Exponent®
Engineering & Scientific Consulting

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Professional Profile

Dr. Gupta is a trained computational physicist and mechanical engineer who specializes in software, reverse engineering, and system architecture evaluation. He has contributed to a wide range of applications, from identifying software vulnerabilities in IoT devices to assessing the system architecture of medical devices for counterfeit resistance. In addition, Dr. Gupta is proficient in Discrete Element Modeling (DEM) and Finite Element Modeling (FEM), applying his expertise to a diverse set of problems, from munitions design to the additive manufacturing of metals.

At Exponent, Dr. Gupta conducts code reviews in support of intellectual property disputes and technical investigations, recovers and analyzes data from electronic devices in civil and criminal cases, and evaluates system architectures for interoperability and compliance with industry standards. He supports FIPS-201 compliance validation on smart cards and contributes to red-team efforts by designing and executing side-channel and fault-injection attacks (e.g., voltage glitching, EMFI) to assess device resilience. Dr. Gupta also performs technical analyses and software audits to support litigation and to evaluate products against privacy standards. In addition, he contributes to projects in particulate physics and material modeling, leveraging both Discrete Element Modeling (DEM) and Finite Element Modeling (FEM) to predict material response under various loading conditions.

Dr. Gupta earned his Ph.D. in Mechanical Engineering from Johns Hopkins University, where he was a computational physicist at the Hopkins Extreme Materials Institute (HEMI). His research focused on modeling and predicting the mechanical behavior of granular materials under high-velocity impact by integrating analytical theory, numerical simulation, and experimental validation. In particular, he employed advanced imaging techniques such as high-speed X-Ray Phase Contrast Imaging (XPCI) and X-Ray Computed Tomography (XRCT), combined with computational models informed by Discrete Element Modeling (DEM), to predict mechanical response across multiple length scales.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Johns Hopkins University, 2024

M.S., Mechanical Engineering, Johns Hopkins University, 2020

B.S., Materials Science and Engineering, University of California, Berkeley, 2018

Keynote Speaker and Session Chair at the Society for Engineering Sciences Conference (2025)

Best Poster Award at the Mach Conference (2023)

Hap Arnold Scholar (2022)

Graduate Student Poster Award at the Society for Engineering Sciences (2021)

JHU Departmental Fellowship (2018)

Blue Ribbon Poster Award at the Lawrence Livermore National Laboratory Summer Student Poster Symposium (2017)

Prior Experience

Graduate Researcher, Johns Hopkins, 2018-2024

Researcher, Air Force Research Laboratory, 2022

Materials Engineer, Chevron, 2018

Researcher, Lawrence Livermore National Laboratory, 2017

Researcher, US Navy (NAVAIR), 2016

Researcher, SRI International, 2014

Languages

French (France)

Hindi

Publications

Hurley, R. C., Tian, Y., Thakur, M. M., Park, J. S., Kenesei, P., Sharma, H., Gupta, A., & Lee, K. (2025). Crystallographic texture, structure, and stress transmission in Nugget sandstone examined with X□ray tomography and diffraction microscopy. Journal of Geophysical Research: Solid Earth, 130(7), e2025JB031690.

Gupta, A., Ramesh, K. T., & Hurley, R. C. (2024). Instabilities in a two-dimensional granular fault gouge: Particle dynamics and stress fluctuations. Journal of the Mechanics and Physics of Solids , 105843.

A. Gupta, K.T. Ramesh, R.C. Hurley (2024). An inclusion model for predicting granular elasticity incorporating force chain mechanics. Granular Matter, 26(2), 40.

A. Gupta, R.S. Crum, C. Zhai, K.T. Ramesh, R.C. Hurley (2021). Quantifying particle-scale 3D granular dynamics during rapid compaction from time-resolved in situ 2D X-ray images. Journal of Applied Physics, 129(22), 225902.

Presentations

A. Gupta, K.T. Ramesh, R.C. Hurley (October 2025). Keynote Talk: Slip, Buckle, Drop: Instabilities and Stress Fluctuations in Granular Materials A Force-Chain Based Plasticity Model for Prediction of Stress Drops in Granular Media. Society of Engineering Science (SES) Annual Conference, 2025, Atlanta, GA.

