Exponent®
Engineering & Scientific Consulting

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Professional Profile

Dr. Eghtesad specializes in computational solid mechanics and mechanics of materials with an emphasis on deformation response and fatigue and failure in metals, alloys and additively manufactured superalloys. Using these specialized skills, Dr. Eghtesad provides assistance to clients in a wide range of industry sectors including medical devices, consumer electronics, automotive, aerospace and heavy industry. He has more than a decade of experience in simulation and review of advanced materials and structures leveraging finite element analysis as well as micromechanical and multiscale tools such as crystal plasticity and associated experimental testing/characterization such as mechanical testing and scanning electron microscopy. He has gained valuable experience in leveraging high performance computing and data science for modeling complex mechanical structures and assemblies, helping clients to assess designs, manage manufacturing challenges, and improve product performance. Dr. Eghtesad's experience in conducting failure analysis using mechanical engineering tools has been leveraged on multiple investigations of complicated failures serving clients with matters ranging from industrial facilities to medical devices.

Prior to joining Exponent, Dr. Eghtesad served as a postdoctoral fellow in the Sibley School of Mechanical and Aerospace Engineering at Cornell University and the Materials Science and Engineering department at the Pennsylvania State University. Dr. Eghtesad received his PhD in the Mechanical Engineering from the University of New Hampshire in 2021. During his postdoctoral appointment at Cornell University, Dr. Eghtesad developed an automated data driven model using neural networks within PyTorch that improved the performance of material modeling in metals. During his postdoctoral appointment at the Pennsylvania State University, Dr. Eghtesad improved uncertainties in modeling the flow response of metals and in particular high-entropy alloys (HEA). He also developed a machine learning based crystal plasticity framework for identifications of microstructural features responsible for micromechanical stress/strain localizations. Dr. Eghtesad's doctoral work was conducted in collaboration with Los Alamos National Laboratory (LANL) where he focused on the structure-property relationships in metals and metallic alloys including advanced high strength steels (AHSS) as well as additively manufactured (AM) Nickel and Cobalt superalloys. He developed a multi-scale crystal plasticity framework within the finite element method for prediction of large plastic deformation in metallic components with arbitrary geometry and loading conditions. The framework takes the advantage of parallel high-performance computing (HPC) with distributed graphics processing units (GPU) parallel capabilities and facilitates efficient multiscale simulations. He applied his work to a wide range of metal forming applications such as cup drawing in Aluminum and bending in Zirconium, Titanium and Uranium.

Prior to his PhD, Dr. Eghtesad served as a design engineer where he utilized and instructed Ansys Workbench for finite element analysis of solids and structures as well as computational fluid dynamics (CFD) for modeling fluid-structure interactions (FSI) at large scales. He developed a meshless Smooth Particle Hydrodynamics (SPH) solver for prediction of high/hyper velocity impact, fracture, fragmentation and failure in metallic, ceramic and functionally graded materials under extreme conditions. Dr. Eghtesad's work has been used in submitting technical reports to National Science Foundation (NSF),

Department of Energy (DOE) and Air Force Office of Scientific Research (AFOSR) and resulted in 24 peer-reviewed journal publications. Dr. Eghtesad has demonstrated the impact of his work through professional talks at international conferences including the Minerals, Metals and Materials Society (TMS).

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, University of New Hampshire, 2021

STAF (Summer TA Fellowship) - University of New Hampshire 2019

DYF (Dissertation Year Fellowship) - University of New Hampshire 2015

CEPS (College of Eng. and Physic. Sci. Fellowship) - University of New Hampshire 2015

IRPS (Int. Postgrad. Research Scholarship) - University of Queensland 2015

MGS (Monash Graduate Scholarship) - Monash University 2015

IGSES (Int. Grad. Scholarship) - University of Manitoba 2015

Prior Experience

Research Scientist (Postdoctoral Fellow), Cornell University, 2022-2023

Research Scientist (Postdoctoral Fellow), Pennsylvania State University, 2021-2022

Research Assistant (PhD), University of New Hampshire, 2016-2021

Design Engineer, National Elites Foundation, 2011-2016

Professional Affiliations

Member of the Minerals, Metals & Materials Society (TMS)

Postdoctoral Fellow, Mechanical and Aerospace Engineering, Cornell University, 2022-2023

Postdoctoral Fellow, Materials Science and Engineering, The Pennsylvania State University, 2021-2022

Publications

Published

Eghtesad, Adnan, Qixiang Luo, Shun-Li Shang, Ricardo A Lebensohn, Marko Knezevic, Zi-Kui Liu, and Allison M Beese (2023). “Machine learning-enabled identification of micromechanical stress and strain hotspots predicted via dislocation density-based crystal plasticity simulations”. In: International Journal of Plasticity, p. 103646.

