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LACE-X The path from a research idea to results-sharing using the EOSC to answer a research question – perspective of the PhD student and the PostDoc researcher

Yunus Emre Yılmaz, Nejc Novak

Faculty of Mechanical Engineering, University of Maribor, Slovenia



Maribor, September 2022

Outline

- Introduction
- From idea to publication and patent
 - -#1 prospective PhD student
 - -#2 PostDoc researcher





Personal presentation

• Nejc Novak



- **Position, Academic title:** Assistant professor
- Affiliation: University of Maribor, Faculty of Mechanical Engineering
- **Research interest:** computational dynamic, crashworthiness, fluidstructure interaction, lightweight materials
- Eng. software skills: LS-DYNA, ABAQUS, ANSYS, Catia, SolidWorks





Personal presentation

• Yunus Emre Yılmaz



- Position, Academic title: Young researcher
- Affiliation: University of Maribor, Faculty of Mechanical Engineering
- **Research interest:** Lightweight materials, computer vision, precision machine design, additive manufacturing
- Eng. software skills: SolidWorks, Siemens-NX, PTC-Creo, Python





LACE-X

Laboratory for advanced computational engineering and experimenting Head of Laboratory: prof. dr. Zoran Ren

Staff: 3 professors, 2 assistant professor, 2 young researchers

Equipment: SHPB, 2x Photron FASTCAM SA-Z + DEWESoft SIRIUSi HS 8x STG+, HPC (~5000 CPUs)













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Problem definition

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Originality analysis



No Key words

- 1 Cellular-structures
- 2 Triply-periodic-minimal-surfaces
- 3 "High-strain-rate-deformation" OR "impact"
- 4 Direct-impact
- 5 Digital-image-correlation
- 6 Computational simulations
- 7 Non-parametric
- 8 Spatial-image-correlation



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Problem definition



long plateau stress \rightarrow high energy dissipation

Figure 1: Pre-collapse stage, plateau stage, densification stage [1]





Problem definition



Figure 2: Typical TPMS structures [2]





Research question

• Research question: How to obtain relevant material data required for appropriate computational modelling of TPMS structures?

 Hypothesis: Improved non-parametric analysis methodology will return the complete set of relevant material data required for computational modelling of TPMS structures.





Computer Vision Algorithms









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Lab Equipment

















Outline #2













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Scientific Domains



Research idea

• Transformatio quadratic to a:





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Idea









State of the art

• Literature and patents review



Idea

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Experiments

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• Design of geometry





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In the context of intangibles, a software tool was purchased – **National Instruments ASL+, LabVIEW and Multisim**. The specified licensed software within the project enables capturing and processing various measurement data.





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Experiments



• Fabrication







Computational simulations

- PrePoMax **PrePoMax**
 - The PrePoMax is designed to prepare input fileand perform finite element analysis, which has been under development since 2016.

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 Basically, it is a modern user environment developed in the C# programming language, which connects several open source libraries in the background in one environment.





https://prepomax.fs.um.si/

Computational simulations

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State of

the art

Idea

Research

• PrePoMax PrePoMax







Computational simulations

• HPC RIVR

- HPC RIVR is the most powerful public supercomputer in Slovenia. It operates with the aim of opening up new research and development fields in segments that help to shape global trends. The computing capacities are available according to the open research infrastructure principle.

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 The project "Upgrading national research infrastructures – HPC RIVR" is aimed at establishing a national supercomputing centre with the principal objective of strengthening national high performance computing capacities for the needs of the Slovenian research and innovation as well as economic area. The project is funded by the European Union from the European Regional Development Fund (80%) and the Ministry of Education, Science and Sport (20%) within the framework of the Operational Programme for the implementation of the European Cohesion Policy in the period 2014-2020.





Patent application

- Slovenian patent granted
- European patent pending
 - Already provided answers to the EPO comments

Vesenjak, M., Novak, N., & Ren, Z. (2021). *Axisymmetric chiral auxetic structure* (Patent No. EP21197296.3). European Patent Office.





Data repositories

• In 2016, a paper by Wilkinson et al. '<u>FAIR Guiding Principles for scientific data management and stewardship</u>' was in the journal *Scientific Data*. The authors provided guidelines to improve the Findability, Accessibility, Interoperability, and Reuse of digital assets. This and similar initiatives emphasize the importance of thorough meta-data, identifiability (e.g. DOI), and machine-readability. The <u>Go-FAIR</u> website offers a more thorough overview of the FAIR principles.

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the art

Research

- Here are some <u>non-profit</u> data repositories that fulfill the FAIR principles:
- <u>EDUAT</u> sustained by a network of more than 20 European research organizations, EDUAT can be used for soring, managing, and sharing research data of any form.
- <u>Harvard Dataverse</u> hosted by Harvard University, this data repository offers free storage of research data. Like all of the services in this list, it will assign a Digital Object Identifier to your data to ensure it is credited to you.
- <u>Zenodo</u> developed by the EU-funded project ApenAire, it is hosted by CERN. The repository is particularly useful for EU-funded projects because it allows directly reporting to the EU research <u>Participant Portal</u>.
- **Dryad** originally developed with funding from the US NSF, Dryad can be used for data sets of any type that correspond to a research paper. The data is curated and the users are charged for submissions.
- Here are some well recognized data repositories, owned by <u>private companies</u>:
- <u>GitHub</u> owned by Microsoft, GitHub has become the default data repository for coders. 500MB of private and unlimited public space is offered for free.
- **Figshare** owned by Digital Science, Figshare provides a DOI for all published files, regardless of the file format. 20GB of private and unlimited public space is offered with a free account.
- **Protocols.io** designed for sharing research methodology, descriptions of clinical trials, and computational workflows. Owned by ZappyLab, Inc.



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- **PsyArXiv** preprint server for papers in psychology
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Conclusions

- More EOSC solution has to be developed and also shared in the field of engineering
- They offer a great possibility to share knowledge which can accelerate the research
- Copyrights and further use of the tools must be considered taken into account





Thank you for your attention!



