COFSE Research Newsletter

Edited by:
Monica Joshi, Research Committee Chair
Candice Bridge, Research Committee Member

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Welcome to the inaugural edition of the COFSE Research Newsletter. Each quarter, this newsletter will feature ongoing research projects by different COFSE members. There are nearly 30 forensic laboratories and academic universities subscribed in LEAP and this newsletter provides the opportunity to connect with researchers in various forensic science disciplines.

71st American Academy of Forensic Sciences (AAFS) Annual Scientific Meeting: February 18-23, 2019, Baltimore, MD.

- Check out the research advancements presented by several COFSE members through the meeting.
- Multidisciplinary session on Forensic Education: Friday, Feb. 22, 1:15pm-3pm
- Annual COFSE Meeting: Tuesday, Feb.19, 3pm-5pm in Hilton Ruth
- COFSE social: Thursday, Feb. 21, 8pm-10pm at Frank and Nic's West End Grille (RSVP at glondino@iupui.edu

News: The Journal of Forensic Science Education will be introduced at the 2019 AAFS meeting. The journal will be on-line and open access and will be maintained by the Texas Digital Library. An Editorial Board has been assembled and the on-line platform has been created. The journal will announce a "Call for Papers" at the 2019 AAFS meeting with the first issue expected to be released in fall 2019. The journal is intended to be a resource to help forensic science educators develop pedagogy and curriculum appropriate to the forensic science discipline, promote scholarship in forensic science education, and serve as a communication resource between forensic science educators.

Send news items or research updates to MJoshi@wcupa.edu

LEAP's Mission

Laboratories and Educators Alliance Program *- Bridging the Gap*

This program facilitates collaborative research between academia and forensic science laboratories. This joint effort between the American Society of Crime Laboratory Directors and the Council of Forensic Science Educators to identifies forensic science needs and provides a platform for laboratories, researchers and students to seek projects aligning with their mutual research capabilities.

To feature your research projects, please visit the "links" and submit the research information form.

For more LEAP information or for additional information about the ASCLD Forensic Research Committee, or to sign up as a forensic laboratory or an educator, please visit:
www.ascld.org/forensic-research-committee
or
http://www.cofse.org/join-leap-laboratories-and-educators-

RESEARCH IN THE COMMUNITY

Firearms and Toolmarks

Infrared Thermal Imaging for Use in Restoration of Defaced Serial Numbers

PI: Prof. Rene Rodriguez
Co-PI: Prof. John Kalivas, Lisa Lau, Ikwulono Unobe, Ph.D., Anit Gurung
Idaho State University, ID

Thermal imaging techniques have been utilized to locate defects in both metals and composite materials. In particular, lock-in infrared thermography has proven to be particularly useful for this purpose, as the pulsed nature of the experiment separates the thermal background noise from the thermal signal of interest. We have been studying the employment of Lock-in Infrared Thermal Imaging, coupled with the image analysis processing methods of moving average filtering (MAF), principal component analysis (PCA), Zernicke moment analysis (ZMA), and a fusion of similarity merit measurements as a versatile, non-destructive method for the recovery of defaced serial numbers. We call this technique the LIT-MIA method. To date, our tests have used the methodology to successfully recover defaced serial and VIN numbers that were stamped into steel shotgun, a steel motorcycle frame, and an aluminum motor, as well as laser engraved numbers from stainless steel forceps. These studies suggest the LIT-MIA technique has good adaptability to recover defaced numbers from a wide variety of materials (aluminum, steel, and stainless steel), from materials that were shaped differently (flat and cylindrical), and from material were the numbers were scribed in different ways (stamped and laser engraved). We are performing further experiments to further determine the adaptability and reproducibility afforded by this technique for a wider variety of defaced samples.

Entomology

Detection of insects artifacts intermixed with human body fluid stains

PI: David Rivers, Ph.D.
Loyola University, MD

Presently there are no methodologies for distinguishing contaminating insect artifacts produced by flies or other insects that visit and feed on a corpse from stains derived from human body fluids. In fact, artifacts derived from common flies are indistinguishable from bloodstains, particularly those associated with high impact or projected blood spatter. Traditional presumptive chemical tests for blood yield positive results for both blood and insect artifacts, or in some cases (i.e., Hemastix®) provide false positives. DNA typing is also not effective for discrimination since the blood meal contains DNA from the victim, and hence both fly artifacts and bloodstains will display the same genetic profile. Semi-quantifiable morphological measures, as well as alternate lighting methods, have been proposed for identifying certain fly spots from bloodstains, but the methodology is not satisfactory because it is not reliable, is not suitable for all fly species, does not make a distinction from other forms of body fluids that may also be present, and in the case of artifact morphology, is dependent on a very small pool of forensic experts. The lack of diagnostic tests for the identification of insect artifacts at a crime scene means that only subjective interpretation is used to distinguish fly evidence from bloodstains. The situation is true when flies consume other body fluids and then deposit artifacts. My laboratory is focused on developing diagnostic tools for distinguishing fly artifacts from human body fluids. As part of this effort, a sensitive immunoassay has been developed that permits detection of fly regurgitate and fecal stains deposited on a range of household materials. We are currently develop a DNA-based method for a more rapid and sensitive means to distinguish insect artifacts from body fluid stains.

