FTCoE Student Research Poster Session 2021

Welcome to the First Annual National Forensic Science Week FTCoE Student Research Poster Session!

As fall semesters are getting back into session and in honor of the upcoming National Forensic Science Week (September 19-25, 2021), the Forensic Technology Center of Excellence (FTCoE) would like to highlight student research in the forensic sciences! The FTCoE would like to thank all the universities, faculty, and students who took the time to prepare poster presentations for submission to this year's event. We recognize your hard work, and we are here to celebrate and learn from your research. Welcome to our virtual poster session!

National Forensic Science Week recognizes the contribution that forensic science makes to the criminal justice system. It is an opportunity to celebrate academic programs, forensic professionals, and scientific research in the various forensic disciplines. Throughout the week, the FTCoE will be engaging with the community to bolster our presence and to highlight the impact that forensic science has in the world! This year, the FTCoE is planning an exciting Murder Mystery event with evidence clues released daily throughout the week. We will also be taking a look at forensic science from multiple perspectives, including students and retired forensic professionals, to see how the field has changed and what may be in store for the future.

Subscribe to the FTCoE Newsletter and follow @ForensicCOE on Facebook, LinkedIn, and Twitter to stay up to date on news and events. Stay tuned for everything that the FTCoE has to offer for this year's National Forensic Science Week!

The Forensic Technology Center of Excellence (FTCoE), led by RTI International, is supported through a Cooperative Agreement from the National Institute of Justice (NIJ), Office of Justice Programs, U.S. Department of Justice (awards 2016-MU-BX-K110). The FTCoE supports the implementation of new forensic technology and best practices by end users and is dedicated to elevating the status of forensic science through advancing technology, sharing knowledge, and addressing challenges. The FTCoE bridges the gap between the scientific and justice communities.

Disclaimer: These presentations were supported by Award No. 2016-MUBX-K110, awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this publication/program/exhibition are those of the author(s) and do not necessarily reflect those of the Department of Justice.

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Analysis of Polymer Coated Bullets Using Spectroscopic Methods

Authors: Liana Albano and Peter Diaczuk, Ph.D.
Affiliations: John Jay College of Criminal Justice

Abstract:
Polymer coated bullets have gained popularity in recent years. To determine the composition of two polymer coated bullets [American Eagle Syntech (red polymer) and Syntech Defense 9 mm Luger (blue polymer)], the solubility, melting point, and molecular vibrations of the polymers were examined. Our results indicate that the blue and red polymers studied had very different solubilities, melting points, and molecular vibrations. Infrared spectroscopy revealed that the blue polymer had similar functional groups to dimethyl iso phthalate, while the red polymer had similar functional groups to poly (ethylene glycol terephthalate). These results confirm that both polymers have different compositions, as evident by the vast differences in solubility, melting point, and their infrared signatures. The next step would be to study various targets shot with polymer coated bullets for the presence of polymer residue. This can be helpful to link evidence from a crime scene to known polymer coated bullets.

Relevant Topics: Firearms

Meet the Presenter

My name is Liana Albano. I am a graduate student studying forensic science with a concentration in criminalistics. My interest in forensic science sparked from a teacher of mine in high school. She thoroughly appreciated teaching forensic science which made me want to learn more about the field and aspire to pursue a forensic-related career.

For questions about this presentation,
contact: liana.albano@jjay.cuny.edu

Raman Spectroscopy on Nanoparticles in Latent Fingerprint Development and Detection

Authors: Sheenamelia Jones[2], Angela Berry[1], Laura Schumaker[1], Tenneil Williams[3], Khalid Lodhi[1], Bhoj Gautam[2]

Affiliations:

[1]Department of Biological and Forensic Sciences, Fayetteville State University, Fayetteville, NC

[2]Department of Chemistry, Physics and Materials Science, Fayetteville State University, Fayetteville, NC

[3]Certified Latent Print Examiner, Cumberland County Sheriff's Office, 131 Dick Street, Fayetteville, NC

Abstract:

Traditionally, a molybdenum disulfide-based method is being used for the development of latent fingerprints. Here we used polymer nanoparticles for developing and detecting latent fingerprints on non-porous surfaces. Polymers as fluorescent materials have several advantages over inorganic counterparts such as strong emission, easy processing, and low cost. In this work, Poly(3-hexylthiophene) (P3HT) nanoparticles were prepared through a phase separation method. The resulting nanoparticles were used to develop the fingerprints on different substrates and characterized using Raman spectroscopy.

