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ABSTRACT BOOK

Global Conference on

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INDEX

Plenary session

Keynote session

15	Title: Development of a Multiplex LAMP-Based Assay for the Rapid and Concurrent Detection of Human DNA and Sex Identification
	Lin Zhang, *Sichuan University, Chengdu, Sichuan, China*

Featured Talks

16	Title: Cybersecurity and Blockchain Integration with IoT: Advancing Secure Smart Systems
	Rahul Mishra, *National Institute of Advanced Manufacturing Technology (NIAMT), Ranchi, India*
17	Title: Unmanned Mining Fleet Management
	Naser Badakhshan, *Amirkabir University of Technology, Iran*
18	Title: Physics-Informed Neural Networks with PDFP Optimization for Regularization-Free Solutions of Backward Time-Fractional Parabolic Equations
	Muhammad Israr, *Government College University Lahore, Pakistan*
19	Title: Unlearning in AI: From Data Deletion to Model Rewriting
	Youyang Qu, *Qilu University of Technology, China*
20	Title:Toward Just-in-Time, Secure, and Resilient Smart Systems with Edge Intelligence
	Md Nurul Absur, *CUNY Graduate Center, USA*
21	Title: Sample records for instrumental analysis experiment
	Hamza Javed, *Central South University, China*
22	Title: Anthropometric Analysis of the Scapula Using 3D CT: Age and Gender Estimation in a Tertiary Hospital
	Shubham Gupta, *Parul University, Gujarat, India*

23	Title: Single-cell Transcriptomics Reveals Time-Resolved Neuronal Death Characteristics in Traumatic Brain Injury
	Qiuyun Yang, *Sichuan University, Chengdu, Sichuan, China*
24	Title: Revolutionising Forensic DNA Analysis with CRISPR-Cas Technology: A Comprehensive Review of its Emerging Applications, Challenges and Future Directions
	Srinjoy Roy, *National Forensic Sciences University Gandhinagar, Gujarat, India*

Gheorghe SEBESTYEN
Technical University of Cluj-Napoca, Romania

Digital framework for Judigial Activity

In the context of the rapid advancement of Information and Communication Technologies (ICT), digital forensic investigations are increasingly supported by specialized tools. Each phase of an investigation—from secure data acquisition and storage to knowledge extraction and information visualization—requires scalable and robust ICT solutions. This paper proposes an integrated framework specifically designed for judicial investigations, aimed at optimizing the acquisition, processing, and analysis of digital evidence.

The proposed solution introduces an operational workflow that ensures the secure handling of digital artifacts while maintaining the rigor required for legal admissibility. A key component of this framework is the data capture module, which enables selective network traffic interception, multiple simultaneous captures based on different criteria from the same data stream, as well as synchronized multipoint capture from geographically distributed locations. This level of flexibility is particularly valuable in cybercrime investigations.

The second major component of the framework is the secure storage module, developed to protect digital evidence from tampering, loss, or unauthorized access. The proposed architecture implements twelve parallel protection mechanisms to ensure data integrity. To optimize communication across distributed subsystems and reduce data traffic, only metadata is stored in a private blockchain. This approach significantly reduces the volume of data replicated between nodes while preserving traceability and verifiability of the evidence. The solution was validated

in closed (air-gapped) infrastructures, demonstrating operational efficiency under high-security constraints.

The third aspect addressed involves the analysis and interpretation of data collected during digital forensic operations. Several methods for automatic evidence extraction were tested, with a particular focus on artificial intelligence (AI)-based techniques. These AI models improve the speed and accuracy of identifying digital evidence by recognizing trained patterns using specialized neural networks.

In conclusion, the proposed framework provides end-to-end support for digital forensic workflows—from intelligent data capture to secure evidence storage and AI-assisted analysis. It enhances the capabilities of judicial and law enforcement institutions in combating cybercrime, while ensuring the integrity and legal admissibility of electronic evidence.

Biography:

Gheorghe SEBESTYEN is a Professor at the Technical University of Cluj-Napoca, Romania, within the Department of Computer Science. He received his Ph.D. in Computer Science in 2003 from the same institution. His main research interests include applied informatics, control systems, forensic digital systems, cybersecurity and malware detection techniques.

With over 35 years of experience in the field of computer science, Professor Sebestyen has authored more than 150 scientific papers published in peer-reviewed journals and conference proceedings. He has led numerous research and development projects funded by national and international bodies, with a focus on applying ICT solutions in industrial control, telemedicine, digital libraries, and information security. He is a PhD coordinatior since 2010.

He is also a peer reviewer for several reputable journals, including Sensors, Electronics, and Advances in Electronics and Computer Engineering, and regularly serves on the program committees of prestigious international conferences such as ICCP and AQTR.

Jeffrey Seif
University of Cambridge, United States

Training Police to be Kindly Disposed Toward Marginalized Persons

In response to ubiquitous calls for police reform, this researcher sought to ascertain the extent to which, if any, basic police academy training in the United States of America has heeded the call. The researcher made twenty years' worth of police training survey data, collected by the US Department of Justice's Bureau of Justice Statistics and published under the titles "State and Local Law Enforcement Training Academies", the object of his attention. The number of academy directors who responded to surveys for this descriptive analysis ranged from 626 to 747. Results were published in 2002, 2006, 2013, 2018 and 2022. Using empathy as a hermeneutical key, this researcher examined (1) ethics-related curriculum content in the BJS reports, (2) the number of content hours assigned to interactional legitimacy, (3) the percentage of contact hours assigned against the overall Basic Peace Officer Course curriculum hours, (4) national trends and (5) compared trends in the BJS data with trends in Texas' academy curriculum. At both the national and Texas-state levels, the researcher observed a significant rise in course content and contact hours that speak to, for and about the need to train neophyte officers to be more kindly disposed toward marginalized persons. Following on the heels of Bureau of Justice Statistics and Texas-based data, are analytical reflections on best practices in police education, related to the inculcation of values. A preliminary, descriptive analysis in a woefully understudied field, it is hoped agencies will use information herein to—if need be—update the quantity and quality of empathy-related course blocks in basic police officer education.

This research is part of its author's PhD research at the University of Cambridge, that began when he was superintending three police academies in Texas, USA, through the Dallas College system. He covets affirmations, critiques, and notification of any related studies—especially from other parts of the world.

