



<http://forensic.unsw.edu.au/>

## Syllabus for ELEC9782 Advanced Forensic Voice Comparison and the Evaluation of Evidence

Document version of 12 December 2012

Course website: <http://forensic.unsw.edu.au/ELEC9781.html> then scroll down

### **Times**

Semester 2, 2012. Mutually convenient times to be arranged between instructor and students. The number of contact hours will exceed 40.

### **Location**

Rm 319, Electrical Engineering Building.

### **Instructor**

*Geoffrey Stewart Morrison*

[geoff-morrison@forensic-voice-comparison.net](mailto:geoff-morrison@forensic-voice-comparison.net)

<http://geoff-morrison.net/>      <http://forensic-voice-comparison.net/>

+61 2 9385 6544

### **Description**

ELEC9781 “Forensic Voice Comparison and the Evaluation of Evidence” introduced the theory and practice of forensic voice comparison conducted within the new paradigm for the evaluation of forensic evidence. The first part of the course focussed on the new paradigm for the evaluation of forensic evidence and its application to forensic voice comparison. The second part of the course focussed on techniques

from automatic speaker recognition and their application to forensic voice comparison.

ELEC9782 “Advanced Forensic Voice Comparison and the Evaluation of Evidence” explores these topics in greater depth and breadth via extensive reading of primary literature and seminar discussions of selected important works. Whereas the readings in the first part of ELEC9781 were primarily authored by Morrison, the readings in ELEC9782 are primarily by other authors.

The course will provide students with an advanced understanding of the new paradigm for the evaluation of forensic evidence its application to forensic voice comparison, as well as related topics in the evaluation of forensic evidence.

### **Prerequisites**

- Completion of ELEC9781 with a high grade, or equivalent skills and experience.
- Permission from the instructor.

### **Learning goals**

The students will gain an advanced understanding of the new paradigm for the evaluation of forensic evidence and its application to forensic voice comparison, as well as related topics in the evaluation of forensic evidence.

### **Course structure**

The topics listed below will be covered. Readings corresponding to each topic appear in the bibliography. Readings for discussion in seminars are asterisked in the bibliography. Other topics and readings may be added or substituted as the course progresses. Guest instructors will be invited to participate in seminars related to their topic. To allow for flexibility on spending more time on some material and adding additional material, the readings to be discussed during each seminar will be announced the week before.

#### TOPICS:

- The Lausanne Group
- The Madrid Group
- The BKA Group
- Legal admissibility (Guest instructors: Gary Edmond & Mehera San Roque, UNSW Law; Kristy Martire, UNSW Psychology)
- Rulings, reports, and position statements, guidelines, and standards
- Forensic science? (Guest instructor: Brynn Hibbert, UNSW Chemistry)
- Other evaluation of evidence
- Other statistical models (Guest instructors: James Curran, U Auckland Statistics; Joshua Abraham & Claude Roux, Centre for Forensic Science, University of Technology Sydney)

## **Teaching/learning approach**

The teaching/learning approach for the course will consist primarily of reading and discussions based on the readings.

## **Assessment**

Students are expected to complete the reading assignments and take an active part in discussions, including orally providing critical assessment of the papers discussed. 25% of the grade will be assigned on the basis of the instructor's assessment of each student's performance during the seminars.

Each student will write a paper of publishable quality related to a topic covered in the course. An outline of the paper including statement of the problem, literature review, and proposed methodology should be submitted to the instructor not later than half way through the course. A full draft of the paper should be submitted to the instructor not later than the last seminar of the course. The final version of the paper should be submitted to the instructor no later than one week before grades are due to be reported to the School. All submissions are to be pdfs e-mailed to the instructor. Quality of writing, e.g., clarity of organisation and clarity of expression, will be taken into account in determining the grade assigned to each paper. This assignment will count for 75% of the grade.

## **Registration**

UNSW students taking the course for credit should register in ELEC9782 Special Topics in Electrical Engineering in Session 2 of 2012.

## **Credits**

The course has 6 units of credit (equivalent to an expected workload is 10–12 hours per week throughout a 12 week session).

## **Academic honesty and plagiarism**

Plagiarism is the unacknowledged use of others peoples work, including the copying of assignment works and laboratory results form other students. Plagiarism is considered a serious offence by the University and severe penalties may apply. For more information on plagiarism, please refer to:  
<http://www.lc.unsw.edu.au/plagiarism>

## **Continual course improvement**

Students are advised that the course in under constant revision in order to improve the learning outcomes of its students. Please forward any feedback on the course to the course instructors.

