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First TU researcher with four ERC grants: Project on machine learning for electron microscopy receives EU funding

Darmstadt, July 11, 2024. Leopoldo Molina-Luna, Professor of Electron Microscopy at TU Darmstadt, is the first TU researcher to receive funding from the European Research Council (ERC) for the fourth time. Following Starting and Consolidator Grants, Molina-Luna is now receiving a Proof of Concept Grant. The new project "BED-TEM", which is receiving 150,000 euros of funding for 18 months, aims to make methods of machine learning accessible for use in electron microscopy in a user-friendly manner. In doing so, it should help to optimise the design of experiments.

"BED-TEM" ("Bayesian Experimental Design for in situ (Scanning) Transmission Electron Microscopy") is designed to give researchers a new tool for working with in situ (scanning) transmission electron microscopy, (S)TEM for short: a software platform that helps to optimise the parameters of experiments.
The aim of the project is to introduce a software platform that combines Bayesian optimisation for optimal experimental design – a special method of experimental optimisation using machine learning – with the analysis of images provided by (S)TEM. This enables researchers to efficiently select and determine the parameters for their experiments. This process is often still determined by trial and error at present. The platform comprises a user interface and image processing and experimental design modules, which offer a rationalised workflow and good user-friendliness.
The challenges of the project include adapting machine learning to (S)TEM data and ensuring market demand for the software platform. The project will address these points through close collaboration with practitioners and industrial partners, among other things. A software solution should thus be created that is oriented towards the needs of users and is economically viable.
Using expert knowledge of machine learning and (S)TEM expertise, the team led by Molina-Luna is closing a gap between complex experimental setups and the practical application of Bayesian methods. This could revolutionise the implementation of in situ experiments.
"BED-TEM" also offers great potential for science and the further development of materials science as a discipline. The new software should enable precise characterisation of the behaviour of materials on the nanoscale under real conditions. One potential field of application is nanoelectronics.
With the BED-TEM project, Molina-Luna is building on the project "Functionality of Oxide based devices under Electric-field: Towards Atomic-resolution Operando Nanoscopy" (FOXON), for which he received an ERC Starting Grant in 2018.

Proof of Concept Grant
A Proof of Concept Grant is funding that supplements the research grants from the European Research Council (ERC). It is exclusively aimed at researchers who already have an ERC grant and want to use research findings from their current or completed project pre-commercially. This is the first step towards a technology transfer. The aim of a proof of concept project should be to assess the market potential of such an idea. Therefore, the ERC does not use these grants to fund research activities, but instead funds measures for further development with regard to the application maturity, commercialisation or marketing of the idea. In the latest round of funding, 100 proposals from 17 countries were

awarded an ERC Proof of Concept Grant.

Personal profile
Leopoldo Molina-Luna has been a professor at TU Darmstadt since March 2020 and heads the Advanced Electron Microscopy (AEM) Division at the Institute of Materials Science (Materials and Earth Sciences Department) and the In Situ Microstructural Analytics Lab at the Center for Reliability Analytics (CRA).
He obtained a doctorate in Physics at the University of Tübingen. His Postdoc Fellowship at EMAT in Antwerp was funded by an ERC Advanced Grant. He received an ERC Starting Grant (for the FOXON project) in 2018 and an ERC Proof of Concept Grant (for the STARE project) in 2020 as well as an MIT Germany Global Seed Fund. The ERC awarded him a Consolidator Grant for his "ELECTRON" project in 2023. Molina-Luna's current research focuses on the understanding of structure-property correlations in functional materials for energy engineering and on the development of in situ/operando transmission electron microscopy.

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