Constance Izuchukwu Amannah
Ignatius Ajuru University of Education, Nigeria

Hybrid Model For Real-Time Reservouir Pressure And Temperature Estimation Using Flowing Tubing Head Pressure Data With Lightgbm Ensemble Algorithm

The increasing need for accurate and timely estimation of subsurface conditions in oil and gas reservoirs has necessitated the integration of machine learning into real-time reservoir monitoring systems. This study specifically addresses the challenge of non-invasively estimating reservoir pressure and temperature by developing a hybrid predictive model that leverages Flowing Tubing Head Pressure (FTHP) data, domain-specific knowledge, and the Light Gradient Boosting Machine (LightGBM) ensemble learning algorithm. Operational data were collected from field-deployed sensors, including FTHP, wellhead temperature, fluid production rates, and environmental conditions. After rigorous data preprocessing and feature engineering—including moving averages, pressure gradients, and contextual metadata—the hybrid model was trained on 80% of the dataset and validated with 20%, incorporating both historical and real-time data. The model's predictive performance was evaluated using standard statistical metrics: Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and R^2 score. The LightGBM-based hybrid model achieved high predictive accuracy, with an RMSE of 0.85 psi and MAE of 0.65 psi for reservoir pressure, and RMSE of 0.45 °C and MAE of 0.32 °C for temperature estimation. R^2 values of 0.96 and 0.95 respectively confirmed the model's reliability. Comparative performance analysis demonstrated that the hybrid model outperformed traditional regression methods (Linear and Ridge Re-

gression) and other ensemble models (Random Forest, XGBoost), offering superior generalization and reduced error margins. To meet the operational requirement for real-time estimation, the model was deployed on an industrial edge computing device, achieving an average prediction latency of 320 milliseconds. The system was also equipped with a feedback loop for adaptive learning and continuous improvement based on periodic ground truth validation from downhole sensors. This research is relevant to smart oilfield operations and digital transformation initiatives. It provides a scalable, accurate, and cost-effective solution for real-time reservoir parameter estimation. Within the defined scope and timeframe, the study achieves measurable improvements in predictive performance and operational decision-making, thereby contributing significantly to the body of knowledge in digital reservoir management and applied machine learning in petroleum engineering.

Biography:

Constance Izuchukwu Amannah is an Associate Professor with twenty-two years cognate teaching experience. He holds B.Sc., M.Sc., and PhD. degrees in Computer Science with distinguished research interest in Computational genetics, Algorithms, Software Engineering, Signal Processing, and Medical AI. He is a Fellow of Scholars Academic and Scientific Society (FSASS), an International Society for Academic & Scientific Integration, and of Nigeria Computer Society (FNCS). He has to his credit, over 100 publications with 5 patents, and 40 Conference Proceedings. He has designed and tested over 80 models, including algorithms for expected date of delivery (EDD) and expected year of death (EYD).

Yasir Akhtar
Chung Yuan Christian University, Taiwan

Revolutionizing Water Purification Selection with Neural Network and Double Picture Hierarchy Linguistic Aggregation Operators

Water holds great cultural and symbolic significance for millions of people, particularly in developing nations, and is a basic necessity as well as a vital resource for economic endeavors. Everyone agrees that having a home water supply is essential for growth and a fundamental human right. Nowadays, there is a physical or economic water scarcity that affects one-third of the world's population. Access to this limited resource for productive, consumptive, and social purposes is becoming more challenging due to increased competition for water from a variety of sectors, including industry, agriculture, power production, residential usage, and the environment. There is growing competition for scarce resources in water-scarce areas and nations, which impacts impoverished rural populations more than others. Pakistan suffers from a widespread water shortage, but Balochistan is particularly heavily afflicted. Balochistan, the biggest province in Pakistan, has a serious water shortage. Therefore, this paper introduces a novel approach called the feed-forward double picture hierarchy linguistic neural networks using double picture hierarchy linguistic term information to handle this issue. For this, we extend the concept of algebraic norms to develop novel operational laws for the picture double hierarchy linguistic term set. We also develop a series of double picture hierarchy linguistic weighted aggregation operators and also discuss their desirable properties. The decision-making process becomes complex due to unknown weight vectors. The entropy measure is introduced to locate unknown weight vectors. The proposed

technique and novel operators are used to select the best option to resolve the water scarcity problem in Quetta, and its feasibility and efficacy are evaluated compared to other MCDM techniques. Finally, we provide some recommendations for water resources management in Quetta.

Biography:

YASIR AKHTAR received his Bachelor's degree in Mathematics from Abdul Wali Khan University Mardan, Pakistan, in 2015. He received the M.S. degree in Applied Mathematics from Lanzhou University of Technology, China, in 2021. Currently, he is pursuing his Ph.D. from the department of Applied Mathematics, Chung Yuan Christian University, Taoyuan, Taiwan. His research interests include fuzzy logic and fuzzy set theory, similarity and dissimilarity measures, fuzzy decision making, aggregation operators, and their applications.

Ayan Paul
Indian Institute of Technology Kharagpur, India

Smart solutions for capsicum Harvesting: Unleashing the power of YOLO for Detection, Segmentation, growth stage Classification, Counting, and real-time mobile identification

This research paper explores a comprehensive approach to advancing capsicum harvesting by integrating cutting-edge technologies. The study addresses key objectives, including capsicum detection using various YOLO algorithms, peduncle detection through YOLO segmentation models in a proposed robotic harvester, laboratory testing of cutting target point coordinates using the Real Sense D455 RGB-D camera, growth stage determination, and capsicum counting/tracking with a supervision algorithm. The investigation highlights the YOLOv8s model as the most successful for capsicum detection, achieving a remarkable mean Average Precision (mAP) of 0.967 at a 0.5 Intersection over Union (IOU) threshold. As part of the growth stage determination task, YOLOv8s achieved a satisfactory mAP of 0.614 at the same IOU threshold. Additionally, the YOLOv8s-seg model demonstrated superior performance in peduncle detection, attaining a box mAP of 0.790 and a mask mAP of 0.771. The YOLOv8s-seg model excels in peduncle detection with a box mAP of 0.790 and a mask mAP of 0.771. Laboratory experiments using the Real Sense D455 RGB-D camera showcased its capability to localize the target point with a maximum error of 8 mm longitudinally, 9 mm vertically, and 12 mm laterally. The developed tracking and counting algorithm achieve a notable counting accuracy of 94.1 % during the third harvesting cycle in the greenhouse. The Android application developed demonstrated robust performance, achieving

high accuracy (Mean IoU: 0.92), precise localization (Mean Euclidean Distance: 5 pixels), responsive user interface (Touch Response Time: 150 ms), and broad compatibility across Android versions and device types, with effective error handling (Success Rate: 95 %). The study not only advances capsicum harvesting techniques but also presents practical insights for the integration of advanced technologies, paving the way for efficient robotic harvesting systems in agriculture.

Biography:

Mr. Ayan Paul is a research scholar in the Agricultural and Food Engineering Department at the Indian Institute of Technology (IIT) Kharagpur, currently in the third year of his Ph.D. program. He is a prestigious recipient of the Prime Minister's Research Fellowship (PMRF), becoming the first awardee in the Farm Machinery specialization. His research focuses on Agricultural Robotics, where he is contributing to the advancement of automation in agriculture. Mr. Paul has authored over 10 research publications and has served as a peer reviewer for more than 15 manuscripts each from leading academic publishers including Elsevier and Springer Nature.