## **Administrative matters**

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights and general expectation of students, please refer to the School policies, see: <http://scoff.ee.unsw.edu.au/>

## **Graduate attributes**

The course delivery methods and course content address a number of the UNSW graduate attributes, see: [http://learningandteaching.unsw.edu.au/content/userDocs/grad\\_attributes.pdf](http://learningandteaching.unsw.edu.au/content/userDocs/grad_attributes.pdf)

## **Bibliography**

\* papers subject to detailed discussion in class

† papers forming the basis of a student presentation

### **– The Lausanne Group**

\*Champod, C. & Meuwly, D. (2000). The inference of identity in forensic speaker recognition. *Speech Communication*, 31, 193–203.

\*Alexander, A. & Drygajlo, A. (2004). Scoring and direct methods for the interpretation of evidence in forensic speaker recognition. In *Proceedings of the 8th International Conference on Spoken Language Processing (ICSLP)*.

Drygajlo, A. (2012). Forensic speaker recognition. *Law Enforcement and Counter-Terrorism*, chap. Automatic Speaker Recognition for Forensic Case Assessment and Interpretation, pp. 21–39. Springer. ISBN 978-1-4614-0262-6.

Arcienega, M., Alexander, A., Zimmerman, P. & Drygajlo, A. (2005). A Bayesian network approach combining pitch and spectral envelope features to reduce channel mismatch in speaker verification and forensic speaker recognition. In *Proc. Interspeech*, pp. 2009–2012. Lisbon, Portugal.

Alexander, A. (2005). Forensic automatic speaker recognition using Bayesian interpretation and statistical compensation for mismatched conditions. Ph.D. thesis, Swiss Federal Institute of Technology, Lausanne.

Alexander, A., Botti, F. & Drygajlo, A. (2004a). Handling mismatch in corpus-based forensic speaker recognition. In *Proceedings of Odyssey 2004: The Language and Speaker Recognition Workshop*, pp. 69–74.

Alexander, A., Dessimoz, D., Botti, F. & Drygajlo, A. (2004b). The effect of mismatched recording conditions on human and automatic speaker recognition in forensic applications. *Forensic*

Science International, 146S, 95–99.

Alexander, A., Dessimoz, D., Botti, F. & Drygajlo, A. (2005). Aural and automatic forensic speaker recognition in mismatched conditions. *International Journal of Speech, Language, and the Law*, 12(2), 214–234.

Botti, F., Alexander, A. & Drygajlo, A. (2004a). An interpretation framework for the evaluation of evidence in forensic automatic speaker recognition with limited suspect data. In *Proceedings of Odyssey 2004: The Language and Speaker Recognition Workshop*.

Botti, F., Alexander, A. & Drygajlo, A. (2004b). On compensation of mismatched recording conditions in the Bayesian approach for forensic automatic speaker recognition. *Forensic Science International*, 146S, S101–S106.

Drygajlo, A. (2007). Forensic automatic speaker recognition. *IEEE Signal Processing Magazine*, pp. 132–135.

#### **– The Madrid Group**

\*Gonzalez-Rodriguez, J., Drygajlo, A., Ramos-Castro, D., Garcia-Gomar, M. & Ortega-Garcia, J. (2006). Robust estimation, interpretation and assessment of likelihood ratios in forensic speaker recognition. *Computer, Speech and Language*, 20, 331–355.

\*Gonzalez-Rodriguez, J., Rose, P., Ramos, D., Toledano, D. T. & Ortega-Garcia, J. (2007). Emulating DNA: Rigorous quantification of evidential weight in transparent and testable forensic speaker recognition. *IEEE Transactions on Audio, Speech and Language Processing*, 15(7), 2104–2115.

\*Ramos-Castro, D. (2007). *Forensic Evaluation of the Evidence Using Automatic Speaker Recognition Systems*. Ph.D. thesis, Universidad Autonoma de Madrid.

Gonzalez-Rodriguez, J., Fierrez-Aguilar, J., Ramos-Castro, D. & Ortega-Garcia, J. (2005). Bayesian analysis of fingerprint, face and signature evidences with automatic biometric systems. *Forensic Science International*, 155(2–3), 126–140.

Gonzalez-Rodriguez, J., Garcia-Romero, M., Garcia-Gomar, M., Ramos-Castro, D., & Ortega-Garcia, J. (2003). Robust likelihood ratio estimation in Bayesian forensic speaker recognition. In *Proc. Eurospeech 2003*.

Ramos-Castro, D., Gonzalez-Rodriguez, J., Champod, C., Fierrez-Aguilar, J. & Ortega-Garcia, J. (2005). Between-source modelling for likelihood ratio computation in forensic biometric recognition. In T. Kanade, A. Jain & N. Ratha (Eds.) *Audio- and Video-Based Biometric Person Authentication*, no. 3546 in *Lecture Notes in Computer Science*, pp. 1080–1089. Springer-Verlag Berlin Heidelberg.