Relevant Topics: Chemistry, Crime Scene Investigation, Latent Print Impressions, Human Identification, Impression & Pattern, Method Development

For questions about this presentation, contact: sjones85@broncos.uncfsu.edu

Evaluation of Laser Induced Breakdown Spectroscopy (LIBS) for the Forensic Discrimination of Copper Metal

Authors: Chase J. Notari, B.S. and Brooke W. Kammrath, Ph.D., ABC-GKE
Affiliations: Department of Forensic Sciences, University of New Haven and Henry C. Lee Institute of Forensic Science

Abstract:
The purpose of this research was to evaluate LIBS to determine if it has the ability to perform comparative analysis of copper, specifically the jacketed metal on different bullets. Copper metal has great potential as forensic evidence due to its presence in a range of cases from thefts of copper wiring and pipes, the use of copper wiring in IEDs, and its common function as bullet jackets. Excellent discrimination of copper metal has been demonstrated through trace element profiles collected using solution-based ICP-MS. Although ICP-MS has many advantages for elemental analysis - including its low detection limits, high accuracy, and excellent precision - alternative methods that are faster, require less (or no) sample preparation, and require smaller sample sizes are being investigated. LIBS is an advantageous tool for elemental profiling due to the fact that it is rapid, requires no sample preparation, is able to simultaneously provide information on multiple elements at once, and is less expensive than other instruments used for elemental analysis. LIBS has proven value for the analysis of glass, paint, soil, ink, and other samples of forensic interest, and this research investigated its capabilities for the discrimination of copper. The ability of LIBS to perform comparative elemental analysis on copper-jacketed bullets has the potential to provide a novel method for forensic scientists to use in comparing ballistic evidence. These results can be extended to other sources of copper, such as pipes and wiring, thus expanding the utility of LIBS instrumentation in forensic laboratories to alternative evidence items.

Relevant Topics: Evaluation and/or Validation, Firearms

Meet the Presenter

Name: Chase Notari
Education: B.S. Forensic Science; Minor in Criminal Justice
Discipline: Graduate student; M.S. Forensic Technology
Why I got into Forensics: I had close family friends that were police officers growing up, so I was always interested in solving crime, but what intrigued me the most was piecing together evidence from a scene to be able to tell the story of what happened and eventually figure out who committed the crime.

For questions about this presentation, contact:
cnota1@unh.newhaven.edu

Optimization of InnoXtract™ Extraction and Purification System for DNA Extraction from Skeletal samples

Authors: Jennifer Snedeker, B.S., Sheree Hughes, Ph.D., and Rachel Houston, Ph.D.
Affiliations: Department of Forensic Science, Sam Houston State University

Abstract:
InnoXtract™ extraction and purification system is a purification method designed for DNA extraction from low-template samples, specifically rootless hair shafts. Its ability to capture highly fragmented DNA suggested its suitability for use with skeletal samples. However, the lysis and digestion parameters required modifications to optimize the method for this sample type. A two-part digestion was developed using a custom digestion buffer (0.5M EDTA, 0.05% Tween 20, and 100 mM NaCl) and a supplemental lysis with the hair digestion buffer included in InnoXtract™. The quality and quantity of recovered DNA from these extracts was comparable to a commercial skeletal extraction method (PrepFiler™ BTA). This modified extraction method purified sufficient quantity of DNA from a variety of skeletal samples (surface decomposition, burned, cremated, and embalmed) to yield complete STR profiles, indicating the potential success of this new extraction method with compromised skeletal remains.

Relevant Topics: Biology & DNA, Human Identification, Missing & Unidentified Persons

Meet the Presenter

Jennifer Snedeker is a doctoral student at Sam Houston State University in the Department of Forensic Science. She is interested in advancing forensic DNA and human identification methods by optimizing DNA extraction procedures from skeletal remains. Her research is focused on highly degraded and challenging skeletal samples that closely mimic those seen in forensic casework.