A. Gupta, K.T. Ramesh, R.C. Hurley (October 2023). A Force-Chain Based Plasticity Model for Prediction of Stress Drops in Granular Media. Society of Engineering Science (SES) Annual Conference, 2023, Minneapolis, MN.

A. Gupta, K.T. Ramesh, R.C. Hurley (October 2022). Linking microscopic force-chains to macroscale mechanical response in granular media. Society of Engineering Science (SES) Annual Conference, 2022,

College Station, TX.

A. Gupta, K.T. Ramesh, R.C. Hurley (April 2022). The effect of force-chain buckling and fabric on bulk stiffness and stress response in granular media. 2022 Mach Conference, Virtual.

A. Gupta, R.C. Crum, C. Zhai, K.T., Ramesh, R.C. Hurley (March 2021). Inferring 3D Particle Kinematics from 2D X-ray Images. APS March Meeting, 2021, Virtual

A. Gupta, K.T. Ramesh, R.C. Hurley (January 2020). Quantifying Kinematics During High Strain-Rate Loading of Granular Materials. 44th International Conference and Expo on Advanced Ceramics and Composites (ICACC 2020), Daytona Beach, FL.

A. Gupta, K.T. Ramesh, R.C. Hurley (October 2019). Quantifying Kinematics During High Strain-Rate Loading of Granular Materials. Society of Engineering Science (SES) Annual Meeting, St. Louis, MO.

A. Gupta, R.O. Ritchie, (October 2017). An Artificial-Intelligence Driven Post-Test Failure Analysis Technique. Materials Science and Technology (MS&T) Annual Meeting. Pittsburgh, PA.

Project Experience

Supported red-teaming efforts on smartcard security through side-channel analysis and fault injection, including voltage glitching, to evaluate device resilience.

Conducted software vulnerability analysis on IoT camera firmware to showcase exploitable weaknesses.

Performed code review for an intellectual property case involving JavaScript-based UI tile elements.

Supported efforts to develop a program to automate smartcard testing and compliance verification against NIST-SP800-73 standards.

Supported efforts to reverse-engineer a DNA sequencing machine for an intellectual property case.

Led the mechanical and software design of an automated card-sorting system utilizing optical character recognition (OCR), computer vision, and microcontrollers for classification and control.

Extracted fingerprint data from a firearm safe as part of a criminal investigation.

Performed mechanical testing of pressurized natural gas lines under both thermal and vibrational loading; designed and implemented a robust data acquisition and monitoring solution.

Developed a cost estimation framework for software development (NodeJS, Typescript, React) in a civil dispute between a catering company and a mobile and web application developer.

Supported failure analysis of delamination mechanisms in smart cards using microscopy and mechanical testing.

Conducted an electrical standards review and compliance evaluation for server rack assemblies.

Inspected and analyzed wireless network infrastructure as part of a forensic investigation following a school shooting incident.

Performed inspection and failure analysis of hydraulic fluid leakage in a drilling rig as part of an insurance investigation.

Executed mechanical testing of consumer electronic devices to evaluate compliance with Reese's Law safety requirements.

Conducted reverse-engineering and functionality analysis of a malware security suite integrated within network switch hardware for an intellectual property dispute.

Analyzed mobile application and Bluetooth communication protocols in Continuous Glucose Monitors (CGMs) to assess reliability, interoperability, and data handling.

Evaluated the design and functional performance of an offset-hoisting apparatus in support of a patent infringement case.

Investigated effects of hotspot geometry and temperature on criticality in single-crystal HMX. Performed thermal modeling using finite element analysis (FEA) and determined conditions most favorable for cook-offs, thermal explosions, and detonation.

Performed a materials selection process to upgrade metallurgy for Crude Units at a refinery to address challenges posed by corrosion damage mechanisms. Developed a Heat Exchanger Inspection Model in an effort to reduce turnaround time.

Evaluated the use of kinetic metallization for repairing F/A-18 aircraft parts. Developed a code that generated meshes from images of microstructure and used finite element analysis (FEA) to model dynamic crack propagation.

Peer Reviews

Physics of Fluids