Eghtesad, Adnan and Germaschewski, Kai and Marko Knezevic (2022). “Coupling of a multi-GPU accelerated elasto-visco-plastic fast Fourier transform constitutive model with the implicit finite element method”. In: Computational Materials Science 208, p. 111348.

Eghtesad, Adnan and Shimanek, John D, Shun-Li Shang, Ricardo Lebensohn, Marko Knezevic, Zi-Kui Liu, and Allison M Beese (2022). “Density functional theory-informed dislocation density hardening within crystal plasticity: Application to modeling deformation of Ni polycrystals”. In: Computational Materials

Science 215, p. 111803.

Liu, Zi-Kui, Shun-Li Shang, Allison M Beese, Yi Wang, Eghtesad, Adnan, John Shimanek, Shipin Qin, Shuang Lin, Hui Sun, and Brandon Bocklund (2022). High Throughput Computational Framework of Materials Properties for Extreme Environments. Tech. rep. Pennsylvania State Univ., University Park, PA (United States).

Eghtesad, Adnan and Knezevic, Marko (2021). “Modeling cyclic plasticity of additively manufactured alloy Mar-M-509 using a high-performance spectral based micromechanical model”. In: Applications in Engineering Science 7, p. 100065.

Eghtesad, Adnan and Germaschewski, Kai, Ricardo A Lebensohn, and Marko Knezevic (2020). “A multi-GPU implementation of a full-field crystal plasticity solver for efficient modeling of high-resolution microstructures”. In: Computer Physics Communications 254, p. 107231.

Eghtesad, Adnan and Knezevic, Marko (2020). “A full-field crystal plasticity model including the effects of precipitates: Application to monotonic, load reversal, and low-cycle fatigue behavior of Inconel 718”. In: Materials Science and Engineering: A, p. 140478.

Barrett, Timothy J., Rodney J. Eghtesad, Adnan and McCabe, Bjørn Clausen, Donald W. Brown, Sven C. Vogel, and Marko Knezevic (2019). “A generalized spherical harmonics-based procedure for the interpolation of partial datasets of orientation distributions to enable crystal mechanics-based simulations”. In: Materialia.

Cantara, Aaron M, Milovan Zecevic, Eghtesad, Adnan, Camille M Poulin, and Marko Knezevic (2019). “Predicting elastic anisotropy of dual-phase steels based on crystal mechanics and microstructure”. In: International Journal of Mechanical Sciences 151, pp. 639–649.

Eghtesad, Adnan and Knezevic, Marko (2019). “High-performance full-field crystal plasticity with dislocation-based hardening and slip system back-stress laws: Application to modeling deformation of dual-phase steels”. In: Journal of the Mechanics and Physics of Solids.

Eghtesad, Adnan, Timothy J. Barrett, Kai Germaschewski, Ricardo A. Lebensohn, Rodney J. McCabe, and Marko Knezevic (2018). “OpenMP and MPI implementations of an elasto-viscoplastic fast Fourier transform-based micromechanical solver for fast crystal plasticity modeling”. In: Advances in Engineering Software 126.December 2018, pp. 46–60.

Eghtesad, Adnan and Barrett, Timothy J and Marko Knezevic (2018). “Compact reconstruction of orientation distributions using generalized spherical harmonics to advance large-scale crystal plasticity modeling: Verification using cubic, hexagonal, and orthorhombic polycrystals”. In: Acta Materialia 155, pp. 418–432.

Eghtesad, Adnan and Germaschewski, Kai, Irene J Beyerlein, Abigail Hunter, and Marko Knezevic (2018). “Graphics processing unit accelerated phase field dislocation dynamics: Application to bi-metallic interfaces”. In: Advances in Engineering Software 115, pp. 248–267.

Eghtesad, Adnan and Zecevic, Miroslav, Ricardo A Lebensohn, Rodney J McCabe, and Marko Knezevic (2018). “Spectral database constitutive representation within a spectral micromechanical solver for computationally efficient polycrystal plasticity modelling”. In: Computational Mechanics 61.1, pp. 89–104.

Eghtesad, Adnan and Knezevic, Marko (2017). “A new approach to fluid–structure interaction within graphics hardware accelerated smooth particle hydrodynamics considering heterogeneous particle size distribution”. In: Computational Particle Mechanics.

Eghtesad, Adnan and Alireza Shafiei (2012). “Study of dynamic behavior of ceramic–metal FGM under high velocity impact conditions using CSPM method”. In: International journal of crashworthiness 17.4,

pp. 384–400.

Eghtesad, Adnan and Shafiei, Alireza (2012). “Body deformation study in a Formula One race car crashing into a rigid barrier at different crash angles”. In: International journal of crashworthiness 17.4, pp. 384–400.