Dr. Tolulop Bayode Abejide
University of Derby, DE22 1GB, United Kingdom

Next-Generation Ballistics: Integrating AI and 3D Imaging to Revolutionize Firearm Forensics

In an era where global justice systems are under increasing pressure to deliver timely, accurate, and unbiased forensic evidence, traditional methods in firearm forensics face limitations in scalability, objectivity, and reproducibility. This presentation explores how innovations in artificial intelligence (AI), machine learning, and 3D imaging technologies are reshaping the landscape of forensic ballistics. We will examine how AI-driven algorithms are being employed to analyse microscopic toolmarks on bullets and cartridge cases with increased precision and speed. 3D imaging technologies now allow for the digital preservation and comparison of ballistic evidence, reducing reliance on subjective visual assessments. These tools not only increase efficiency in high-volume casework but also open the door to the development of international, interoperable databases for global firearm tracking. The talk will highlight the real-world impact of some technologies using case studies and current research including data from automated systems like Evofinder and the National Integrated Ballistic Information Network (NIBIN). Special attention will be given to how lower-resource jurisdictions can implement cost-effective, cloud-based alternatives to enhance their forensic capabilities. Ultimately, this session aims to illustrate how integrating next-generation technologies into forensic ballistics strengthens global justice systems by increasing reliability, reducing backlogs, andminimizing the risk of wrongful convictions.

Biography:

It is a privilege to introduce Tolulope Bayode Abejide, a distinguished forensic scientist, educator, and humanitarian, as a speaker at this international conference. A lecturer in Forensic Chemistry, Crime Scene Investigation, and Ballistics at the University of Derby, UK, Tolulope brings over a decade of experience in high-profile forensic investigations and education. He has significantly shaped forensic science policy and practice in Nigeria, notably organizing the country's first International Forensic Stakeholders Forum and advancing medico-legal frameworks. With academic credentials spanning the UK and Nigeria, he bridges global standards with local relevance. His work in training over 300 professionals and involvement in disaster victim identification and conflict zone reconciliation underscores his commitment to justice and humanitarian service. As a member of leading forensic bodies worldwide, Tolulope Abejide stands as a global authority and visionary, shaping the next generation of forensic professionals and systems.

Dr. Waqas Ghulam Hussain
The Islamia University of Bahawalpur, Punjab, Pakistan

Examining the Relationship Between Obesity and Income Distribution Using Body Mass Index (BMI) and Body Shape and Size Index (BSSI): A Case Study of Pakistan

Statement of the Problem: Obesity has become a significant public health challenge worldwide, impacting millions and linked to various health issues, including hypertension, Type 2 diabetes, cardiovascular diseases, and certain cancers. This study investigates the relationship between obesity, as measured by Body Mass Index (BMI) and Body Shape and Size Index (BSSI), and family income distribution among children and adults in Pakistan. The rising prevalence of obesity, especially in context of changing socioeconomic conditions, poses urgent public health concerns.

Methodology & Theoretical Orientation: This cross-sectional study analyzed data from 2,223 individuals aged 2 to 19 years in Multan, Pakistan. Utilizing standardized procedures for measuring height and weight, we calculated BMI and introduced the BSSI as a more comprehensive anthropometric measure. Statistical analyses were performed to examine the relationship between obesity indices and family income, with a focus on gender differences as well.

Findings: The study found a significant correlation between higher family income and increased BMI and BSSI values, particularly among female participants. The mean BMI for individuals with family income below 10,000 PKR was 18.00, and

it increased to 20.59 for those earning more than 50,000 PKR. Similarly, BSSI levels showed a corresponding upward trend with rising income.

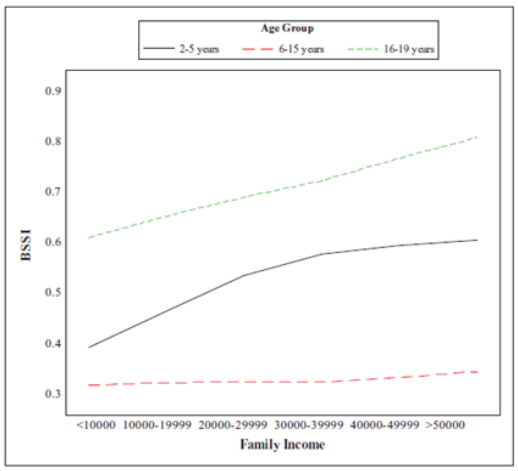


Figure 2. Comparison chart of family monthly income and BSSI with different age groups.

Conclusion: Results indicate that socioeconomic factors play a crucial role in shaping body composition among the Pakistani population, suggesting a need for targeted public health interventions. Addressing the rising obesity rates necessitates a multi-faceted approach that includes improving socioeconomic status and access to healthcare. Recommendations highlight the importance of incorporating socioeconomic considerations into public health strategies aimed at combatting obesity.

Biography:

Dr. Waqas Ghulam Hussain is a PhD Scholar in the Department of Statistics at The Islamia University of Bahawalpur, Pakistan. He has been actively involved in research related to obesity and body composition, particularly focusing on the relationships between socioeconomic status and health outcomes in diverse populations. Since 2021, he has collaborated on various studies aimed at understanding the impact of income distribution on health metrics like Body Mass Index (BMI) and Body Shape and Size Index (BSSI). Dr. Hussain has presented at numerous national conferences, disseminating findings on obesity trends and health disparities among children and adults. He has co-authored multiple research articles published in reputable journals, contributing valuable insights to the fields of public health, statistics, and gerontology. His work emphasizes the importance of integrating socioeconomic factors into health policy and program design aimed at addressing obesity and improving overall health in Pakistan. In addition to his research activities, Dr. Hussain is committed to mentoring students and enhancing the academic capabilities of aspiring statisticians. He is focused on fostering a greater understanding of statistical applications in public health research, aiming to contribute to evidence-based solutions for prevalent health challenges.

Erin Kruger
Western Sydney University, Australia

The Diversity of Forensic Toxicology(ies) in Counterfeit Drug Analyses

Illicit and licit counterfeit drugs present new opportunities and challenges for forensic toxicology, expanding the discipline from a 'singular' to 'plural' set of techniques, experiments, and future directions. Counterfeit drugs can simultaneously take many forms and manifestations, including spurious, substandard, and falsified formations. Contemporary modes of forensic toxicology seek to assess such drugs at bodily levels (i.e., through emergency department and postmortem analyses), and in analytical contexts that scrutinize the chemical composition of drugs themselves (i.e., at scene investigations, in forensic laboratories). There are further overlaps between these modes of forensic toxicology as applied to counterfeit drugs that include, but are not limited to, pharmaceutical industries, and national and global coordinated legislative and investigative approaches. The consequence is an escalating amalgamation between more standard forensic toxicological approaches (i.e., autopsies, chromatographic and spectrometric), with emerging technologies and rationalities (i.e., modes of artificial intelligence, and Omics data mining). The counterfeit drug occurrence is unique in that it continues to evolve and innovate at a significant international pace, with the capability to often adapt and override the legal controls put in place to prohibit such drug manufacturing and distribution. This results in an equally diverse set of global forensic toxicological approaches at the level of scientific techniques used, the combination and separation of human processes and artificial intelligence operations, evidential outcomes produced, and

variance depending on geographic location. This presentation considers the novelty of forensic toxicology(ies) considering the counterfeit drug cases and scenarios the discipline is increasingly presented with, especially as forensic detection methods become more complex, interlaced, and sophisticated.

