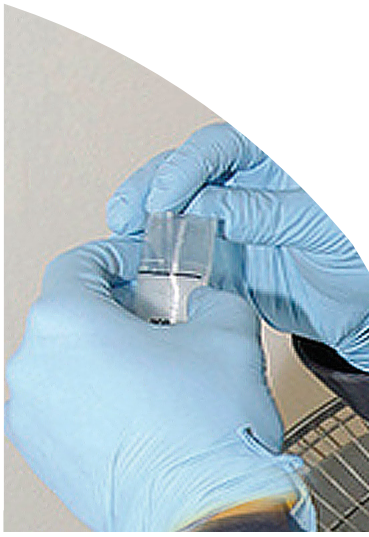
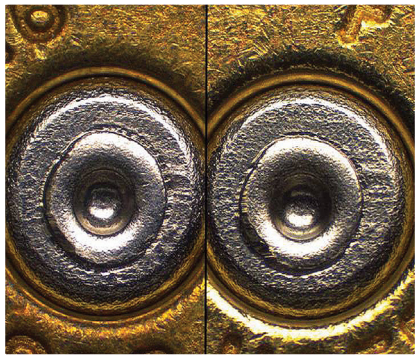
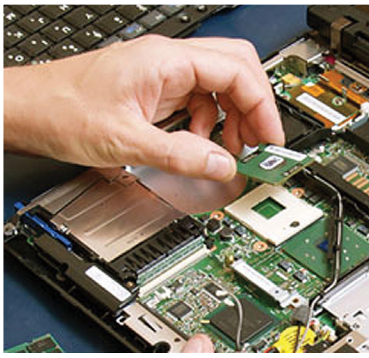
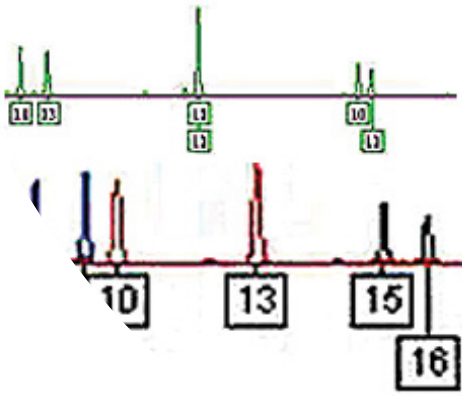
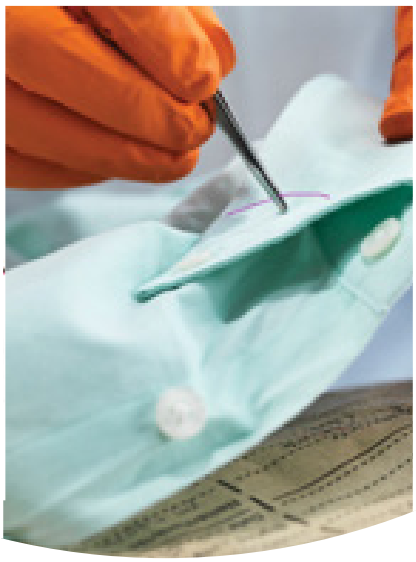
FORENSICS @ NIST











November 7–8, 2018

NOVEMBER 7–8

NOVEMBER 7, 2018

8:00am Registration

9:00 – 9:10 Welcome Remarks and Safety – Robert Thompson

9:10 – 9:20 ADLP Remarks – Associate Director for Laboratory Programs

9:20 – 9:45 Keynote – John Butler

FORENSIC GENETICS

9:45 – 9:55 Forensic Genetics Introduction: Pete Vallone

One aspect of the Applied Genetics group is focused on forensic genetics. Using DNA–based technologies, the AG group develops standards and assesses emerging forensic methods in support of the human identity community. These activities provide a foundation to ensure accurate measurements and validations performed by the forensic DNA typing community.

9:55 – 10:15 Characterization of noise in targeted sequencing of STR markers: Sarah Riman

The interpretation of STR profiles generated by targeted sequencing methods are susceptible to the same factors as for profiles generated using capillary electrophoresis. These factors include noise, stutter artifacts, heterozygote imbalance, and allelic drop–out/in. Our goal is to characterize and understand how these behave in targeted sequence datasets of single source DNA profiles by developing a framework of statistical tools.

10:15 – 10:35 Results from the 2018 Rapid DNA Maturity Assessment: Erica Romsos

The Rapid DNA Act, which amends the DNA Identification Act of 1994, allows for the integration of rapid DNA instruments for use by law enforcement for DNA testing of arrestees in a booking station environment. Of the multiple efforts to integrate the forensic DNA work flow, three platforms were included as part of a rapid DNA maturity assessment. NIST provided 20 single–source buccal samples to participants and evaluated the samples for successful analysis of the 20 CODIS core loci.

