Exponent®
Engineering & Scientific Consulting

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Professional Profile

Dr. Tu specializes in solid mechanics, computational finite element analysis (FEA), additive manufacturing, metallurgical characterization, and possesses a profound understanding of novel alloys, structural design, and manufacturing processes.

Dr. Tu's expertise in FEA model development, troubleshooting, and parameter validation benefits a range of industrial applications, including automotive, aerospace, medical devices, digital products, CAE software and material database development. His hands-on experience in manufacturing processes optimization provides valuable insights into factory audits, fabrication digital twinning, and failure root cause analysis for metal fabrication companies, and the energy sector. He utilizes his metallurgical and micromechanics knowledge to investigate strength, fatigue, and creep properties of alloys such as Ti-6Al-4V, CoCr, and stainless steels, and develop advanced surface technology and functional gradient material for metal R&D centers. Dr.Tu is also proficient in product safety reviews and export eligibility checks, and has helped clients in medical devices and electrical appliances to mitigate risks and avoid compliance hurdles.

Dr. Tu is well-versed in cutting-edge manufacturing technologies such as 3D printing (Renishaw SLM, 3D System PBF machines) and laser welding, complemented by post-heat treatment expertise. Dr. Tu's capabilities extend to the development of computational tools, with proficiency in programming languages like Fortran, Python, and MATLAB. He has integrated multi-scale and interdisciplinary approaches to conduct FEA meshing and predict mechanical properties directly from SEM/EBSD microstructural images. He also develops automation and deep learning tools for straightforward and efficient quality control.

Prior to joining Exponent, his research at the National University of Ireland, Galway, included the creation of computational models for additive manufactured alloys, highlighting a dedication to process-structure-property research. These works include the through-process ABAQUS (core modified and constitutive subroutine implemented) models to predict dislocation-based stress and fatigue life, phase-field theories (MOOSE and OpenPhase) to control grain growth during heat treatment, VASP calculation of stacking fault energy on plastic deformation, and a machine learning tool (TensorFlow) with GUI in the industry.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, National University of Ireland Galway (NUIG), Ireland, 2022

M.Sc., Materials Science and Engineering, University of Birmingham, UK, 2017

B.Eng., Materials Forming Control Engineering, Nanjing Institute of Technology (NJIT) 南京工程学院, 2016

Publications

Tu, Y, Yang, L, Vasquez, D, Novel Insight into Finite Element Modeling: Applications in Failure Analysis and Engineering Problem Solution, 19th China Annual CAE Conference Journal Collection

Tu, Y., Leen, S. B., & Harrison, N. M. (2023). Managing the Inevitable Microstructural and Property Heterogeneity in Powder Bed Fusion Ti-6Al-4V Parts via Heat Treatment. Journal of Alloys and Compounds, 172309.

Tu, Y, Liu, Z, Carneiro, L, Ryan, CM, Parnell, AC, Leen, SB, Harrison, NM. Towards an instant structure-property quality control tool for additive manufactured steel using a crystal plasticity trained deep learning surrogate. Materials & Design 213 (2022) 110345.

Tu, Y, Leen SB, Harrison NM. A high-fidelity crystal-plasticity finite element methodology for low-cycle fatigue using automatic electron backscatter diffraction scan conversion: Application to hot-rolled cobalt–chromium alloy. Proceedings of the Institution of Mechanical Engineers, Part L: Journal of Materials: Design and Applications. 2021;235(8):1901-1924.

Presentations

Tu, Y. "Modelling the effect of inevitable microstructural inhomogeneity on the strength of powder bed fusion manufactured Ti-6Al-4V parts", 11th European Solid Mechanics Conference (ESMC), 4-8 July 2022, Galway, Ireland

Tu, Y. "Crystal plasticity inspired deep learning surrogate for instant structure-property prediction of additive manufactured alloys", 24th Sir Bernard Crossland Symposium, 22-24 September 2021, Dublin, Ireland.

Tu, Y. "Coupled phase-field and crystal plasticity modelling to investigate the process-structure-property relationship of heat treatment for additive manufactured alloys", 32nd Solid Freeform Fabrication (SFF) Symposium, 2-4 August 2021, Texas, USA

Tu, Y. "Investigate the effect of heat treatment on metals manufactured via powder bed fusion using image-based phase-field and crystal finite element modelling", The 14th Congress WCCM & ECCOMAS 2020, 8-12 January 2021, Paris, France

Tu, Y. "A methodology for image-based crystal plasticity finite element modelling of microstructure-sensitive fatigue behavior", International Congress on Welding, Additive Manufacturing and Associated Non-destructive Testing (ICWAM), 3-7 June 2019, Metz, France.

Project Experience

1. Analyzed welding failure, focusing on microstructural features, grain size, weld penetration, inclusions, and HAZ in weld area. Employed optical microscopy, SEM/EDS, micro-hardness, nano-indentation, and peel tests to evaluate weld strength and quality.
2. Conducted a safety design review for consuming electrical products, from mechanical and structural, electrical, and thermal aspects.

Peer Reviews

Materials & Design

Metals and Materials International

Journal of Materials Informatics

Journal of Open-access Software