PREP Research Associate

This position is part of the National Institute of Standards and Technology (NIST) Professional Research Experience Program (PREP). NIST recognizes that its research staff may want to collaborate with researchers at academic institutions on specific projects of mutual interest and, therefore, requires those institutions to be recipients of a PREP award. The PREP program involves staff from a wide range of backgrounds conducting scientific research across various fields. Individuals in this position will perform technical work supporting the collaboration's scientific research.

U.S. Citizen Preferred

Research Title:
Artificial Intelligence for Forensic Firearm and Toolmark Analysis

The work will entail:
The Sensor Science Division at the National Institute of Standards and Technology (NIST) is seeking a researcher to advance the application and scientific understanding of Artificial Intelligence and Machine Learning (AI/ML) in forensic firearm and toolmark analysis. Forensic examiners compare toolmarks on cartridge cases or bullets to evaluate whether they were fired from the same firearm. A similar comparison is made with marks from other tools, such as pliers and additive manufacturing systems (e.g. 3D printers). These analyses are currently subjective and rely heavily on examiner expertise. This position will lead the development, evaluation, and characterization of AI/ML methods to improve the objectivity, reproducibility, and accuracy of toolmark pattern evidence analysis. The researcher will address critical challenges in the application of AI/ML to forensic science, including transparency, robustness, and bias, through the development of guidelines for training and validation datasets; procedures to rigorously characterize model performance, uncertainty, and operational limitations; and approaches to provide insight into model decision-making processes. The researcher will collaborate with interdisciplinary teams and communicate findings through technical reports, publications, and presentations, contributing to the development of scientifically grounded and standards-based approaches for forensic evidence evaluation.

Responsibilities include but are not limited to:

1) Develop a forward-looking research program on AI/ML in forensic firearm and toolmark analysis and collaborate on cross-cutting techniques for other types of pattern evidence.
2) Lead the development of a computational pipeline for the consistent segmentation of toolmark images using AI/ML methods.
3) Investigate application of AI/ML to address major challenges in forensic toolmark analysis, such as characterizing toolmark quality and, ultimately, the direct comparison of toolmark images.
4) Benchmark AI/ML-assisted results against those obtained with procedural algorithms and traditional human examinations. Investigate where AI/ML can provide the most significant improvements in objectivity and efficiency.
5) Investigate approaches for quantifying the uncertainty of AI/ML outputs to ensure objective communication of the strength of the evidence in courtroom testimony. Explore the feasibility of explainable AI (XAI) frameworks to inform examiners on the toolmark features that drive the model’s output.
6) Collaborate with the forensic community to translate research findings into actionable standards and best practice guides.

7) Publish research findings in peer-reviewed journals and present results at scientific conferences.

Qualifications

1) Ph.D. or master's degree in computer science, physics, engineering, statistics, forensic science, or a closely related field.
2) Research experience in the development and application of AI/ML for image analysis.
3) Proficiency with Python or MATLAB.
4) Evidence of independent research experience and a strong enthusiasm for learning new theoretical, computational, and experimental techniques.
5) Strong oral and written communication skills.
6) U.S. Citizenship preferred.

Privacy Act Statement

Authority: 15 U.S.C. § 278g-1(e)(1) and (e)(3) and 15 U.S.C. § 272(b) and (c)

Purpose: The National Institute for Standards and Technology (NIST) hosts the Professional Research Experience Program (PREP) which is designed to provide valuable laboratory experience and financial assistance to undergraduates, post-bachelor's degree holders, graduate students, master's degree holders, postdocs, and faculty.

PREP is a 5-year cooperative agreement between NIST laboratories and participating PREP Universities to establish a collaborative research relationship between NIST and U.S. institutions of higher education in the following disciplines including (but may not be limited to) biochemistry, biological sciences, chemistry, computer science, engineering, electronics, materials science, mathematics, nanoscale science, neutron science, physical science, physics, and statistics. This collection of information is needed to facilitate administrative functions of the PREP Program.

Routine Uses: NIST will use the information collected to perform the requisite reviews of the applications to determine eligibility, and to meet programmatic requirements. Disclosure of this information is also subject to all the published routine uses as identified in the Privacy Act System of Records Notices: NIST-1: NIST Associates.

Disclosure: Furnishing this information is voluntary. When you submit the form, you are indicating your voluntary consent for NIST to use of the information you submit for the purpose stated.