She is the recipient of the Institute for Forensic Research, Training, and Innovation Scholarship for the 2021-2022 academic year. Prior to beginning her PhD research, Jennifer received a Bachelor of Science in human biology from Michigan State University.

For questions about this presentation, contact: jls191@shsu.edu

DNA Recovery and Transfer on Non-Porous Surfaces Submerged in Spring Water

Authors: Morgan Korzik and David San Pietro, Ph.D.
Affiliations: University of New Haven

Abstract:
Submerged items are commonly thought to lack evidentiary value. For instance, some investigators believe that all DNA could be lost once an item is exposed to a flowing current or tossed into a body of water. However, previous studies have shown the ability to recover DNA from submerged porous items for upwards of six weeks. The crevices or interweaving fibers in porous items are thought to protect DNA from being washed away. Smooth non-porous surfaces inherently lack the traits that might aid in DNA retention. We have hypothesized that, because non-porous surfaces do not have traits that might aid in DNA retention, then DNA quantities and the number of alleles recovered will decrease over longer submersion periods. Additionally, we have hypothesized that DNA quantity and the number of alleles will decrease at a slower rate in stagnant water versus in a flowing current. Neat saliva of known DNA quantity was applied to glass slides and exposed to stagnant and flowing spring water to observe the effects on both DNA quantity and STR amplification. Results from the first two experimental phases support that DNA quantities decrease, and allele dropout occurs when samples are submerged for longer times, especially under flow conditions. Additionally, preliminary results have suggested that transfer and allele drop-in may occur from sample to blank slides submerged in the same water vessel. Observed results could indicate the possibility that DNA recovered from submerged non-porous evidence is a result of transfer.

Relevant Topics: Biology & DNA, Crime Scene Investigation, Human Identification

Meet the Presenter

Hello! My name is Morgan Korzik, and I am currently a graduate student studying Forensic Science at the University of New Haven. With a background in biology, I am focused on forensic biology and forensic DNA analysis. My great grandfather was a police officer who was always willing to serve his community on and off-duty. The inspirational news clippings of my grandfather that were passed through my family coupled with my passion for science steered me towards forensic science. I am also passionate about mentoring, teaching, and sparking the interest of young forensic scientists.

For questions about this presentation, contact: mkorz1@unh.newhaven.edu

Methods to Enhance and Preserve Blood Impressions from the Skin of Decedents During the Early Stages of Decomposition

Authors: Kristen Szabelski, Sarah Holton, and Jessica Zarate
Affiliations: Madonna University

Abstract:
Blood and other proteinaceous impression evidence have great value in criminal investigations and can be present on human skin due to the nature of contact between people during violent physical encounters. The constant substrate involved in the interaction between people during the commission of homicides and violent crimes is human skin. However, skin is one of the least studied substrates in the impression discipline. Amido Black is a commonly utilized chemical enhancement method for research trials on skin and it has been used on decedent skin in casework. Hungarian Red has also been utilized to enhance blood impressions on human skin and has been recognized as a more effective method over Amido Black, and when enhanced impression are lifted onto BVDA Gellifters®, the impressions have fluorescent properties to improve visualization. Zar-Pro™Fluorescent Lifters are a fairly novel enhancement method used to effectively lift, enhance, and preserve blood, semen, and some saliva impressions from various substrates. This applied research project explored the enhancement and recovery of blood impressions from decedent skin during the early stages of decomposition. A comparative analysis was conducted between two known dye stains: Amido Black and Hungarian Red, and Zar-Pro™Fluorescent Lifters.

Relevant Topics: Latent Print Impression, Crime Scene Investigation, Human Identification, Medicolegal Death Investigation

Meet the Presenters

Kristen Szabelski and Sarah Holton are 5th year students enrolled in the FEPAC accredited Forensic Science program at Madonna University in Livonia, Michigan. Sarah and Kristen are paid student researchers under the Future-Focus Workforce Initiative working at the Madonna University Forensic Science Research Facility working on a National Institute of Justice Grant (2019-R2-CX-0070) titled, *Methods to Enhance and Preserve Proteinaceous Impressions from the Skin of Decedents during the Early Stages of Decomposition while Examining Environmental Variations across Seasons* under Faculty Jessica Zarate and Dr. Jodi Lynn Barta.

