BIOMETRICS CENTER

ENFSI

FORENSIC SPEECH AND AUDIO ANALYSIS WORKING GROUP

Tutorial:
Forensic Automatic Speaker Recognition: Theory, Implementation and Practice

Presenter:
Dr. Andrzej Drygajlo
Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland
LIDIAP Speech Processing and Biometrics Group

Goal

This tutorial provides an ample coverage of theoretical and applied state-of-the-art research work as well as new trends and directions in the forensic automatic speaker recognition (FASR) field. It offers attendees a thorough understanding of how core signal processing and pattern recognition building blocks of the FASR system are developed, implemented, tested and applied.

The attendees will have the opportunity to:
-   Gain an up to date knowledge of modern automatic speaker recognition technology and its applications for evaluative and investigative purposes,
-   Understand universal data-driven deterministic, statistical and combined deterministic-statistical models for developing forensic automatic speaker recognition systems, corresponding to challenges of real casework and digital communication networks,
-   Learn how to develop automatic speaker recognition methodology supporting the criminal-justice system, within the Bayesian interpretation framework including calculation of the biometric evidence value, its strength (likelihood ratio) and the evaluation of this strength under operating conditions of the casework,
-   Learn how to develop objective, automatic techniques based on sound statistical and probabilistic methods, such as Gaussian mixture models (GMMs) and iVectors, with embedded explicit inter-session variability compensation techniques of joint factor analysis, for forensic speaker recognition supporting this methodology,
-   Receive an overview of current technological support for calibration, comparative analysis and evaluation of developed methods and techniques using simulated and real case databases.

The methodology presented in this tutorial results from real-world problems in the domain of forensic sciences and speech engineering and necessitates a cooperative and integrated approach when identifying demand-driven problems and working towards successful solutions. Attendees of the tutorial will learn the essential knowledge required for the development of advanced methods and techniques adapted to modern communication systems and judicial system procedure, which have the potential to improve and accelerate the criminal analysis aspects of today's laborious and time-consuming police investigations and forensic evaluations

when the use of automatic speaker recognition systems for fast narrowing the search and identification of suspects is urgently needed.

Targeted audience

The tutorial is designed for researchers and professionals (from academia, industry and public authorities), interested in understanding signal processing, pattern recognition and interpretation challenges in forensic automatic speaker recognition (FASR). PhD students, post-docs and young researchers in the field are particularly encouraged to participate. The tutorial is also intended for anyone who needs to learn how forensic automatic speaker recognition techniques are specified, designed, tested and applied.

Outline

1. **Forensics and Biometrics**
2. **Forensic Speaker Recognition (FSR)**
3. **Automatic Speaker Recognition (ASR)**
4. **Bayesian Interpretation of Forensic Evidence**
5. **Forensic Automatic Speaker Recognition (FASR)**
6. **First Measure:** Biometric Evidence
7. **Second Measure:** Strength of Evidence - Likelihood Ratio
8. **Third Measure:** Evaluation of the Strength of Evidence
9. **FASR - Data Driven Methodology** : Univariate (Scoring) and Multivariate (direct) Methods
10. **FASR -** Data-driven deterministic, statistical and combined deterministic-statistical models
11. **Compensation for Mismatch in Recording Conditions**
- Principal Gaussian Compensation Technique
- Joint Factor Analysis Based Techniques
12. **Performance Metrics for Calibration**
13. **Comparative Evaluation of Calibrated Deterministic and Statistical Models**
- Simulated databases
- Real-Case databases
14. **Practice:** Case Assessment and Interpretation
- Best Practice Methodological Guidelines
- Collaborative Exercises
- Proficiency Tests
15. **Spreading FASR Technology in the Law Enforcement Environments**

Biography of the presenter:

Andrzej Drygajlo, head of the Speech Processing and Biometrics Group (SPBG) at EPFL, he conducts research on technological and methodological aspects of speech and biometrics for security and forensic applications. In 1993 he created the EPFL Speech Processing Group (SPG) and then the EPFL Speech Processing and Biometrics Group (SPBG). Currently he conducts research and teaching in speech processing, biometrics and human-machine communication at EPFL and at the School of Criminal Justice at the University of Lausanne.

Dr. Drygajlo has participated in and coordinated numerous national (e.g., Swiss National Science Foundation project "The Challenge of Forensic Speech Processing: Automatic Speaker Recognition for Criminal Investigations" and "Biometric Evidence in Forensic Automatic Speaker Recognition") and international projects (e.g., BioSecure Network of Excellence, COST IC 1106, 2101, 276, 275, 249, 250) in the domain of speech processing and biometrics. At present, he (EPFL) is the Grant Holder of the European COST IC 1106 Action "Integrating Biometrics and Forensics for the Digital Age". From 2006 to 2011 he was chairman of the European COST 2101 Action "Biometrics for Identity Documents and Smart Cards". He is also a member of the

International Association for Forensic Phonetics and Acoustics (IAFPA) and chairman of the Expert Working Group for Forensic Speech and Audio Analysis (FSAAWG) of the European Network of Forensic Science Institutes (ENFSI). Since 2011 he has led the FSAAWG project "Methodological guidelines for semi-automatic and automatic speaker recognition for case assessment and interpretation" in the framework of the ENFSI Monopoly Programme 2011 "Improving Forensic Methodologies across Europe (IFMAE)". In the domain of forensics, he invented with his Ph.D. students some pioneering approaches, among others Bayesian interpretation of evidence in forensic automatic speaker recognition using data-driven methodology. Nowadays, this approach is seen as a current trend of developing new and more reliable methods in forensic automatic speaker recognition (FASR).

Contact information

Dr. Andrzej Drygajlo
Speech Processing and Biometrics Group (GTPB)
School of Engineering (STI)
Swiss Federal Institute of Technology Lausanne (EPFL)
Address: EPFL-STI-IEL-LIDIAP
ELD 230, Station 11
CH-1015 Lausanne
Phone: +41 21 693 43 28
Fax: +41 21 693 52 63
Email: andrzej.drygajlo@epfl.ch