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10. Forensic Science

Northeastern State University

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Abstracts from the 2016 Oklahoma Research Day

Held at Northeastern State University

05. Mathematics and Science

10. Forensic Science

05.10.01 Evaluation and Validation of IDenta Corporation's Bullet-hole Testing Kit (BTK)

Crandell, Katelyn *University of Central Oklahoma*

Originally developed in 1982, IDenta Corporation's Bullet-hole Testing Kit (BTK) is currently being used around the world in the field of crime scene analysis, including within the United States. IDenta claims the kit can successfully be used to identify a bullet hole and determine its caliber. The kit was used to test 180 holes made by firearms and other non-firearm weapons. Though the statistical analysis of the data shows there is not enough evidence to conclude the BTK is capable of identifying a bullet hole or determining a bullet's caliber, there are additional factors that must be considered. When visual examination after proper training and upper and lower bounds for the diameters are included in the use of the BTK, the kit proves to be of value in the field of shooting reconstruction.

05.10.02 Forensic Sciences Review: A New Technology, RapidHIT System, Generates Full STR Profiles in Ninety Minutes

Hopkins, Ashley *Northeastern State University*

Wang, Kevin *Northeastern State University*

Forensic Sciences have been researched and developed over the past decades to aid in crime solving and other areas of research. There are numerous developments that have been studied to improve the science as a whole making the tasks easier and less time consuming. The new technologies, in combination with the known techniques used in this science field can make a great impact in the area of science that some seem to look past. The ability to obtain a full STR profile in such a short time frame makes it easier for convictions and having the capability of getting the guilty off the streets instead of spending numerous hours in the lab while the suspect has a chance to run free. The company that is known as IntegenX have made the impossible, possible. A System known as RapidHIT was created. This system has the ability to generate a full STR profile, in a database, in approximately ninety minutes with a cost of about \$300 per testing sample. There are numerous studies on the RapidHIT in the past five years to test its accuracy, validation and its full potential to take forensic sciences to another level.

05.10.03 Beyond DNA: An Epigenetic Approach to Identical Twin Identification

Scrivner, Coltan *University of Central Oklahoma*

The field of forensic DNA analysis currently lacks a DNA-based method for resolving the genetic identity of monozygotic twins. Previous studies using high-throughput DNA sequencing have indicated that the analysis of variably methylated genetic loci within human genomes has the potential for discriminating between monozygotic twins. In particular, genome-wide methylation analyses have shown that CGI (C-G island) shelves show a high rate of methylation discordance between twins. In this study, the author utilizes bisulfite conversion followed by DNA amplification and capillary electrophoresis-based sequencing to analyze methylation differences between monozygotic twins at a CGI shelf. While a few studies have had success using next generation sequencing (NGS) to analyze methylation differences between twins, next generation sequencing has not been adopted by the majority of state and local forensic laboratories, or by the national FBI laboratory. Likewise, it is unknown if or when NGS machines will be commonly incorporated among state and local forensic laboratories. With more than 1 in 200 individuals having a monozygotic twin, this study provides the early work necessary to meet the forensic community's need for a practical protocol that can be used to distinguish between DNA samples from monozygotic twins.

05.10.04 Illicit Drug and Drug Metabolite Detection Using Latent Fingerprint Deposits

Smith, Elizabeth *University of Central Oklahoma*

No one is immune to the risks of an individual driving under the influence of alcohol or drugs. According to the National Highway Traffic Safety Administration, alcohol-impaired driving has decreased between the years of 2005 and 2014 but drug-impaired driving has increased. Drivers suspected of drug-impaired driving will have blood or urine collected for toxicological testing and may undergo a Drug Recognition Evaluation (DRE). When using blood or urine, issues arise that make sampling problematic: biohazard risks, necessary training for collection of blood, and proper storage protocols. This study explores an alternative medium for illicit drug detection. Latent fingerprint deposits along with blood samples and psychophysical evaluation will be collected during the final stage of DRE training clinicals. Individuals participating in the evaluation will press his or her fingerprints to a digital livescan fingerprinting system. Upon completion of the scan the screen will be swabbed and the swab will be immersed in 25% methanol-water and the extract will be analyzed using liquid chromatography tandem mass spectrometry (LC-MS/MS). The results will be compared to the toxicological analysis of the collected blood specimen. This study will demonstrate that the simple sample preparation, lack of biohazard risk, and ease of storage makes latent fingerprints a viable medium for illicit drug and drug metabolite detection.

