RAJAE BOUSSELHAM

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OBJECTIVE:

PhD-trained engineer with a strong foundation in heat transfer, multiphysics simulation, and experimental validation, seeking an Full-time position. Excelled in developing finite element simulations and machine learning models to enhance energy efficiency and product quality. Demonstrated expertise in optimizing materials and processes, and passionate about applying engineering principles to solve complex problems and drive innovation in thermal and optical systems.

EDUCATION

Worcester Polytechnic Institute (WPI), Worcester, MA. **August 2021 - December 2025**

PhD, Thermal and Optical Systems Optimization for Architectural Engineering (**GPA:** 4.0/4.0).

Advanced passive adaptive thermal enclosures by integrating SS-PCM, adaptive conductivity, and radiative surfaces, supported by expertise in optical characterization, bioinspired surface optimization, and thermal–optical simulations.

Ecole Nationale Supérieure d'Arts et Métiers (ENSAM), Meknes, Morocco. **September 2014 - July 2019**

Civil Engineering Diploma equivalent to BS/MS degree (Undergrad **GPA**: 3.2/4.0 + Master's degree **GPA**: 3.8/4.0).

PROFESSIONAL WORK EXPERIENCE

Research and development internship – Saint-Gobain. **May – August 2025**

I. Improvement of optical performance of polymer based-films:

- Led R&D project for polymer-based films, optimizing filler type, size, and concentration for maximum optical performance while preserving transparency.
- Developed scalable film formulations and prototypes, performing experimental validation and material characterization to identify the most effective filler–matrix combinations suitable for commercial application.

II. Optimization of pressure sensors for cost-performance efficiency:

- Compared pressure-based sensing to traditional methods and identified advantages in sensitivity and resolution.
- Optimized pressure sensors for high-resolution mapping with minimal structural impact, including design, fabrication, and mechanical testing.
- Validated sensor precision, durability, and minimal structural impact under high-load compression testing.

Teaching Assistant and Researcher (PhD Candidate) – Worcester Polytechnic Institute. **August 2021 – December 2025**

Manage multiple research projects in passive adaptive thermal systems and photonic structures, and mentor undergraduate students in laboratory techniques and research methodologies.

I. Optimization of a multilayer thermal enclosure thickness for Year-Round Energy Efficiency

- Investigated the synergy of combining passive adaptivity thermal conductivity, thermal diode, heat storage, and radiative layers and the impact on thermal behavior and energy consumption.
- Optimized different thermal enclosure configurations for minimum (near zero) year-round energy consumption and material usage for different applications and climates.
- Designed and conducted laboratory experiments to validate optimized theoretical results.
- Developed and implemented advanced Machine Learning models, such as neural networks and Random Forest, to provide optimized wall characterization and design guidance for personalized applications.

II. Bio-inspired optimized surface features for enhanced passive adaptive radiative coating

- Investigated biological surface morphologies and their impact on thermal–optical behavior.
- Built COMSOL finite-element models of PCM-based coatings and integrated global optimization algorithms.
- Optimized surface features to minimize annual heat demand through multi-objective computational modeling.
- Validated designs using nanoscale 3D printing, AFM characterization, and FTIR optical measurements.
- Authored two scientific articles.

III. Teaching assistant for multiple courses including project management, analytical mechanics, introduction to architectural engineering designs, and sustainable engineering systems.

Civil Engineer Manager - Civil Engineering Design Office Karim Berrada (Morocco). **January 2020 – July 2021**

- Led design and planning of multiple building and infrastructure projects with a combined budget of $2.5 million.
- Utilized advanced engineering and management software for structural design and project management.
- Assisted and managed on-site project execution, including field investigations, quality control, planning, and administrative documentation.
- Supervised technical staff, coordinated cross-functional teams, and ensured quality control of the previous projects.

SKILLS

Analyzing and Designing Software: Experienced in numerical modeling using COMSOL Multiphysics, ANSYS Fluent, and Robot Analysis, and design AutoCAD, MATLAB, Revit (BIM), SolidWorks.