10:35 – 10:55 Sequencing and standards for characterization of the mitochondrial genome: Kevin Kiesler

Advanced DNA sequencing technologies have reduced the barriers to sequencing the mitochondrial DNA genome. The Applied Genetics Group at NIST has explored the use of several next generation sequencing technologies to develop Standard Reference Materials (SRMSs) for process quality assessment in laboratories wishing to validate next generation sequencing technologies. Population scale sequencing studies are also underway at NIST to add to the content of databases for forensic mtDNA matching, to refine match statistics with mtDNA results.

10:55 – 11:05 Q&A SESSION

11:05 – 11:20 BREAK

FINGERPRINTS

11:20 – 11:40 Five decades of fingerprint research at NIST: Elham Tabassi

This talk will overview NIST Image group fingerprint research and contributions over the past 50 years.

11:40 – 12:00 The Making of NIST Special Database 302: Greg Fiumara

In September 2017, the Intelligence Advanced Research Projects Activity held a data collection as part of its Nail to Nail Fingerprint Challenge. An elaborate elicitation of latent print data was conducted by Certified Latent Print Examiners during the collection. The result is a new NIST Special Database of latent print and exemplar images, NIST SD 302. Learn about how the data was collected and the techniques used for development.

12:00 – 12:20 The confidence interval for the likelihood ratio with application to biometrics data: Larry Tang

The purpose of this talk is to introduce the score–based likelihood ratio based on receiver operating characteristic curve analysis. The explicit expression of the variance and the resulting confidence interval for the likelihood ratio is derived. The method is evaluated through a large–scale simulation study and is illustrated through a finger and facial recognition dataset.

12:20 – 12:30 Q&A SESSION

12:30 – 1:30 LUNCH on your own

DIGITAL & MULTIMEDIA

1:30 – 1:40 Digital and Multimedia Introduction: Barbara Guttman

Digital evidence includes data on computers and mobile devices, including audio, video, and image files as well as software and hardware. Digital evidence can be a part of investigating most crimes, since material relevant to the crime may be recorded in digital form. Methods for correctly acquiring, storing and analyzing digital evidence quickly and efficiently are critical.

1:40 – 1:55 The NSRL and Video Games – Why I get to buy video games at the office: Austin Snelick

The National Software Reference Library (NSRL) continues to expand the types of software it collects. Our latest major addition is video games from Steam, Blizzard, and Origin. Having new software types helps law enforcement more efficiently process digital evidence.

1:55 – 2:10 Approximate Matching – Testing how well matchers work: Monika Singh

Finding items that are exactly the same, as is done with the NSRL, is very useful, but often forensics practitioners need to find similar items, for example a picture that is a part of a Word document. Approximate matching is the name of this type of technique. But how can a practitioner know how well the matcher works and for which kinds of situations?

2:10 – 2:25 Drone Forensics and other new additions to CFReDS: Ben Livelsberger

The Computer Forensics Reference Dataset (CFReDS) is a collection of test files and simulated digital evidence that practitioners, tool developers and educators can use for training and testing. The CFReDS keeps growing with work developed at NIST and by the community. Our latest major addition is drone forensics images. Given the growth of drones, and their potential involvement in various types of crimes, this collection should be useful to the community.

2:25 – 2:40 Going deeper and deeper into Cell Phones: Jenise Reyes Rodriguez

Getting information from cell phones started with looking at the contacts, calls and text messages and now includes GPS, social media, and other

apps. Forensic techniques have been getting more and more sophisticated including analysis of the cell phone chips. Our latest testing program looks at tools that can analyze raw physical dumps of these chips.

2:40 – 2:50 Q&A SESSION

2:50 – 3:30 BREAK and POSTER SESSION

FOOTWEAR IMPRESSIONS

3:30 – 3:40 Footwear Impression Intro: Martin Herman

Footwear evidence is often the most abundant form of physical evidence at a crime scene. The 2009 National Academy of Sciences and 2016 President's Council of Advisors on Science and Technology reports state that forensic footwear identifications are largely subjective. Both reports have expressed the need for quantitative assessments of footwear evidence using scientifically valid methods. The long–term goal of NIST research in footwear forensics is development of a system called SHOECALC, a system for footwear analysis that will allow (1) researchers/developers to have a workbench for development of quantitative methods and (2) examiners to use these quantitative methods during casework.

3:40 – 3:55 Towards an end–to–end system for quantitative footwear impression comparisons: Martin Herman

This talk describes research towards an end–to–end system for quantitative footwear evidence evaluation using image processing and statistical approaches. Scores computed by the system represent the degree of correspondences and discrepancies between features in two compared footwear impressions. The scores are meant to be used by footwear examiners to help them in making conclusions by relating the scores to the SWGTREAD conclusions scale.