Biography:

Erin Kruger is a Lecturer in Criminology and Policing at Western Sydney University, Australia. She primarily teaches and researches in international crime, forensic science, risk assessment in offending populations, health and well-being, and social theory.

Enas Fawzi Khairullah
King Abdulaziz University, Jeddah, Saudi Arabia

Investigating Cloud Forensics: Challenges, Tools, and Case Studies

Cloud computing has introduced transformative benefits in data storage and accessibility while posing unique forensic challenges. This paper explores cloud forensics, focusing on investigating and analyzing evidence from cloud environments to address issues such as unauthorized data access, manipulation, and breaches. The research highlights the practical use of open source forensic tools such as autopsy and bulk extractor in real-world scenarios, including unauthorized data sharing via Google Drive and the misuse of personal cloud storage for sensitive information leaks. This work underscores the growing importance of robust forensic procedures and accessible tools to ensure data security and accountability in cloud ecosystems.

Biography:

Dr. Enas Khairullah is an Assossiate Professor of Computer Science at King Abdulaziz University, Jeddah, Saudi Arabia. She holds two M.S and a PhD in Computer Science. She is also Huawei certified in HCIA-Storage. She earned a six-sigma yellow belt from the American Society for Quality (ASQ). Her main area of interest is dynamic spectrum access networks, wireless networks, resource allocation, scheduling, routing, cognitive radio, auctions, and conflict graph. Her publication record includes scholarly papers in some of the most prestigious peer-reviewed journals in these fields. Dr.Khairullah was awarded several local/international programming competitions awards, and a KAU distinguished researcher award.

Asma O. Jebril
University of Tripoli, Libya

The variation of traditional enzymatic and new HS-GC\FID methods results for Blood alcohol Determination of Heart disease patients in Libya

Determination of Blood alcohol concentration (BAC) in heart disease patients is crucial for both clinical and forensic purposes, enzymatic ethanol assays are widely used to determine blood alcohol content for individuals admitted to a hospital. In some instances, this hospital data is later used as evidence in a court of law, As the enzymatic assay targets, but does not exclusively measure ethanol, it is theoretically possible that interference could occur and produce a falsely elevated result, leading to wrongful convictions or other consequences. This Study examined the potential of clinically relevant levels of one potential interferant lactate dehydrogenase (LDH) enzyme to cause significant and falsely elevated results and compering this method with chemical and new HS-GC/FID methods, This study was conducted on 48 individuals (24 myocardial infarction patients, 24 healthy volunteers) in Tripoli –Libya.

The BAC (mg/dl) result for healthy and MI patients statistically showed a significant difference ($p<0.05$) by using enzymatic method and no significant by using HS-GC/FID method. A clear difference with a High significant ($p<0.01$) of Blood Alcohol Concentration appear for MI Patients by using the enzymatic and HS-GC/FID method. The Pearson correlation coefficient between LDH levels and BAC (mg/dl) by enzymatic method is 0.76, indicating a strong positive ،This suggests that as LDH levels increase BAC levels and also tend to decrease (LDH interfer-

ence may contribute to falsely elevatedethanol readings in MI patients.) the accuracy of BAC determination. HS-GC/FID is advised over the enzymatic approach, particularly in individuals with myocardial infarction patients (elevated LDH levels).

Dr. Faisal Mohammed Alzubaidi
King Fhad Security College,
Saudi Arabia

Fatal Penetrative Cervical Spine Injury Following Misdeployed Airbag

Road traffic injuries are one of the leading causes of global mortality rates and entail various health and economic-related consequences. When used in combination with seatbelts, vehicle airbags are intended to reduce cervical spinal injuries to the car driver during sudden impact. However, it is increasingly recognized that airbag misdeployment trauma injuries are becoming more prevalent and can lead to severe injuries or even death. This case report presents a fatal penetrative cervical spine injury in a 22-year-old nonrestrained male following a misdeployed airbag in Saudi Arabia. Misdeployed airbag trauma may be a potential factor in road traffic fatalities, particularly when it is linked to penetrating injuries caused by metal fragments penetrating the car's passenger compartment. Postmortem imaging assists the medical examiner in planning autopsy procedures and to rule out other injuries. To ensure a safe driving experience, it is imperative to adhere to road safety policies and enhance the safety features of automobiles to meet industry standards.

Biography:

finished Foresic medicin saudi bored 2021, 35 years old years from king fahad security college. He is the chief of Foresic medicin depatment king fahad security college,. He has Published in excess of 10 papers in rumored diaries and has been filling in as a publication board individual from notoriety – 2023 Collages Security Fahd King of Center Medical (DIO (official Institutional Designated and affairs academic of Head Present – 2023 Collages Security Fahd King of Center Medical medicine forensic of director programmers consultant and professor Assistant Present – 2022 Medicine Forensic of Society Saudi Officer.

Shengqiu Qu

Sichuan University, Chengdu, Sichuan, China

Identification and characterization of Multi-InDels from whole genome

Mixtures are common biological materials in forensic science, and their analysis has long been a major challenge in this field. In DNA mixture analysis, one of the key difficulties lies in the imbalance between contributors. When the component ratios differ significantly, conventional methods often fail to effectively identify the genetic information of minor contributors. Due to the higher DNA content of major contributors, their amplification advantage tends to mask the signals of minor contributors, making the genetic markers of the latter difficult to detect. The maternal plasma represents a typical unbalanced two-person mixture, which consists mainly of maternal cfDNA along with a small fraction of cell-free fetal DNA. Accurate analysis of such samples is of great significance for noninvasive prenatal paternity testing. In recent years, some studies have reported that allele-specific amplification combined with compound genetic markers can be applied on capillary electrophoresis (CE) platforms to detect minor contributors in unbalanced mixtures. This technique targets the amplification of specific alleles, significantly improving the sensitivity of detecting low-abundance DNA components, and providing a new approach for addressing the challenge of unbalanced mixture analysis. Multi-InDels, as a novel type of compound genetic marker, are widely distributed, exhibit length polymorphisms, and contain sequence differences between alleles. Therefore, this study aimed to explore the feasibility of combining Multi-InDels with allele-specific amplification, with the goal of establishing a new technical pathway

for detecting unbalanced mixtures and enabling noninvasive prenatal paternity testing. In this study, we screened Multi-InDel loci across the whole genome and designed allele-specific primers, which were applied on the CE platform to detect minor components in mixtures. Ultimately, two multiplex amplification systems containing 11 Multi-InDels were established (L and S systems). Results demonstrated that each primer pair could detect unbalanced mixtures at ratios as high as 1:1000, while the multiplex systems L and S achieved detection at ratios of 1:200 and 1:500, respectively. Moreover, fetal DNA components were successfully detected in 36 maternal plasma samples. Overall, this study significantly improved the detection sensitivity of unbalanced mixtures on the CE platform and provides a new technical reference for forensic science and prenatal testing.