Kristen Szabelski is majoring in forensic science with minors in biology and chemistry. Kristen is a paid student researcher, a Laboratory Assistant, and a Student-Athlete on the Madonna University golf team.

Sarah Holton is majoring in forensic science with a focus on pre-medical studies with minors in biology, chemistry, and psychology. Sarah is a paid student researcher and is also a Student-Athlete on the Madonna University softball team. Sarah grew a strong interest in forensic science after having an introductory class in high school and decided to pursue it further.

For questions about this presentation, contact: sholton@my.madonna.edu

Likelihood Ratios of Hair Using RGB Color Values and Diameter

Authors: Victoria Echternach, Casey Rech, Emma Redman, Isabel Sandone, and Lawrence Quarino, Ph.D., ABC-GKE
Affiliations: Cedar Crest College, Forensic Science Program

Abstract:
Microscopic hair comparison has been under scrutiny for many years by scientists, lawyers, and legal scholars, and has caused many forensic laboratories and laboratory systems to discard it. One of the major criticisms is the subjective nature of hair comparison and a lack of statistical evaluation. The presented study hopes to establish a model whereby a likelihood ratio could be calculated to assess the probability of encountering a random hair using two objective, measurable variables - diameter and color.

Relevant Topics: Trace Evidence

For questions about this presentation, contact: emredman@cedarcrest.edu

Estimating Muzzle to Target Distance from the Physical Characteristics of a Bullet Hole in Different Wood Substrates

Authors: Alan Lee, M.S. and Peter Diaczuk, Ph.D.
Affiliations: John Jay College of Criminal Justice

Abstract:
Determining the muzzle to target distance of a firearm discharge is an integral part in crime scene reconstruction. Shooter distance is most often estimated using the Modified Griess test, which analyzes gunshot residue (GSR) patterns around bullet holes. However, this test has a 3- to 5-feet range limit as the plume of GSR particles can only travel a certain distance past the muzzle. The purpose of this study was to develop a new method that overcomes this range limitation by analyzing the physical damage characteristics of a bullet hole. Test fires were conducted with a .22 caliber rifle over a range of muzzle to target distances and different bullet velocities. The goal of the study was to simulate an indoor shooting on plywood and Medium Density Fiberboard (MDF) panels. The results show that as muzzle to target distance increases, bullet hole depth decreases. In addition, specific damage patterns were observed on the back of the substrates relating to shooter distance and bullet velocity. A predictions model was developed using this data that allowed shooter distance to be estimated based on bullet hole depth. Our conclusions show that not only does this new method cover the limitations of the Modified Griess test, but it also works in tandem with other ballistics analysis methods. With some finetuning, this method may be of use to forensic scientists in casework.

Relevant Topics: Crime Scene Investigation, Firearms

Meet the Presenter

Hello, my name is Alan Lee, and I am a graduate of the John Jay College of Criminal Justice with a Master of Science Degree in Forensic Science. My discipline in forensic science is molecular biology, which is also the focus of my career path. I have always been fascinated by genetics and dedicated my undergraduate studies to the field. After receiving my bachelor's degree from Stony Brook University, I explored different avenues of genetics in hopes of finding a career path that can expand and utilize my knowledge of molecular biology. Through a recommendation from a colleague, I began to pursue my studies in forensic science. It reminded me of the mystery and crime novels I had taken an interest in as a child, and most importantly, genetics was a key part of the field. During my time at John Jay, I was encouraged to explore the other disciplines of forensic science as well. I was always intrigued by firearms and how they worked, which led me to study under the renowned Dr. Peter Diaczuk. Together, we worked on my research project involving the physical characteristics of bullet hole damage on wooden substrates, which I published as my thesis. I am very proud of my work and hope that it becomes beneficial to the field.