3:55 – 4:10 Image Alignment and Feature Extraction for Shoeprint Matching: Gautham Venkatasubramanian

Steps towards quantitative footwear impression comparisons include aligning the questioned and test impressions and then extracting and comparing features in the two impressions. The features considered here are based on a combination of design, wear, and size. This talk describes some of the alignment methods and features extracted from the images.

4:10 – 4:25 Deep Learning Feature Extractors for Shoeprint Matching: Sarala Padi

A step towards quantitative footwear impression comparisons involves comparing features in the questioned and test impressions. The features considered here are based on a combination of design, wear, and size. This talk presents a comparison approach based on transfer learning from a deep learning network model. Experiments are described in which the feature extractors from the deep learning model are applied to shoeprint matching to compute pairwise comparison scores.

4:25 – 4:40 Matching Randomly Acquired Characteristics (RACs) in Footwear Impressions: Weiqing Chen

Comparison of RACs in the questioned and test impressions is required for quantitative footwear impression comparisons. Experiments are described that involve detecting, extracting, and matching RACs. Comparison scores for the RACs are computed. These scores are part of an end-to-end system for quantitative shoeprint comparisons.

4:40 – 4:50 Q&A SESSION

4:50 – 5:00 CLOSING REMARKS – Robert Thompson

NOVEMBER 8, 2018

TRACE EVIDENCE

9:00 – 9:05 Welcome and Safety – Robert Thompson

9:05 – 9:35 Keynote – Sheila Willis

9:35 - 9:45 Trace Evidence Introduction: Eric Steel and Will Guthrie

Trace evidence is ubiquitous at most crime scenes and has great potential to positively impact both the investigative and testimonial aspects of a case when properly used. However, trace evidence is also among the most varied in both type and quality. As a result, the range of skills needed for the physical analysis of trace evidence and for contextually-relevant interpretation of the information it contains are major challenges for forensic scientists. This session will describe some of the applied research that NIST is engaged in to better understand and optimize methods for trace evidence analysis. Statistical methods for interpretation of evidence in court also will be discussed.

9:45 – 10:30 A Framework for Optimizing Gas Chromatography Mass Spectrometry (GC/MS) Methods for Analysis of Ignitable Liquid Residues

9:45 – 10:00 Edward Sisco
10:00 – 10:15 Dennis Leber
10:15 – 10:30 Charles Hagwood

Method optimization is a fundamental component in validating new instruments for forensic casework. The most commonly utilized instrument in the field of fire debris analysis is a gas chromatography mass spectrometry (GC/MS) system. While there has been some research, the impact and interplay of GC/MS instrument settings on chromatographic and mass spectrometric responses in ignitable liquid residue (ILR) analysis is not well understood. Because ILR analysis involves comparing chromatographs of questioned samples to known samples, identifying a method that produces well–resolved and repeatable data is crucial. This talk will describe ongoing efforts to develop a holistic framework that laboratories will be able to employ to optimize GC/MS instrument settings for ILR analysis. Discussion will include the state of methods currently used in the forensic fire debris analysis community, the development of a fire debris test mixture for study, the importance of collaboration with practitioners, the statistical experimental design and decision analytic framework underlying the study, and how shape analysis will be used in quantifying the chromatograph data. The potential for implementation of this framework for drug analysis will also be discussed.

10:30 – 10:45 BREAK

10:45 – 11:00 Portable Headspace Sampling for Field Applications in Forensic Science: Megan Harries

Forensic analyses often must be conducted in field environments, for example, when screening cargo for illegal activity and other hazards. This presentation will discuss a recently developed portable device for headspace sampling (PLOT-cryoadsorption) and present the results of its first test in the field using a simulated cargo container.

11:00 – 11:15 Human Hair Keratin Extraction and Genetically Variant Peptide Detection: Meghan C. Burke

Recent reports have demonstrated that genetically variant peptides (GVPs) derived from human hair shafts can be used to differentiate individuals of different biogeographic origin. Our work aims to evaluate protein extraction methods from a single human hair strand. Furthermore, the construction of a human hair mass spectral library, including previously reported GVPs, enables the evaluation human hair proteome coverage and the effects of each protein extraction method on genetically variant peptide identification and quantification.

NOVEMBER 8

11:15 – 11:35 **Likelihood Ratio as Weight of Forensic Evidence: A Closer Look: Steven Lund**

We discuss components of several published responses to our Journal of Research of NIST article and their impact on our current perspectives regarding evidence evaluation and reporting. We highlight areas of agreement, as well as those where potential concerns persist.

11:35 – 11:45 Q&A SESSION

11:45 – 12:00 **A Review of NIJ and NIST Collaborative Research and Development Efforts: Gerry LaPorte**

The National Institute of Justice (NIJ) and the National Institute of Standards and Technology (NIST) have forged a critical research and development collaboration with the objective of strengthening the forensic sciences. The objective of this presentation is to highlight the support NIJ has provided to some of the important research efforts at NIST.