Biography:

Shengqiu Qu received her PhD in Medicine from Sichuan University in 2022 and is currently an Associate Professor specializing in forensic genetics. Her research focuses on the detection and tracing of challenging forensic biological samples and the development of novel genetic markers for forensic applications. She has published more than 40 SCI-indexed papers in leading international forensic journals, including over 20 as first or corresponding author.

Weibo Liang
Sichuan University, Chengdu, Sichuan, China

Forensic challenges of low-template DNA mixtures: A systematic evaluation of probabilistic genotyping with high-efficiency microhaplotype panels

Low-template DNA mixtures pose inherent analytical challenges due to limited genetic information and the high risk of allele dropout. The presence of multiple contributors and highly imbalanced mixture proportions further complicates interpretation, making it increasingly difficult to reliably assess evidential weight in forensic casework. Microhaplotypes, defined as clusters of closely linked SNPs within short DNA segments, provide several advantages for addressing these challenges. Their high polymorphic information content, low mutation rates, and compatibility with next-generation sequencing (NGS) make them particularly well suited for mixture deconvolution. To systematically evaluate the risks associated with low-template and complex mixtures, this study analyzed samples of varying complexity using three published high-efficiency NGS-based microhaplotype panels, encompassing conditions such as extremely low DNA inputs (down to 0.05 ng), mixtures with up to four contributors, and highly unbalanced ratios (as skewed as 1:40). Probabilistic genotyping was performed with EuroForMix to assess likelihood ratio (LR) distributions when either the true minor contributor or a non-contributor was considered the person of interest (PoI). Results demonstrated that all three panels reliably distinguished contributors from non-contributors in two-person balanced mixtures, even at the lowest input, with LRs consistently exceeding forensic significance thresholds. The most polymorphic panel expanded the genotype space,

thereby reducing the risk of spurious LR inflation for close relatives and providing the clearest separation between contributors and non-contributors. Conversely, panels with larger numbers of loci proved advantageous under conditions of extreme imbalance, partially compensating for allelic information loss and preserving limited but informative discriminatory power. These findings underscore the context-dependent performance of marker systems, shaped by both locus number and polymorphism. The introduction of the contributor mixture proportion deviation metric (Dratio), proposed here for the first time, further corroborated the strong discriminative capacity of these panels and demonstrated its potential as a complementary tool in mixture interpretation. Additionally, we explored kinship-based inference to identify contributors when reference profiles of true contributors were unavailable. This approach calculates LRs to evaluate whether a known reference genotype corresponds to a close relative of an unknown contributor or an unrelated individual. Results demonstrated clear discrimination between non-contributors and genetically related individuals in most complex mixtures, enabling investigators to focus on relevant family groups. Collectively, these findings provide guidance for the design and selection of multiplex panels, analytical strategies, and interpretation frameworks for complex DNA mixtures. The proposed approaches are anticipated to support robust forensic evaluation as sequencing and genotyping technologies continue to advance.

Biography:

Dr. Weibo Liang received his PhD in Medicine from Sichuan University in 2006 and is currently Vice Dean of the West China School of Basic Medical Sciences & Forensic Medicine, Sichuan University. His main research areas include forensic medicine and medical genetics. He has led five projects funded by the National Natural Science Foundation of China, published more than 200 peer-reviewed papers with over 3,000 citations, and holds more than 10 authorized invention patents.

Xiameng Chen

Sichuan University, Chengdu, Sichuan, China

From degraded to deciphered: Applying ATAC-seq to forensic molecular diagnosis under degradation conditions

In recent years, molecular biology-based diagnostic techniques have made remarkable strides and are now extensively utilized in clinical practice, providing invaluable insights for disease diagnosis and treatment. However, forensic medicine, especially forensic pathology, has witnessed relatively limited progress in the application of molecular biology technologies. A significant challenge in employing molecular techniques for forensic diagnoses lies in the quantitative and qualitative changes observed in diagnostic markers due to sample degradation-a recognized and formidable obstacle. Inspired by the success of DNA sequencing in forensic practices, which enables accurate individual identification even in cases involving degraded and deteriorated tissues and organs, we propose the application of the assay for transposase-accessible chromatin with sequencing (ATAC-seq) to identify targets at the transcriptional onset, exploring chromatin and DNA-level alterations for injury and disease inference in forensic samples. This study employs ATAC-seq to explore alterations in chromatin accessibility post-injury and their subsequent changes over a 2-hour degradation period, employing traumatic brain injury (TBI) as a representative model. Our findings reveal high sensitivity of chromatin accessibility sites to injury, evidenced by shifts in thousands of peak positions post-TBI. Remarkably, these alterations remain largely unaffected by early degradation. Our results robustly endorse the notion that integrating and incorporating these specific loci for injury and disease diagnosis in forensic samples holds tremendous prom-

ise for practical application. We further validated the above results using human cortical tissue, which supported that late-stage degradation did not significantly affect chromatin accessibility. This pioneering advancement in molecular diagnostic techniques may revolutionize the field of forensic science, especially forensic pathology.

Biography:

Dr. Xiameng Chen obtained her M.D. in Forensic Pathology and Forensic Clinical Medicine from Sichuan University and is currently an Associate Professor at the West China School of Basic Medical Sciences and Forensic Medicine, Sichuan University. She has published research articles as corresponding author in journals including International Journal of Legal Medicine, Genome Research, and Journal of Neuroscience. She has presided over multiple research projects, including those funded by the National Natural Science Foundation of China. Dr. Chen also serves as a forensic consultation expert for the Sichuan Provincial Department of Public Security and as a specially appointed expert for the Criminal Investigation Bureau of Chengdu Public Security Bureau. In addition, she is a member of the editorial board for the undergraduate textbook Experimental Guidance in Forensic Pathology.

Lin Zhang
Sichuan University, Chengdu, Sichuan, China

Development of a Multiplex LAMP-Based Assay for the Rapid and Concurrent Detection of Human DNA and Sex Identification

In forensic practice, the rapid and accurate identification of human DNA and sex is essential for analyzing biological samples collected at crime scenes. Conventional PCR-based methods are reliable but time-consuming, equipment-intensive, and poorly suited for on-site applications. In recent years, molecular diagnostic methods based on isothermal amplification have gained increasing attention. Among isothermal amplification methods, loop-mediated isothermal amplification (LAMP) has gained considerable attention as a promising alternative owing to its rapid reaction, high sensitivity, minimal equipment requirements. Nevertheless, its adoption in forensic science is still limited by several challenges. Current assays depend heavily on high-quality DNA templates, while the requirement for DNA extraction increases workflow complexity and stringent reagent storage conditions hinder portability. In this study, we developed a multiplex LAMP assay targeting partial sequences of the Cyt b and SRY genes for simultaneous human DNA detection and sex identification. Multiple primer sets were designed and screened, resulting in an optimized assay with a sensitivity of 25 pg. To enhance portability and long-term usability, the assay reagents were further formulated into lyophilized beads,. The streamlined workflow, including both sample lysis and amplification, can be completed within 40 minutes, providing a rapid and user-friendly detection scheme. Mixed-donor experiments confirmed the assay's robustness, with trace male DNA reliably detected even in female whole blood at a tenfold excess. Val-

idation using diverse body fluid samples from clinical specimens further demonstrated 100% accuracy. Overall, the multiplex LAMP assay provides a sensitive, accurate, and portable solution for rapid human DNA and sex identification, making it highly suitable for on-site forensic analysis.