Eghtesad, Adnan and Shafiei, Alireza and Mojtaba Mahzoon (2012). “A new fluid–solid interface algorithm for simulating fluid structure problems in FGM plates”. In: Journal of Fluids and Structures 30, pp. 141–158.

Eghtesad, Adnan, Alireza Shafiei, and Mojtaba Mahzoon (2011). “Predicting fracture and fragmentation in ceramic using a thermo-mechanical basis”. In: Theoretical and Applied Fracture Mechanics 56.2, pp. 68–78.

Presentations

Lavanya, Raman, Ahn Marcia, Debnath Arindam, Lin Shuang, Eghtesad, Adnan, Krajewski Adam, Shang Shunli, Reinhart Wesley, Beese Allison, Poudel Bed, Liu Zi-Kui, Li Wenjie, and Priya Shashank (2022). “The Phase, Microstructure and Mechanical Properties of High Entropy Mo-Nb-Ti-V-W-Zr Ultrahigh Temperature Refractory Alloy””. In: 152th Annual Meeting Exhibition, San Diego Convention Center Hilton San Diego Bayfront. TMS.

Eghtesad, Adnan, Kai Germaschewski, R.A. Lebensohn, and Marko Knezevic (2020). “A Multi-GPU Implementation of a Full-field Crystal Plasticity Solver for Efficient Modeling of Highresolution Microstructures”. In: 149th Annual Meeting Exhibition, San Diego, California. TMS.

Eghtesad, Adnan and Marko Knezevic (2020). “High-performance Full-field Crystal Plasticity with Dislocation based Hardening and Slip System Backstress Laws: Application to Modeling Deformation of Dual-phase Steels”. In: 149th Annual Meeting Exhibition,San Diego, California. TMS.

Barrett, Timothy J, Eghtesad, Adnan, Rodney J McCabe, Vogel Sven C, and Marko Knezevic (2019). “Procedures for the Interpolation of Orientation Distributions from Coarse Grid Experimental Measurements to Fine Grid Finite Element Meshes”. In: 148th Annual Meeting Exhibition, San Antonio, Texas. TMS.

Eghtesad, Adnan, Kai Germaschewski, I.J. Beyerlein, A. Hunter, and Marko Knezevic (2018). “GPU Accelerated Phase Field Dislocation Dynamics: Application to Bi-metallic Interfaces”. In: 147th Annual Meeting Exhibition, Phoenix, Arizona. TMS.

Eghtesad, Adnan, Kai Germaschewski, Ricardo Lebensohn, Rodney J McCabe, and Marko Knezevic (2018). “Coupled elasto-plastic Fast Fourier Transform Micromechanical Solver with Spectral Database Constitutive Representation”. In: 147th Annual Meeting Exhibition, Phoenix, Arizona. TMS.

Eghtesad, Adnan, Barrett Timothy, and Marko Knezevic (2018). “Compact reconstruction of orientation distributions using generalized spherical harmonics to advance large-scale crystal plasticity modeling: Verification using cubic, hexagonal, and orthorhombic polycrystals”. In: Graduate Research Conference, University of New Hampshire, New Hampshire, Durham. GRC.

Eghtesad, Adnan and AR Shafiei (2011). “A general comparetive study in long rod penetration using corrective smoothed particle method”. In: PARTICLES II: proceedings of the II International Conference on Particle-Based Methods: fundamentals and applications. CIMNE, pp. 930–941.

Project Experience

• Developed a physics informed data driven model using deep Neural Networks in PyTorch that improved the performance of material modeling by 20%.

• Implemented deep Neural Networks to Predict and extrapolate material strength in Aluminum and Ni as function of grain size resulted in 400% performance gain in modeling and simulations.

• Developed a machine learning software for analyzing Ni alloys and optimized the mechanical properties by 10%.

• Improved uncertainties in simulation of material strength and deformation in metals by 40%.

• Studied strength in high entropy refractory metals with phase compositions of Nb, Ta, Mo, W, Mb, V, Ti, Zr.

• Developed a Finite Element (FE) software to simulate deformation in metals and improved the performance of these simulations by developing high performance distributed computing package that accelerated the product up to 400 times on 10 GPUs or 400 CPUs.

• Performed multiscale numerical simulations of materials behavior in additively manufactured superalloys and advanced high strength steels resulted by improving model predictions by 10%.

• Designed and optimized composite structures using ANSYS Workbench and Particle methods that resulted in improved strength by 40%.

• Optimized strength of elastomer components of a ship using ANSYS Workbench and CFX that resulted in enhanced stiffness by 25% and lowered the manufacturing cost by 50%.

• Performed stress analysis and design optimization of a bridge structure using ANSYS Workbench followed by structural 60% weight reduction.

Peer Reviews

Computational Materials Science (Elsevier)

JOM (Springer)

Theoretical and Applied Fracture Mechanics (Elsevier)

International Journal of Material Forming (Springer)