05.10.05 The Use of Forensic Corpora In Validation Of Data Carving On Solid State Drives

Hegstrom, Kristina *University of Central Oklahoma*

The need for greater focus on the validation and verification of tools has become more evident in recent years. The research in this area has been minimal. Continued research regarding the validation of digital forensics tools is necessary to help meet demands from both the law enforcement and scientific communities and to bring digital forensics in line with other forensic disciplines (as cited in Guo, et al., 2009). One of the most effective ways to perform validation and verification of digital forensics tools is to enlist the use of standardized data sets, or forensic corpora. This study will focus on the use of forensic corpora to validate the file carving function of a common digital forensics tool, Access Data's Forensic Tool Kit. The study will center specifically on FTK's ability to recover data on Solid State Drives (SSDs). The goal of this study is to both evaluate the use of forensic corpora in the validation and verification of digital forensic tools, as well as to serve as a validation study of FTK's carving function on Solid State Drives.

05.10.06 A Method for Validating Procedures for Interpreting DNA Mixtures Using Nichvision's ArmedXpert DNA Analysis Software

Gibson, Keylie *University of Central Oklahoma*

Due to a wider variety of sample types being analyzed and increased sensitivity of analytical processes, more complex DNA mixtures are being observed by forensic DNA laboratories. To evaluate these increasingly complex DNA mixtures, more sophisticated mathematical models must be employed to provide appropriate weight to any inclusions that are made. When dealing with models that can handle the demand of increased complexity, it is necessary to establish and validate procedures for interpretation. ArmedXpert is a software program that provides tools to conduct a variety of mathematical calculations to both interpret DNA mixtures as well as assess the weight of any inclusion. A methodology for establishing and validating procedures for the interpretation of DNA mixtures using ArmedXpert was developed. The validation method sets limits to DNA mixture interpretation to insure that only meaningful information is reported. To establish an initial set of criteria and limits for interpretation, thirty known two person mixtures were evaluated by three analysts using ArmedXpert. The initial interpretation methods and limits were validated by applying the general procedure to seventy additional known two person mixtures. The result is a procedure for interpreting mixed DNA profiles of two individuals that includes interpretation thresholds, which can be used to accurately reflect the weight of any inclusion being made and ensure that any reported inclusion is not due to random chance.

05.10.07 Analysis of Premature Fossilization in Submerged Marine Vertebrate Remains Using Rare Earth Element (REE) Indicators

McElreath, Caitlyn *University of Central Oklahoma*

Prim, Alexa *University of Central Oklahoma*

King, Kama *University of Central Oklahoma*

Jourdan, Thomas *University of Central Oklahoma*

Coyer, James *Other*

Lord, Wayne *University of Central Oklahoma*

Conservation organizations, governmental institutions, and enforcement agencies have avid interests in research programs targeted at enhancing the protection and preservation of marine mammals and sea turtles. Recently, examinations of marine mammal and sea turtle remains, recovered from subtidal and coastal maritime environments, have revealed signs of premature fossilization following decomposition. These seemingly atypical taphonomic changes complicate attempts at skeletal element aging and time since death estimation. Among the different elemental aspects of bone composition, Rare Earth Element (REE) is frequently analyzed as a way to measure progressive taphonomic changes and fossilization rates. The goal of our study is to measure REE composition in a variety of submerged marine vertebrate samples in order to gauge rates of fossilization in the marine environment. Skeletal remains from submerged porpoises, seals, and sea turtles will be periodically sampled and analyzed for REE composition, along with a terrestrial ungulate control, in order to explore plausible explanations for premature fossilization. Bones, recovered at necropsy, will be segregated by species and placed in subtidal cages at sampling sites in the Gulf of Maine. A broad spectrum of disciplines including ecology, oceanography, anthropology, and applied wildlife forensic science will participate in this cooperative research.