Biography:

Dr. Lin Zhang received his PhD in Medicine from Johannes Gutenberg University Mainz, Germany, in 1995, and is currently a Professor and doctoral supervisor in forensic medicine. With more than 30 years of teaching and research experience in forensic medicine, he has published over 200 SCI-indexed papers. His research focuses on forensic genetics, novel genetic markers, and molecular diagnosis of brain injury.

Dr. Rahul Mishra

National Institute of Advanced Manufacturing Technology (NIAMT), Ranchi, India

Cybersecurity and Blockchain Integration with IoT: Advancing Secure Smart Systems

The proliferation of Internet of Things (IoT) devices has revolutionized industries, cities, and everyday life, creating smart environments that are highly interconnected and dynamic. However, this rapid expansion also brings significant cybersecurity challenges, including data integrity risks, device vulnerabilities, and the complexity of managing trust across distributed networks. Traditional security models often fall short in addressing the unique demands of IoT ecosystems, which require scalable, flexible, and decentralized solutions.

This talk, "Cybersecurity and Blockchain Integration with IoT: Advancing Secure Smart Systems," explores how blockchain technology can transform IoT security. Blockchain's decentralized, tamper-resistant architecture offers new possibilities for enhancing trust, transparency, and resilience across smart systems. We will examine key integration models where blockchain supports secure device authentication, data validation, and decentralized decision-making in IoT networks. The session will highlight emerging frameworks, lightweight blockchain solutions designed for resource-constrained devices, and the role of smart contracts in enabling autonomous and secure operations. Real-world applications from sectors such as healthcare, manufacturing, and critical infrastructure will be discussed to illustrate the practical impact of blockchain-enabled IoT systems. I will also address open challenges, including scalability, latency, energy efficiency, and the need for regulatory frameworks that can support widespread adoption. By uniting cybersecurity

principles with blockchain innovation, we can build resilient, sustainable smart ecosystems that are capable of withstanding evolving cyber threats. This talk will provide researchers, practitioners, and policymakers with actionable insights into advancing secure, intelligent infrastructures, and will outline the path toward creating trustworthy smart environments that form the backbone of the future digital society.

Biography:

Dr. Rahul Mishra holds an M.Tech. and Ph.D. from the prestigious IIT (ISM), Dhanbad, specializing in Network Security, Formal Verification, and Blockchain Technology. Currently serving as an Assistant Professor at the National Institute of Advanced Manufacturing Technology (NIAMT), Ranchi, Dr. Rahul Mishra brings a strong research focus on advancing secure, resilient digital systems. With over 17 publications in reputed journals and conferences, Dr. Rahul Mishra 's work bridges theory and real-world applications, contributing significantly to the fields of cybersecurity and blockchain integration. Passionate about building future-ready smart infrastructures, Dr. Rahul Mishra combines academic excellence with practical innovation, inspiring the next generation of secure technology solutions.

Naser Badakhshan
Amirkabir University of Technology, Iran

Unmanned Mining Fleet Management

Production scheduling in open-pit mines is a complex yet essential challenge that significantly impacts productivity and cost reduction. This study addresses the growing need for intelligent fleet management systems that can maximize the utilization of unmanned mining fleets, leading to more efficient production Our proposed model is based on a multi-objective production scheduling framework that leverages deep reinforcement learning and the Internet of Things (IoT) for real-time fleet management. This model is designed to minimize fleet idle time and transportation costs while maximizing overall production through the simultaneous control of multiple shovels and mining trucks. By integrating IoT-based travel time estimation, fleet coordination is enhanced, and scheduling accuracy is improved. The model has been evaluated under various conditions, including real-world scenarios from the Sarcheshmeh Copper Mine in Iran. The proposed model has successfully reduced truck idle time and improved fleet utilization. Additionally, operational costs have decreased. These results not only emphasize the superiority of the proposed model but also highlight the practical benefits of integrating deep reinforcement learning and IoT in real-time fleet scheduling. Such advancements can lead to significant improvements in efficiency and reductions in operational costs in mining operations.

Biography:

Naser Badakhshan graduated from Amirkabir University of Technology in 2024. He is currently a postdoctoral researcher at the same university in the field of parallel mining and intelligent unmanned mining fleets. He is also teaching in the field of robotics at this university.

Muhammad Israr
Government College University Lahore, Pakistan

Physics-Informed Neural Networks with PDFP Optimization for Regularization-Free Solutions of Backward Time-Fractional Parabolic Equations

In this work, we present a Preconditioned Davidon–Fletcher–Powell (PDFP) optimization framework for efficiently solving backward higher-order time-fractional parabolic equations over extremely long time spans. These equations are well known to be severely ill-posed, and traditional numerical techniques often rely on heavy regularization or data estimation to stabilize the solution. To overcome these challenges, we employ a regularization-free strategy based on Physics-Informed Neural Networks (PINNs), where the proposed PDFP optimizer plays a central role in ensuring convergence stability and numerical robustness. The PDFP method extends the classical quasi-Newton DFP algorithm by integrating a nonlinear preconditioning mechanism that adaptively corrects curvature information and efficiently handles stiffness arising from fractional-order derivatives. By incorporating two boundary conditions and a terminal time-wave function, the framework establishes the group symmetry of the governing equation, which is subsequently transformed into a linear combination of basis functions for the complete solution. Moreover, the approach allows the construction of an alternative symmetry group basis, enabling the governing equation to be represented as a solvable linear system. Comprehensive numerical experiments demonstrate that the proposed method can accurately and stably recover solutions even when terminal data are extremely small or contaminated with significant noise. The main advantages of

the proposed approach are: (i) it eliminates the need for additional data estimation, (ii) it avoids the use of regularization parameters, and (iii) it maintains a simple yet powerful optimization structure for fractional-order modeling in complex dynamical systems.

Biography:

I am a mathematics researcher with a strong focus on deep learning, optimization, and scientific computing. I completed my M.Phil. in Mathematics from the Abdus Salam School of Mathematical Sciences, GC University Lahore, where my thesis focused on Preconditioned Optimizers for Physics-Informed Neural Networks (PINNs). My research centers on developing advanced optimization algorithms and neural architectures that integrate physical laws with data-driven learning, particularly through quasi-Newton and preconditioning strategies. I have published several papers in reputed international journals covering topics such as Physics-Informed Neural Networks, deep image priors, and machine learning optimization. In addition to research, I have served as a lecturer of mathematics and actively participate in seminars and workshops on artificial intelligence and applied mathematics. My aim is to contribute to the development of efficient and interpretable AI models for solving complex physical and engineering systems.