- Ramos, D. & Gonzalez-Rodriguez, J. (2008). Cross-entropy analysis of the information in forensic speaker recognition. In Proceedings of Odyssey 2008: The Language and Speaker Recognition Workshop.
- Ramos, D., Gonzalez-Rodriguez, J. & Fierrez, J. (2008a). Information-theoretical comparison of evidence evaluation methods for score-based biometric systems. In Seventh International Conference on Forensic Inference and Statistics. Lausanne.
- Ramos, D., Gonzalez-Rodriguez, J., Zadora, G., Zieba-Palus, J. & Aitken, C. G. G. (2007). Information-theoretical comparison of likelihood ratio methods of forensic evidence evaluation. In International Workshop in Computational Forensics, IAS 2007, pp. 411–416.
- Zadora, G. & Ramos, D. (2010). Evaluation of glass samples for forensic purposes - an application of likelihood ratios and an information-theoretical approach. *Chemometrics and Intelligent Laboratory Systems*, 102, 63–83.

### – The BKA Group

- \*Becker, Jessen, Alsbach, Broß, Meier (2010) Automatic forensic voice comparison using recording adapted background models. In Proceedings of the 39th International Audio Engineering Society (AES) Conference – Audio Forensics: Practices and Challenges, Hillerød, Denmark (pp. 162–166).
- \*Becker, Jessen, Alsbach, Broß, Meier (2010) SPES- The BKA forensic automatic voice comparison system. In H. Cernocký and L. Burget (Eds.), Proceedings of Odyssey 2010: The Language and Speaker Recognition Workshop, Brno, Czech Republic (pp. 58–62). International Speech Communication Association.
- \*Becker, Solewicz, Jardine, Gfrörer (2012) Comparing automatic forensic voice comparison systems under forensic conditions. In Proceedings of the 46th Audio Engineering Society (AES) Conference on Audio Forensics: Recording, Recovery, Analysis, and Interpretation, Denver, CO (pp.197–202).
- \*Solewicz, Becker, Jardine, Gfroerer (2012) Comparison of speaker recognition systems on a real forensic benchmark. In Proceedings of Odyssey 2012: The Language and Speaker Recognition Workshop, Singapore (pp. 86–91). International Speech Communication Association.
- Becker, Broß, Meier (2011) The effect of MP3 compression on automatic voice comparison
- Becker, Jessen, Grigoras (2008) Forensic speaker verification using formant features and Gaussian mixture models
- Becker, Jessen, Grigoras (2009) Speaker verification based on formants using Gaussian mixture models

Jessen (2008) Forensic phonetics

Jessen, M. (2010). *The Routledge Handbook of Forensic Linguistics*, chap. Jessen (2010) The forensic phonetician - Forensic speaker identification by experts, pp. 378–394. Routledge.

### – Legal admissibility

\*Edmond, Martire, San Roque (2011) Unsound law: Issues with (‘expert’) voice comparison evidence. *Melbourne Law Review*, 35, 52–112.

### – Rulings, reports, and position statements, guidelines, and standards

*Daubert v Merrell Dow Pharmaceuticals* (92–102), 509 U.S. 579 (1993)

National Research Council, (2009). *Strengthening Forensic Science in the United States: A Path Forward*. Washington, DC: National Academies Press.  
[http://www.nap.edu/catalog.php?record\\_id=12589](http://www.nap.edu/catalog.php?record_id=12589)

Association of Forensic Science Providers (2009). “Standards for the Formulation of Evaluative Forensic Science Expert Opinion”. *Science & Justice*, 49, 161–164.  
doi:10.1016/j.scijus.2009.07.004

*R v T* (2010) EWCA Crim 2439

Evetts IW, and other signatories (2011). “Expressing evaluative opinions: A position statement”. *Science & Justice*, 51, 1–2. doi:10.1016/j.scijus.2011.01.002

Berger CEH, Buckleton J, Champod C, Evetts IW, Jackson G (2011). “Evidence evaluation: A response to the Court of Appeal judgment in *R v T*”. *Science & Justice*, 51, 43–49.  
doi:10.1016/j.scijus.2011.03.005

B, Vignaux GA, Berger CEH (2011) “Extending the confusion about Bayes”. *Modern Law Review*, 74, 444–455. doi:10.1111/j.1468-2230.2011.00857.x

Redmayne M, Roberts P, Aitken CGG, Jackson G (2011). “Forensic science evidence in question”. *Criminal Law Review*, 5, 347–356.

Fenton N (2011). “Improve statistics in court”. *Nature*, Vol. 479, 3 November, 36–37.