12:00 – 1:00 **LUNCH**

DRUGS & TOXINS

1:00 – 1:10 **Drugs & Toxins Intro: Eric Steel**

1:10 – 1:30 **Trace Detection of Fentanyl–related Substances in Screening Environments: Jennifer Verkouteren**

Technologies are needed for detecting fentanyl–related substances by law enforcement, the military, first responders, customs and border protection agents, and others. Trace detection is particularly advantageous in that it limits exposure to amounts below toxic levels. A significant challenge is the complexity of the targeted samples, including the number of different analogues, the presence of additional illicit drugs, and the potentially low concentration (<1 %) of the fentanyl. This talk will focus on two trace detection technologies, ion mobility spectrometry (IMS) and direct analysis in real time (DART) – mass spectrometry (MS), and the approach to testing given the specific needs of different screening environments. The approach includes a proposed common sample set, instrument evaluation criteria, and evaluation of sources of error from environmental background.

1:30 – 1:50 **Is It A Fentanyl? : Arun S. Moorthy**

The Hybrid Search is a mass spectral library search technique that we have developed over the past several years. In this seminar, we discuss an extended process (and software tool) that helps us decide whether an experimental spectrum (1) comes from a novel fentanyl analog, (2) the location of modification(s) if it is an analog, and (3) the correct identification if a representative spectrum is contained in the library. Following several examples, we discuss how this process can be applied for other classes of illicit drugs.

1:50 – 2:10 **NPS Data Hub, a Web–based Community Driven Analytical Data Repository for New Psychoactive Substances: Aaron Urbas**

In recent years there has been a rapid proliferation of new compounds emerging in the sphere of recreational drug use. These compounds are typically developed in an effort to stay ahead of drug scheduling laws banning their use and distribution. Keeping pace with the identification of these compounds is becoming an increasing challenge for forensic labs. The introduction of new psychoactive substances (NPSs) is a global problem and reliable data to aid in the identification of these compounds is not always available and typically lags their distribution and proliferation. To help address these issues, a new web–based database, the NPS Data Hub, has been developed to serve as a community driven repository for analytical data related to new psychoactive substances. The aim is to elicit data from the global forensic community to facilitate identification of unknown substances and eliminate unnecessary duplication of elucidation efforts.

2:10 – 2:30 **Building the Chemical Foundation for Intelligent Breath Analysis: Kavita Jeerage**

Quantitative and reliable breath analysis requires choosing the best chemical(s) for analysis, designing materials and methods for the capture of chemicals present in trace quantities, and having the ability to relate measured quantities to those present in blood. This presentation will describe thermophysical property measurements that build the foundation for reliable breath analysis, focusing on pure component vapor pressures and partitioning of drugs and drug analogs.

2:30 – 2:40 **Q&A SESSION**

2:40 – 3:00 **BREAK**

FIREARMS & TOOL MARKS

3:00 – 3:10 **Firearms and Tool Marks Intro: Johannes Soons**

In partnership with the forensics community, NIST is working to establish a sound metrology infrastructure for firearm and tool mark examination with scientifically justified protocols to quantify the weight of the evidence. We will present a brief overview of our work on reference artifacts, measurement uncertainty, a research database of tool marks, objective comparison methods, comparison score distributions, and error rates.

3:10 – 3:40 **Congruent Matching Features (CMF) Method for Ballistics Identifications with Subclass Characteristics: John Song**

We present the Congruent Matching Features (CMF) method for the objective comparison of impressed tool marks. The method quantifies the similarity of peak and valley features in the topography of compared samples and the congruency of their distribution patterns. The method builds on the Congruent Matching Cells (CMC) method developed at NIST for objective firearm identification and error rate estimation. In comparisons of breech face and firing pin impressions on cartridge cases, the CMF method shows promise in addressing the challenges of subclass characteristics. The proposed comparison of binarized surface topography images can enhance search performance of large image databases.

3:40 – 4:10 **Objective Comparison of Deformed Bullets: Zhe Chen**

Fired bullets can be severely deformed or fragmented. The resulting distortions of the striated tool marks from the firearm cause additional challenges in manual and automatic tool mark comparison. To overcome these challenges, we developed an algorithm to correct lateral distortions in the topography image of a bullet's Land Engraved Area (LEA) and extract the striae profile of interest. The Congruent Matching Profile Segments (CMPS) method was then applied to quantify the similarity of compared profiles. We will describe the improvements observed in same–source profile similarity for several bullet jacket materials and comparison metrics.

4:10 – 4:20 **Q&A SESSION**

4:20 **CLOSING REMARKS**