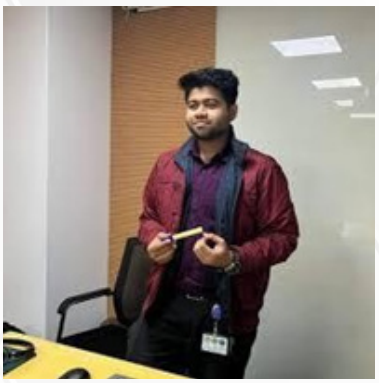
Youyang Qu
Qilu University of Technology, China

Unlearning in AI: From Data Deletion to Model Rewriting

As machine learning systems become increasingly embedded in critical decision-making pipelines, the demand for machine unlearning—the ability to selectively remove the influence of specific data from trained models—has grown significantly. This talk will explore the emerging field of machine unlearning, from foundational definitions and formal desiderata, to practical mechanisms and privacy guarantees. We will cover major categories of unlearning approaches, including exact unlearning via retraining, certified removal using influence functions, and approximate techniques leveraging weight perturbation or synthetic data. Special focus will be given to recent developments in federated unlearning, time-series unlearning, and unlearning in large language models. The session will also highlight the trade-offs between forgetting accuracy, utility preservation, and computational efficiency, as well as open challenges in certifiability, scalability, and alignment with legal frameworks like the "right to be forgotten." Case studies in privacy-preserving healthcare, recommendation systems, and security-critical applications will be discussed to demonstrate real-world applicability.

Biography:

Youyang Qu is has a research focus on privacy-preserving machine learning, federated learning, and machine unlearning. His work explores secure and explainable AI systems in critical domains such as energy systems, telecommunications, and government services. Dr. Qu has led multiple national and international research collaborations, including projects on federated unlearning, edge intelligence, and quantum machine learning. He has published extensively in top-tier venues and serves on editorial boards and program committees for major conferences. With a background spanning both academic innovation and applied research, his work bridges theoretical rigor and real-world deployment. He is also actively involved in shaping the ethical and regulatory landscape for AI adoption through his contributions to trustworthy AI frameworks. Dr. Qu holds multiple prestigious titles and regularly supervises graduate students and postdoctoral researchers in AI security and privacy.



Md Nurul Absur
CUNY Graduate Center, USA

Toward Just-in-Time, Secure, and Resilient Smart Systems with Edge Intelligence

Modern intelligent systems must strike a balance between the competing demands of real-time performance, resilience, and trust. At the edge of IoT and immersive computing, this requires innovations that span computer vision, networking, and distributed intelligence. This talk presents an integrated research agenda that addresses these challenges across 3D IoT, programmable networks, and XR environments.

First, I would like to introduce our Just-in-Time 3D IoT framework, which leverages edge intelligence for low-latency, reliable multi-view reconstruction in bandwidth-constrained environments. This work, recently presented at IEEE MASS 2025, demonstrates how reconstruction quality and timeliness can be jointly optimized to support disaster response and healthcare monitoring.

Second, I discuss our SDN anomaly detection methods that target misreporting and reconnaissance in programmable infrastructures. By modeling per-switch traffic epochs and integrating temporal anomaly detection, our IEEE CNSM 2025 paper shows how such systems can protect immersive environments and load-balancing functions from subtle misreporting attacks.

Third, I highlight our MobiHoc XR Workshop 2025 study on adversarial slow-

pose drift in offloaded visual–inertial odometry. We reveal how edge offloading pipelines can be destabilized by gradual adversarial drift, and propose detection and recovery mechanisms that restore XR session integrity.

Together, these projects underscore a central vision: enabling innovative systems that are just-in-time, disruption-resilient, and trustworthy. I will also outline ongoing efforts in multimodal fusion methods and LLM-augmented IoT self-healing. These works aim to broaden the foundations of edge intelligence, ensuring scalable and privacy-preserving operation across IoT, healthcare, disaster management, and XR systems.

Biography:

Md. Nurul Absur is a PhD candidate in Computer Science at the CUNY Graduate Center, USA. His research lies at the intersection of edge intelligence, computer vision, and distributed systems, with applications in 3D IoT, XR, and programmable networks. He is the lead author of several papers, including Reliable Multi-view 3D Reconstruction for Just-in-Time Edge Environments (IEEE MASS 2025), Detection of Misreporting Attacks on Software-Defined Immersive Environments (IEEE CNSM 2025), and Detection and Recovery of Adversarial Slow-Pose Drift in Offloaded VIO (ACM MobiHoc XR Workshop 2025). His broader portfolio spans multimodal HAR (CSI + depth), LLM-driven IoT management, biomedical imaging, and CDN optimization. He has served as a reviewer for IEEE conferences and journals and received the IEEE SEC 2024 Student Travel Grant and KNIT11 Travel Stipend 2025.

Hamza Javed
Central South University, China

Sample records for instrumental analysis experiment

Malware presents considerable problems to digital security, underscoring the need for robust detection techniques to counter possible cyberattacks. For detection, relying completely on a single model has limitations in effectively understanding the complexity and variety of malware samples. In response to the identified issues, this paper introduces a novel ensemble method for identifying malware. Using the combined strengths of several deep learning models, it improves the robustness and accuracy of detection. We rigorously optimize proven pre-trained models like Xception and MobileNetV3 to include the ability to predict into a stack ensemble architecture. This ensemble method integrates the decisions of the three models via a stacking strategy, yielding results characterized by strong generalizability as well as low variance. Our methodology effectively obviates the necessity for traditional approaches such as feature engineering and other domain- specific methodologies historically employed in the classification of malware. The suggested methodology was evaluated using two datasets. The first dataset named Malimg, comprising 9,335 images across 25 distinct classifications. Our methodology overtakes each model individually and achieves an exceptional accuracy rate of 98.75% using the Malimg dataset. The MaleVis dataset has 14,226 images across 26 distinct classes, with the model achieving an accuracy to 98.55%. Additionally, statistical studies, including McNemar's test, are performed to validate the importance of our findings. Comparative assessments with current methodologies highlight the efficacy of our suggested ensemble methodology in effectively identifying malware cases.

Biography:

I finished my post graduation at 28 years old years from Central South University. I have Published in excess of 5 papers in rumored diaries and has been filling in as a publication board individual from notoriety.

Mr. Shubham Gupta
Parul University, Gujarat, India

Anthropometric Analysis of the Scapula Using 3D CT: Age and Gender Estimation in a Tertiary Hospital

This study aims to evaluate the forensic significance of scapular anthropometric variables by utilizing three-dimensional computed tomography (3D-CT) images for enhanced identification in radio-forensic medical research. The scapula, being a resilient and morphologically variable bone, offers valuable insight into biological profiling, particularly in sex estimation and, to a lesser extent, age approximation. A total of 200 thoracic CT scans from individuals aged 20 to 70 years, representing the West Gujarat population, were retrospectively analyzed. Anthropometric parameters, including MSH (Maximum Scapula Height), TLL (Transverse Longitudinal Length), GH (Glenoid Height), GB (Glenoid Breadth), and LS (Length of Spine) of both right and left scapulae, were systematically measured. These data were statistically analyzed to determine the presence of significant sexual dimorphism and the potential utility of scapular dimensions in the forensic identification of unknown skeletal remains.

