

# Abdullah El Sabea

PhD Researcher in Additive Manufacturing and Computational Mechanics

Opole University of Technology, Poland | Opole, Poland

Email | Website | LinkedIn | ORCID

## RESEARCH PROFILE

Mechanical engineer and PhD researcher investigating the fatigue response of additively manufactured metallic lattice structures. His work combines controlled mechanical testing, S–N and mean-stress analysis, finite-element modelling, micro-CT, and SEM fractography, with a focus on laser powder bed fusion 18Ni300 gyroids. Earlier work in numerical heat transfer and mechanical design provides a broader computational engineering foundation. A visiting research period at Universidad Politécnica de Madrid extended his lattice research toward functionally graded structures for cervical vertebral-body replacement. His current direction connects experimental evidence, probabilistic fatigue analysis, architected-material design, and emerging biomedical applications.

## RESEARCH EXPERTISE

**Core** Additive manufacturing and LPBF · metallic gyroid/TPMS lattices · fatigue and S–N behaviour · mean-stress effects · finite-element and computational mechanics

**Complementary** Experimental mechanics · micro-CT · SEM fractography · statistical fatigue analysis · architected implant design

## ACADEMIC AND RESEARCH APPOINTMENTS

**PhD researcher, Mechanical Design Engineering** | Opole University of Technology, Poland Oct 2024–present

- Investigates fatigue behaviour of LPBF EOS MS1/18Ni300 gyroid lattices through controlled testing, S–N analysis, mean-stress modelling, and finite-element assessment.

**Research and technical specialist** | Opole University of Technology, Poland Oct 2024–present

- Supports additive-manufacturing workflows, including FDM operation and LPBF/SLM build preparation, and conducts mechanical fatigue testing.

**Research project scholarship holder** | Opole University of Technology, Poland 2025

- Contributed to an NCN OPUS project on building energy flexibility through dynamic-emulator development, structured research data, and literature analysis.

## CURRENT DOCTORAL RESEARCH

**Fatigue mechanics of LPBF 18Ni300 gyroid lattices** | Opole University of Technology 2024–present

- Quantified S–N response across multiple stress ratios and examined mean-stress sensitivity using Walker-type modelling and probabilistic fatigue analysis.
- Integrated lattice geometry, surface condition, mechanical testing, numerical modelling, micro-CT, and SEM fracture-surface evidence to interpret fatigue behaviour.
- Developing a three-factor Box–Behnken fatigue campaign spanning 13 gyroid families at controlled nominal density, with approximately 260 specimens planned.

## SELECTED RESEARCH PROJECTS AND INTERNATIONAL MOBILITY

**Functionally graded gyroid cervical vertebral-body replacement** | Poland and Spain Ongoing

- Developing a graded TPMS/Gyroid architecture for cervical vertebral-body replacement through computational design and mechanical assessment; initiated in Poland and advanced during research activity in Madrid.
- Future work targets more realistic biomechanical validation; the current project is a computational and engineering study.

**Visiting researcher** | Universidad Politécnica de Madrid, Spain Apr–May 2025

- Collaborated on lattice design and optimisation, biomedical lattice development, and experimental and numerical assessment of architected structures.

**Numerical heat-transfer research** | Gdańsk University of Technology, Poland 2021–2022

- Modelled heat transfer in gas-fired water-boiler exchangers using analytical calculations and ANSYS Fluent; the work later appeared as a TechRxiv preprint.

## PUBLICATIONS

### Peer-reviewed journal articles

**Abdullah El Sabea**, Mateusz Kowalski, Andrzej Kurek. Mean stress effects in laser powder bed fusion 18Ni300 gyroid lattices: Probabilistic fatigue behaviour and Walker model collapse. *International Journal of Fatigue*, 214 (2027), 109934. 10.1016/j.ijfatigue.2026.109934

Yuanfeng Dai, Yuanchao Qiu, **Abdullah El Sabea**, Jakub Zielonka, Zhixiong Li. A comprehensive 6E analysis and optimization of a SOFC-based trigeneration system model for marine applications. *Energy Conversion and Management: X*, 28 (2025), 101327. 10.1016/j.ecmx.2025.101327

### Preprint

**Abdullah El Sabea**, Jacek Barański, Paweł Dąbrowski. The numerical analysis of the heat transfer process in selected surfaces of the water boiler. *TechRxiv* (2024). 10.36227/techrxiv.171319767.72580674/v1

## EDUCATION

|                                                                                       |              |
|---------------------------------------------------------------------------------------|--------------|
| <b>PhD in Mechanical Design Engineering</b>   Opole University of Technology, Poland  | 2024–present |
| <b>MBA in Artificial Intelligence</b>   Talal Abu-Ghazaleh University, Jordan         | 2024–2025    |
| <b>MSc in Mechanical Design Engineering</b>   Gdańsk University of Technology, Poland | 2021–2022    |
| <b>BEng in Mechanical Engineering</b>   Beirut Arab University, Lebanon               | 2013–2018    |

## GRANTS, SCHOLARSHIPS AND DISTINCTIONS

|                                                                                                                                                                                           |      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>STER Best PhD Student award and scholarship</b>   Opole University of Technology / NAWA                                                                                                | 2025 |
| <b>STER international research mobility grant</b>   Opole University of Technology / NAWA                                                                                                 | 2025 |
| <b>RID doctoral research minigrant</b>   Opole University of Technology<br>Project: “Surface Area Effects on Fatigue Performance of Lattice Structures in 3D Printed EOS MS1 Tool Steel.” | 2025 |
| <b>NCN OPUS research project scholarship</b>   Opole University of Technology                                                                                                             | 2025 |
| <b>Ignacy Łukasiewicz Scholarship</b>   Polish National Agency for Academic Exchange                                                                                                      | 2020 |

## SELECTED PRESENTATION AND RECOGNITION

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| <b>First-place poster award</b>   XXXIX PRMR Conference, Zakopane, Poland<br>Poster on fatigue analysis of additively manufactured lattice structures. | 2026 |
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## EARLIER ENGINEERING EXPERIENCE

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| <b>Application Engineer</b>   Diabatix, Belgium<br>Applied computational thermal design and topology optimisation to heat-sink engineering.               | 2023      |
| <b>Mechanical Design Engineer</b>   Freelance, Poland<br>Developed 3D mechanical designs and CFD studies for thermal and mechanical engineering projects. | 2020–2023 |

## TECHNICAL EXPERTISE

**Experimental mechanics** Fatigue and mechanical testing · specimen preparation · design of experiments · micro-CT · SEM fractography  
**Computational mechanics and design** Finite-element analysis · numerical modelling · fatigue modelling · CAD · TPMS/Gyroid design · ANSYS Fluent  
**Scientific computing and data** Python · MATLAB · statistical analysis · experimental data processing  
**Manufacturing** LPBF/SLM build preparation · FDM operation · additive-manufacturing workflows

## LANGUAGES

Arabic (native) · English (C1) · Polish (A2)