=** 09/03/2024 - 09/05/2024 ● The 2024 International Maha Fluid Power Conference, Purdue University, West Lafayette, IN, U.S. [Invited Speaker On the Development of Spatial Visual Abilities among STEM Students via Interactive Mixed Reality Modules **i** 06/23/2024 - 06/26/2024 ● The 2024 ASEE Annual Conference and Expositions, Portland, Oregon, U.S. [Poster] * Presented under NSF Grantees Poster Session ☐ Mixed Reality Technology: A Virtual Training Tool in Fluid Power Engineering **i** 10/16/2023 - 10/18/2023 The 2023 ASME BATH Symposium on Fluid Power and Motion Control, Sarasota, Florida, U.S. [Conference Paper ☐ Virtual Reality: A Learning Tool for Promoting Learners' Engagement in Engineering = 06/25/2023 - 06/28/2023▼ The 2023 ASEE Annual Conference and Exposition, Baltimore Convention Center, MD, U.S. [Conference Paper] Design Validation of a Mechanically Actuated Digital Pump Using Mixed Reality **=** 05/30/2023 - 06/1/2023 lacktriangle The 18^{th} Scandinavian International Conference on Fluid Power, Tampere University, Tampere, Finland. [Conference Paper] ☐ Fluid Power in the Era of Digital Reality: Exploring Innovations and Applications $\frac{1}{100}$ 05/9/2023 - 05/10/2023 ▼ The 2023 Maha Fluid Power Conference, Purdue University, IN, U.S. [Invited Speaker] **Extended Reality (XR) for Fluid Power Education a** 04/11/2023 - 04/13/2023 • The 2023 CCEFP Spring Summit, University of Minnesota, MN, U.S. [Invited Speaker] Mixed Reality Technology: A Design Validation Tool for Engineering Applications 03/31/2023 The 2023 Spring Polytechnic Research Impact Area Student Poster Symposium: Realize Digital Enterprise (RDE), Purdue University, IN, U.S. [Poster] * Best Student Poster Presentation Award Gerotor Pump Simulation Modules for Enhancing Fluid Power Education **i** 09/14/2022 - 09/16/2022 ● The 2022 ASME BATH Symposium on Fluid Power and Motion Control, Bath University, Bath, U.K. [Conference Paper] ☐ Hydraulic Gripper Designs for Enhancing Construction Robotics and Automation **a** 06/28/2022 - 06/30/2022 • The 2022 Polytechnic Summit, Darmstadt University of Applied Sciences, Germany. [Conference Paper] **☐** Modular Hydrostatic Vehicle used for Engineering Technology **=** 06/26/2022 - 06/29/2022 ▼ The 2022 ASEE Annual Conference and Exposition, Minneapolis Convention Center, MN, U.S. [Conference Paper

Academic and Community Service

Manuscript Reviewer

2022-Ongoing

American Society of Engineering Education (ASEE).

Journal of Advanced Technological Education (J ATE).

Journal of Expert Systems with Applications (ESWA).

Journal of Engineering Technology (JET).

Archive of Mechanical Engineering.

Regional Conference Coordinator

2025-Ongoing

Manufacturing Division at the American Society of Engineering Education (ASEE).

Academic and Community Service (continued)

Conference Session ModeratorIndustrial Engineering Division at the American Society of Engineering Education (ASEE).

Treasurer and Primary ContactPolytechnic Graduate Student Organization (PGSO), Purdue University, U.S.

Volunteer Contributor

Fluid Power Club (FPC), Purdue University, U.S.

Professional Associations

Elected Member of Phi Kappa Phi Honor Society at Purdue University

Member of the American Society of Engineering Education (ASEE)

Member of the American Society of Mechanical Engineers (ASME)

2022-2024

Skills

- Programming Languages: C++, Visual Basic, Block Programming, LATEX.
- **CAD Design Software**: AutoCAD, 3ds Max, SolidWorks.
- **Modeling/Simulation**: MATLAB-Simulink/Simscape, LABVIEW, Proteus, Automation Studio.
- **©** Control/Optimization: Convex Programming, Mathematica, Yalmip, ROS.
- **Gaming Engines and Toolkits**: Unity, Blender, Mixed Reality Toolkit, Oculus VR, AR Foundation.
- **Text Analysis**: Natural Language Processing (NLP), Sentiment Analysis, Topic Modeling.
- **Q** Languages: Arabic, English

References

Dr. Farid Breidi: Assistant Professor at the School of Engineering Technology (SOET) at Purdue University, U.S.

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765-496-5140

Dr. Faisal Aqlan: Associate Professor for Industrial Engineering in Engineering Management Programs at the University of Louisville, U.S. ■ faisal.aqlan@louisville.edu ✔ 814-315-7690

Dr. Jose Garcia: Associate Professor at the School of Engineering Technology (SOET) at Purdue University, U.S. **■** jmgarcia@purdue.edu **→** 765-494-7312

Dr. Gaurav Nanda: Assistant Professor at the School of Engineering Technology (SOET) at Purdue University, U.S. ■ gnanda@purdue.edu → 765-496-3380

Dr. Christos Mousas: Associate Professor at the Computer Graphic Technology (CGT) Department at Purdue University, U.S. **□** cmousas@purdue.edu **→** 765-496-0633