The results revealed statistically significant differences in all measured anthropometric variables between males and females ($p < 0.001$), indicating marked sexual dimorphism. Functional discriminant analysis of these variables yielded a high classification accuracy of 97.5% for sex determination, underscoring the scapula's diagnostic potential in forensic contexts. In contrast, the same approach yielded a much lower accuracy of 52.5% in the classification of age groups, suggesting

a limited role of scapular morphology in precise age estimation, possibly due to inter-individual variability and age-related changes being less pronounced or consistent in scapular bone structure.

In conclusion, the study demonstrates that 3D-CT-based scapular anthropometry offers a reliable and non-invasive modality for sex estimation, making it a valuable adjunct in forensic identification protocols. While CT imaging provides precise anatomical visualization and measurement capabilities, its utility in age estimation remains constrained and warrants further exploration with larger and more diverse population samples. These findings support the incorporation of CT-derived scapular measurements into standard forensic anthropological practices, especially in cases where traditional methods are unfeasible due to the incomplete or damaged condition of remains.

Biography:

Shubham Gupta, Head of the Department and Assistant Professor in Radio Imaging Technology, is in the final stage of his Ph.D. at Teerthanker Mahaveer University. With over six years of experience, he focuses on forensic radiology, anthropological studies, and morphometry-based investigations. He has published six research articles in National and International journals, contributing significantly to the scientific community. Gupta has presented his work at various academic forums and was awarded the second-best oral presentation award at the international conference Healthforce. He is a lifetime member of both the European Society of Radiology and the Indian Society of Radiographers and Technologists, demonstrating his commitment to professional development and international collaboration in radiological sciences.

Qiuyun Yang
Sichuan University, Chengdu, Sichuan, China

Single-cell Transcriptomics Reveals Time-Resolved Neuronal Death Characteristics in Traumatic Brain Injury

Accurate determination of injury timing in traumatic brain injury (TBI) is a persistent challenge in forensic pathology, with direct implications for reconstructing injury events, estimating survival intervals, and establishing legal responsibility. Conventional histopathological markers such as hemorrhage, gliosis, and neuronal degeneration lack sufficient specificity and temporal resolution, often leading to uncertainty in forensic practice. To address this, we integrated multi-phase single-cell transcriptomic datasets of murine cortical neurons at acute (24 hours), subacute (7 days), and chronic (6 months) stages after TBI. This approach enabled high-resolution mapping of dynamic molecular and cellular alterations, with direct forensic relevance for estimating post-traumatic survival intervals. Our results revealed distinct temporal transcriptional trajectories, shifting from acute oxidative stress responses and inflammatory cascades to subacute neural remodeling and ultimately to chronic synaptic degeneration. By developing a 14-modality cell death signature matrix, we identified predominant mechanisms characterizing each phase: necroptosis, pyroptosis, and oxidative stress–driven cell death in the acute stage; mixed and transitional forms such as panoptosis in the subacute stage; and ferroptosis and autophagy as dominant mechanisms in the chronic stage. Importantly, several molecular biomarkers exhibited stage-specific expression patterns with strong forensic potential for time-of-injury estimation.This study demonstrates that integrating single-cell transcriptomics with systematic cell death pathway analysis provides a powerful framework for forensic applications. In conclusion, our work

establishes a novel molecular reference for forensic assessment of TBI, bridging advanced transcriptomic technologies with practical forensic needs.

Biography:

Dr. Qiuyun Yang received her MD in Forensic Medicine from Sichuan University after completing a combined MD-PhD program. She is currently an assistant researcher at West China School of Basic Medical Sciences and Forensic Medicine, Sichuan University. Her research focusing on forensic pathology and molecular mechanisms underlying traumatic brain injury (TBI) and nerve injury. Her work applies single-nucleus transcriptomics to uncover pathological changes in neuronal and glial populations, identify molecular markers, and explore potential therapeutic targets. She has contributed to understanding ferroptosis, neuroinflammation, and tissue repair after TBI, with publications in Genome Research, Scientific Data, iScience, Nutrition,and International Journal of Legal Medicine. She aims to integrate forensic pathology with advanced molecular approaches to improve diagnosis and research in forensic medicine.

Srinjoy Roy
National Forensic Sciences University Gandhinagar, Gujarat, India

Revolutionising Forensic DNA Analysis with CRISPR-Cas Technology: A Comprehensive Review of its Emerging Applications, Challenges and Future Directions

Forensic DNA analysis, a central domain in Forensic Science, has emerged as a transformative tool in personal identification, paternity and kinship testing and disaster victim identification. Traditional methods used such as Short Tandem Repeat (STR) and Single Nucleotide Polymorphism (SNP) profiling are often limited by challenges such as low template DNA, degraded samples in mass disasters, allele dropout and mixed contributor profiles in sexual assault cases, thereby leading to inconclusive results and misinterpretation. A recent approach in genome-editing technology, the CRISPR-Cas (Clustered Regularly Interspaced Short Palindromic Repeats – CRISPR Associated), initially characterised as a prokaryotic adaptive immune mechanism, has revolutionised the field of biotechnology with the capability to demonstrate potential in targeted marker enrichment, rapid sequencing, non-PCR-based detection and enhanced specificity, sensitivity and performance in degraded samples. This review analysed 11 peer-reviewed studies till 2025 selected from Google Scholar, Scopus and Web of Science through stringent exclusion and inclusion criteria. It critically appraises the emerging applications of various CRISPR-Cas platforms (Cas9, Cas12a, Cas12b, Cas13, Cas14) in Forensic DNA Analysis and their benefits over conventional DNA profiling techniques. Most applications of this novel genome technology remain at proof-of-concept and laboratory validation stage. Though the use of this advanced technology is deemed

helpful in mixed profile attribution in LCN contributors, the CRISPR-Cas technology poses a significant risk from the generation of ghost DNA profiles by modification or alteration of target genetic markers. Additionally, the review underscores the importance of ethical and legal issues and integration of CRISPR with digital forensics and biosensor platforms. However, CRISPR-Cas systems need to meet validation standards such as Daubert's or Frye's standard to be admissible as evidence in the court of law. Continued research and widespread application of CRISPR-Cas systems in pilot forensic casework studies are crucial for this field to be incorporated into routine forensic practice.

KEYWORDS: CRISPR-CAS, DNA Profiling, STR, Ghost Profile, Mixed Profile.

Biography:

I am Srinjoy Roy and my roots are in West Bengal, India. I am a driven, flexible and responsible student pursuing my third year in B. Sc - M. Sc Forensic Science (Integrated) in the prestigious field of Forensic Science from National Forensic Sciences University, Gandhinagar, under the Ministry of Home Affairs, Government of India. I also serve as the Core Team Associate at C.A.S.E. 23 – Forensically Yours – a student led forensic organisation.