

ADMISSION TO DOCTORAL STUDIES

Session September 2025

Field of doctoral studies: Mechanical Engineering

Doctoral supervisor: Prof. Dr. Eng. Călin Itu

TOPICS FOR THE ADMISSION TO DOCTORAL STUDIES

TOPIC 1: Study of the mechanical behaviour of 3D printed components through correlation of digital images and advanced numerical simulations

Contents / Main aspects to be considered

- analytical models for calculating stresses and strains in a part under various loading scenarios
- finite element analysis of stress and strain fields of 3D printed parts
- experimental analysis techniques based on digital image correlation DIC
- correlation between experiment and simulation
- case studies and practical applications

Recommended bibliography:

1. Gibson, I., Rosen, D. W., & Stucker, B. (2021).
Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing. Springer.
2. Ngo, T. D., Kashani, A., Imbalzano, G., Nguyen, K. T. Q., & Hui, D. (2018).
Additive manufacturing (3D printing): A review of materials, methods, applications and challenges. *Composites Part B: Engineering*, 143, 172–196.
3. Rankouhi, B., Javadpour, S., Delfanian, F., & Letcher, T. (2016).
Failure analysis and mechanical characterization of 3D printed ABS with respect to layer thickness and orientation. *Journal of Failure Analysis and Prevention*, 16(3), 467–481.
4. Sutton, M. A., Orteu, J. J., & Schreier, H. (2009).
Image Correlation for Shape, Motion and Deformation Measurements. Springer.
5. Pan, B., Qian, K., Xie, H., & Asundi, A. (2009).
Two-dimensional digital image correlation for in-plane displacement and strain measurement: a review. *Measurement Science and Technology*, 20(6), 062001.
6. Sutton, M. A., & Schreier, H. W. (2021).
Digital Image Correlation: Advanced Applications and Emerging Trends. Springer.
7. Zienkiewicz, O. C., Taylor, R. L., & Zhu, J. Z. (2013).
The Finite Element Method: Its Basis and Fundamentals. Elsevier.
8. Baig, M. U., Sherazee, M. A., & Rehman, M. (2022).
Numerical modeling of 3D printed structures using finite element analysis (FEA). *Additive*

Manufacturing Letters, 1, 100006.

9. Helfenstein, P., & Michaud, V. (2015).

Validation of finite element simulations using digital image correlation: application to polymer composite structures. *Composites Part A: Applied Science and Manufacturing*, 77, 106–118.

10. Blaysat, B., Lubineau, G., & Grédiac, M. (2013).

A comparative study of three techniques for the validation of finite element models using full-field measurements. *Mechanical Systems and Signal Processing*, 37(1-2), 103–122.

11. ASTM F2971-13.

Standard Guide for Characterizing Properties of Metal Materials Made via Additive Manufacturing Processes. ASTM International.

MATLAB / Python (NumPy, SciPy, PyDIC) – official documentations.

Prerequisites / Remarks:

- knowledge and calculation methods from Strength of Materials and Theory of Elasticity;
- Fundamental knowledge of finite element analysis (FEM) and experimental data processing

☒ **Scientific Doctorate (full-time only)**

☐ **Professional Doctorate (full-time or part-time)**

☒ **without tuition fee (state budget funded)**

☐ **with tuition fee or with funding from other sources than the state budget**

Doctoral supervisor,

Prof. Dr. Eng. Călin Itu

Coordinator of the field of doctoral studies,

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