Other area	Toxicology
Bioinformatics Approach to Assess the Biogeographical Patterns of Soil Communities: The Utility for Soil Provenance	**The Evolution and Impact of the Electronic Cigarette as an Alternative Drug Delivery Device**
PI: DeEtta Mills, Ph.D. *Florida International University, FL*	***PI: Michelle Peace, Ph.D*** *Virginia Commonwealth University, VA*
Soil DNA profiling has potential as a forensic tool to establish a link between soil collected at a crime scene and soil recovered from a suspect. However, a quantitative measure is needed to investigate the spatial/temporal variability across multiple scales prior to their application in forensic science. In this study, soil DNA profiles across Miami-Dade, FL, were generated using length heterogeneity PCR to target four taxa. The objectives of this study were to (i) assess the biogeographical patterns of soils to determine whether soil biota is spatially correlated with geographic location and (ii) evaluate five machine learning algorithms for their predictive ability to recognize biotic patterns which could accurately classify soils at different spatial scales regardless of seasonal collection. Results demonstrate that soil communities have unique patterns and are spatially autocorrelated. Bioinformatic algorithms could accurately classify soils across all scales with Random Forest significantly outperforming all other algorithms regardless of spatial level.	E-cigarettes were created as an alternative nicotine delivery system, but the designs evolved to facilitate the aerosolization of drugs other than nicotine. E-cigs deliver nicotine by rapidly heating an e-liquid solution, made up of nicotine, flavoring agents, propylene glycol, and vegetable glycerin. The aerosol quickly condenses as it leaves the e-cig into a “cloud” which is inhaled. The size of the droplets, called particles, formed in the aerosol can vary and is a major factor in determining where and if that particle will deposit in the lung, with small particles penetrating into the deep alveoli of the lung tissue. The growing popularity of these products has caused an increase in internet sources promoting the use of drugs other than nicotine (DOTNs) in e-cigarettes. DOTNs include natural and plant-based products, designer drugs, traditional and non-traditional pharmaceuticals. The purpose of this research has been to characterize the liquids and the evolution of the devices, particularly as the lack of regulations has facilitated wide and rapid development to facilitate the vaping of crystal, wax, and plant material. Additionally, the research has compared the size of the particles of the aerosol between nicotine, methamphetamine, and methadone based liquids, demonstrating their deposition in the deep lung, independent.

DNA/Biochemistry

Antibody-Mediated Sperm Cell Capture for Sexual Assault Sample Processing on a Microdevice Platform

PI: Tracey Dawson Cruz, Ph.D.
Co-PIs: *Brittany Hudson, M.S., Jordan Cox, M.S., James P. Landers, Ph.D.,*
Virginia Commonwealth University, VA

With the backlog of sexual assault kits exceeding 400,000 in the United States, many efforts have been made to improve laboratory methods used to process these samples. Differential extraction is the most commonly employed technique for sexual assault samples, but it is both time-consuming and inefficient, leading to lengthy processing times that often still result in complex mixtures to interpret on the back end. In an effort to reduce sample processing and DNA profile analysis time, our group has been exploring the use of sperm-specific antibodies bound to polystyrene microbeads as a means of separating sperm from non-sperm cells prior to DNA purification. Additionally, this research aims to incorporate this antibody-mediated cell separation onto a rotationally-driven microchip platform for automated cell separation, DNA liberation, and PCR amplification of STR loci. This approach would provide CE-ready multiplex STR products that could move immediately to a laboratory's previously validated traditional capillary electrophoresis platform in under 90 minutes, reducing hands-on time, contamination risks, and overall costs. Further, this sexual assault microdevice provides for a scientist-controlled process, allowing for storage of the excess DNA and easy retrieval of the DNA for off-chip quantification or additional analyses. Several antibodies have been evaluated for their specificity and efficiency and results have shown that the SPAM1 (PH20) antibody was able to generate "bound fractions" from sperm-epithelial mixtures that resulted in profiles that, on average, displayed >10:1 male:female peak height ratios. The efficacy of other antibodies such as CRISP2 and MOSPD3 is being explored as well as the use of antibody combinations in an effort to further maximize sample sperm cell enrichment. Developmental validation testing is ongoing and will include sensitivity testing. Ultimately, this microchip-based antibody-mediated cell separation aims to provide a means of tackling the current sexual assault backlog in a cheaper, faster, and more efficient manner than traditional DNA methodologies.