For questions about this presentation, contact: AlanLee72828@gmail.com

Development of an Intelligent Handheld Raman Analyzer for Scene Investigation

Authors: Ting-Yu Huang, M.S. and Jorn Chi-Chung Yu, Ph.D.
Affiliations: Department of Forensic Science, Sam Houston State University

Abstract:
Gasoline is one of the most commonly used ignitable liquids (ILs) in arson cases. The classification of gasoline octane numbers provides essential information to determine the ILs that the suspect used to set a fire. However, standard forensic testing using gas chromatography-mass spectrometry (GC/MS) is time-consuming and labor-intensive in sample preparation and data analysis. In this study, we developed an artificial intelligence (AI) analyzer to discriminate gasoline grades. A hand-held Raman spectrometer was utilized to collect 450 Raman spectra of gasoline samples with three grades. Continuous wavelet transform (CWT) was adopted to process the spectra into 2-dimensional images. Inspired by the superior capability of image discrimination by convolutional neural networks (CNNs), we employed transfer learning, namely to re-train an existing CNN (GoogLeNet) for our new task. To evaluate the performance of the GoogLeNet model, we additionally trained six classical machine learning algorithms using the same dataset. The results demonstrate that the GoogLeNet model achieved higher performance than other models regarding the accuracy, precision, sensitivity, and F1-score. Though the performance decreased when analyzing weathered gasoline samples, the GoogLeNet model still maintained the highest performance---73% and 53% accuracy when 50% and 25% weathered gasoline samples were analyzed, respectively. Overall, CWT processing of Raman spectra followed by transfer learning was promising to develop AI for rapid field analysis of crime scene evidence. The new platform does not require hand-crafted engineering and an analyst's interpretation of data. We envision this platform to be a promising tool for facilitating forensic field analysis of physical evidence.

Relevant Topics: Chemistry, Crime Scene Investigation, Trace Evidence

For questions about this presentation, contact: txh038@shsu.edu

Development of an Extraction Method for the Elemental Analysis of Microscopic Particles in Automotive Greases using SEM/EDS

Authors: Jared Estevanes, B.S., Patrick Buzzini, Ph.D, and Geraldine Monjardez, Ph.D.
Affiliations: Sam Houston State University

Abstract:
Automotive grease residues may be recovered as evidence in the course of investigations of vehicular accidents. Few studies have been conducted in the characterization and differentiation of vehicular fluids, particularly greases. Initial microscopic examinations showed the presence of microscopic particles embedded in the unused greases that were part of the original manufacturing formulation. These particles differed considerably between different grease samples, and this potentially allows the discrimination for these lubricating compounds. Initial analysis using FTIR and SEM/EDS for these particles revealed interference from the grease matrices and yielded inadequate data for characterization. Therefore, an efficient extraction method for the removal of these particles was developed. A modified solvent extraction scheme was built using three solvents, including two petroleum solvents (n-hexane, and pentane) and one green solvent (D-limonene). Light microscopy observations after extraction facilitated the evaluation of the extraction success of the solvents. Microscopic observations also revealed that the extraction procedure removed most of the base oil and left the particles intact. Since it was observed that each solvent dissolved the greases with similar efficiency, D-limonene was selected due to it being more environmentally friendly. The developed extraction scheme allowed the elemental characterization of these particles using SEM/EDS, and the study determined these particles to be solid lubricant additives within the greases.

Relevant Topics: Chemistry, Method Development, Trace Evidence

Meet the Presenter

My name is Jared Estevanes, and I am a PhD student in the Forensic Science Department at Sam Houston State University. I've always been interested in science from a young age, but I was really captured by forensic science while I watched the original CSI TV show, specifically the trace evidence aspect. I was amazed at how the investigators could get so much information from a small amount of evidence. I then decided to pursue a graduate degree with an emphasis in trace evidence.

For questions about this presentation, contact: jae031@shsu.edu

High Resolution Mass Spectrometry Screening in Impaired Driving Investigations

Authors: Jessica Ayala, M.S. and Sarah Kerrigan, Ph.D.
Affiliations: Sam Houston State University

Abstract:
Impaired Driving investigations have become increasingly more challenging with the influx of new psychoactive substances (NPS) into the drug market. NPS become more prevalent as drug users pursue “legal highs.” However, as these compounds gradually become controlled substances, new structural analogues emerge. As a result, traditional immunoassay-based drug screening is unable to keep pace with new and emerging drug trends. Immunoassays are not available for all drugs or drug classes, and due to their reliance on antibody-based reagents, they are expensive and time consuming to develop. When used alone, they have insufficient scope and sensitivity. As a result, forensic toxicology laboratories are exploring high resolution mass spectrometry (HRMS)-based technologies for toxicological drug screening. The purpose of this study was to re-analyze adjudicated blood specimens and compare HRMS-based drug screening to reported immunoassay results.