General Skills: MS Project (Planning), Office (Word, Excel, PowerPoint).

Programming Languages: Python, PyTorch, TensorFlow

Relevant Skills and Coursework: Design and Optimization of Thermal Systems, Polymer Processing, Optical Testing, Mechanical Testing, Sensor Design, Thermodynamics, Heat Transfer, Applied Finite Element Methods, Solar Cells, Numerical Methods for Nonlinear and Unconstrained Optimization, Data Analysis, Machine and Deep Learning.

Characterization Techniques: Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), UV-Vis Spectrophotometry, Fourier Transform Infrared Spectroscopy (FTIR).

Foreign Language: English (Advanced), French (Intermediate), Arabic (Mother tongue), Hindi (Intermediate).

Life Skills: Teamwork, Communication, Self-motivation, Time Management, Adaptability, Dynamism, Perseverance.

OTHER PROFESSIONAL WORK EXPERIENCE & RELEVANT ACADEMIC PROJECTS

Characterizing Hydrophobicity and Wear Resistance links in Plant Surfaces – WPI. **January – May 2025**

- Investigated the surface morphology of different plant leaves to extract design principles for durable, water-repellent features using AFM combined with controlled nanoscale wear tests.
- Demonstrated that highly structured surfaces exhibited strong hydrophobicity by measuring static contact angles.
- Identified rapid structural degradation and wax displacement in hydrophilic surfaces, correlating smooth surface features with lower contact angles and reduced wear resistance.

Design and Optimization of a Water Distribution System - WPI. **August – December 2022**

- Applied the Lagrange Multiplier technique and used MATLAB to solve a system of nonlinear equations, resulting in a cost-optimized solution with characterized pipe diameters and pump power requirements.
- Conducted a comparative carbon footprint analysis between optimized and non-optimized designs, demonstrating a 68% reduction in annual CO_2 emissions through energy-efficient pump sizing.
- Integrated environmental considerations into system design, including material selection and installation methods, to reduce emissions from construction and operation phases.

Civil researcher internship – Worcester Polytechnic Institute. **February 2019 – July 2019**

Completed research on pavement milling optimization using finite element modeling and novel laboratory experiments.

- Developed and validated computational models using ANSYS for pavement milling simulation.
- Studied and controlled the pavement milling parameters through finite element modeling to optimize the needed energy while maintaining a good quality milling product.
- Tested the milling process using the Drop Tower to validate and confirm the theoretical results.
- Authored a scientific article, and a lecture note.

SCIENTIFIC PUBLICATION

- **Bousselham, R.** et al. (2026). A bioinspired approach for adaptive solid-solid phase change material coatings with optimized surface features for passive thermal regulation. Solar Energy Materials & Solar Cells. https://doi.org/10.1016/j.solmat.2025.114000.
- Xiao, Z., **Bousselham, R.** et al. (2025). Machine learning-optimized porous thermally responsive SS-PCM with switchable transparency for adaptive building envelope coatings. Energy & Buildings. https://doi.org/10.1016/j.enbuild.2025.116593.
- Diouri, K., **Bousselham, R.** et al. (2020). A Study on the Effect of Milling on Stress Distributions in Asphalt Pavements. Springer LNCE. https://doi.org/10.1007/978-3-030-48679-2_89.
- Diouri, K., Wang, S., **Bousselham, R.** et al. (2020). Empirical Study of High Strain Rate Loading and Fragmentation of Hot Mix Asphalt. In ASCE's Journal of Materials in Civil Engineering. ASCE JMCE. https://doi.org/10.1061/(ASCE)MT.1943-5533.0003387.
- Optimizing Multi-layer/Multi-Physics Passive Adaptive Thermal Enclosures for Climate-Responsive Energy Regulation: A Numerical Study. Energy and Buildings. http://dx.doi.org/10.2139/ssrn.5732724 (Under Review).
- Machine Learning–Based Surrogate Modeling for Predicting Energy Performance and Optimal Geometry of Multi-Layer Adaptive Thermal Envelopes (In Preparation).