Relevant Topics: Toxicology

For questions about this presentation, contact: jessica.ayala@shsu.edu

Synthetic Cathinone Isomer Differentiation Using GC-EI-MS and Multivariate Analysis

Authors: Ruby Liliedahl, B.S. and J. Tyler Davidson, Ph.D.
Affiliations: Department of Forensic Science, Sam Houston State University

Abstract:
Synthetic cathinone constitutional and positional isomers present analytical challenges for compound identification using the standard analytical approaches available in forensic laboratories. This research describes the use of canonical discriminant analysis (CDA) for the differentiation of synthetic cathinone isomers using gas chromatography-electron ionization-mass spectrometry (GC-EI-MS). This study also investigates strategies to reduce the required number of replicate sample injections through the incorporation of multiple scans across the chromatographic peak and using fewer ions for CDA model construction. This study involved the analysis of the chloroethcathinone (CEC) and methoxymethcathinone (MeOMC) positional isomers, as well as the constitutional isomers dibutylone, eutylone, pentylone, and the positional isomer 2,3-pentylone. When using 15 ions and peak apex data to construct CDA models, the CDA leave-one-out cross-validation (LOOCV) classification rates were greater than 90% for all isomer sets. Even when the most extreme reduction strategies were applied, the LOOCV classification rates were at least 67.9%, 98.0%, and 98.1%, for the CEC, MeOMC, and constitutional isomers, respectively. In addition, when the lowest concentration samples were removed from the reduction strategies dataset, the LOOCV classification rates improved for all three isomer sets to 75.3%, 99.3%, and 99.4%, respectively. Finally, a comparison of ion selection methods highlighted the applicability of using relative ion abundance as an ion selection method for CDA classification based on similar LOOCV classification rates to CDA models generated using the ions with the highest principal component analysis (PCA) loadings.

Relevant Topics: Chemistry, Seized Drugs, Toxicology

Meet the Presenter

My name is Ruby Liliedahl, and I am a doctoral student in the Department of Forensic Science at Sam Houston State University. I became interested in forensic science because of the Science Olympiad event Crime Busters. After taking chemistry and forensic science classes during high school, I decided to study forensic chemistry. During my undergraduate degree, I chose to continue enhancing my skills to become a forensic toxicologist through graduate studies.

For questions about this presentation, contact:
rel020@shsu.edu

The Differentiation of Dark Colored Automotive Carpet Fibers Using Plane-Polarized Light Ultraviolet-Visible Microspectrophotometry

Authors: Andra D. Lewis, M.S.F.S. and Patrick Buzzini, PhD.
Affiliations: Department of Forensic Science, Sam Houston State University

Abstract:
Automotive carpet fibers found in vehicles are made from recycled polyester derived from plastic bottles and blends of fibers including polyamides, polypropylene (PP), polyester (PET), and polyolefins. The analysis of these fibers is challenging due to their peculiar and blended compositions. Most fiber examinations start with light microscopy for both identification and comparison purposes followed by visible microspectrophotometry (MSP) and occasionally thin layer chromatography (TLC). The inclusion of the ultraviolet spectral range in MSP analyses (i.e., UV-Vis MSP) has shown the addition of further discriminatory capabilities. The same applies to the use of dichroism (plane-polarized microscopy or PPL) in conjunction with visible MSP. This research aimed to investigate the combined discriminating abilities of light microscopy followed by the joint use of UV-vis MSP and PPL. One of the major objectives was the determination of objective criteria to develop a protocol for the capture, processing, and interpretation of spectral patterns for fiber specimens encountered in casework. Forty (40) macroscopically similar black automotive carpet fibers were analyzed using microscopical examinations to include color and fluorescence followed by different applications of UV-vis microspectrophotometry. The microspectrophotometer used in this study was not only equipped with full polarizing capabilities (i.e., polarizing filters and a rotating stage), but the analyzer and the polarizer transmitted UV radiation down to 240 nm, making pairing of the ultraviolet with plane polarized light a reality. The results of this study showed that about 70% of the samples could be differentiated through the combination of both ultraviolet radiation and plane polarized light.

Related Topics: Trace Evidence, Forensic Fiber Examinations

For questions about this presentation, contact: adl054@shsu.edu