Morrison GS (2012). “The likelihood-ratio framework and forensic evidence in court: A response to *R v T*”. *International Journal of Evidence and Proof*, 16, 1–29. doi:10.1350/ijep.2012.16.1.390

Standards Australia Draft Standard DR AS 5388.3 Forensic analysis - Part 3- Interpretation

## Responses to Standards Australia Draft Standard DR AS 5388.3 Forensic analysis - Part 3-

### Interpretation:

- Morrison et al.
- Aitken
- Balding
- Lucy
- Martire & Kemp
- Rose & Selby
- Sjerps

### – **Forensic science?**

- \*Cole (2010) Acculturating forensic science: What is ‘scientific culture’, and how can forensic scientists adopt it? *Fordham Urban Law Journal*, Vol. 38, No. 2.  
<http://ssrn.com/abstract=1788414>
- \* Hibbert DB (2003) Scientist vs the law. *Accreditation and Quality Assurance*, 8,179–183.  
doi:10.1007/s00769-003-0609-9
- \*Eriksson, A. & Lacerda, F. (2007). Chalantry in forensic speech science: A problem to be taken seriously. *International Journal of Speech, Language, and the Law*, 14.2, 169–193.
- \*Gruber J.S., & Poza F. (1995). Voicegram Identification Evidence. In: *American Jurisprudence Trials*. Westlaw. Vol. 54.

### – **Other evaluation of evidence**

- \*Lindley (1977) Probability and the law. *The Statistician*, 26, 203–220.  
<http://www.jstor.org/stable/2987898>
- \*Evet (1991) Interpretation - A personal odyssey. In Aitken C G G & Stoney D A (1991) *The use of statistics in forensic science*. Chichester, UK: Ellis Horwood.
- Meuwly, D. (2006). Forensic individualisation from biometric data. *Science & Justice*, 46(4), 205-213.
- Buckleton J (2005). “A framework for interpreting evidence”. In Buckleton J, Triggs CM, Walsh SJ (Eds.), *Forensic DNA Evidence Interpretation* (pp. 27–63). Boca Raton, FL: CRC.
- Evet, I. (1990). The theory of interpreting scientific transfer evidence. *Forensic science progress*, 4, 141-179.
- Sjerps, M. & Meester, R. (2009). Selection effects and database screening in forensic science. *Forensic Science International*, 192, 56-61.



Jackson, G., Jones, S., Booth, G., Champod, C. & Evett, I. (2006). The nature of forensic science opinion - a possible framework to guide thinking and practice in investigation and in court proceedings. *Science & Justice*, 46(1), 33-44.

Cook R, Evett IW, Jackson G, Jones PJ, Lambert JA (1998). "A hierarchy of propositions: Deciding which level to address in casework". *Science & Justice*, 38, 231–239.  
doi:10.1016/S1355-0306(98)72117-3

## – Other statistical models

\*Reynolds, D. (1997). Comparison of background normalization methods for text-independent speaker verification. *Proceedings of Eurospeech, Rhodes, 1997*, 963–966.

\*Hepler, A. B., Saunders, C. P., Davis, L. J., Buscaglia, J. (2012). Score-based likelihood ratios for handwriting evidence. *Forensic Science International*. doi:10.1016/j.forsciint.2011.12.009

\*Neumann, Evett, Skerrett (2012) Quantifying the weight of evidence from a forensic fingerprint comparison- A new paradigm. doi:10.1111/j.1467-985X.2011.01027.x  
<http://onlinelibrary.wiley.com/doi/10.1111/j.1467-985X.2011.01027.x/full>

\*Junod, S., Pasquier, J., Champod, C. (2012). The development of an automatic recognition system for earmark and earprint comparisons. *Forensic Science International*, 222, 170–178.  
doi:10.1016/j.forsciint.2012.05.021

\*Prince SJD, Elder HN (2007). Probabilistic linear discriminant analysis for inferences about identity. In *Proc. IEEE International Conference on Computer Vision*.  
[http://web4.cs.ucl.ac.uk/research/vis/pvl/index.php?option=com\\_content&view=article&id=63&Itemid=61](http://web4.cs.ucl.ac.uk/research/vis/pvl/index.php?option=com_content&view=article&id=63&Itemid=61)

\*†Brümmer N (2011, October). Fully Bayesian forensic LR: Extending the paradigm shift. Talk given at Netherlands Forensic Institute. <https://sites.google.com/site/nikobrummer/>

†Brümmer, N. (2011). Tutorial for Bayesian forensic likelihood ratio. Unpublished manuscript.  
[https://sites.google.com/site/nikobrummer/dna\\_tut.pdf](https://sites.google.com/site/nikobrummer/dna_tut.pdf)

†Brümmer, N. (2010). Bayesian PLDA. Unpublished manuscript.  
<https://sites.google.com/site/nikobrummer/bplda.pdf>

†Brümmer, N. & de Villiers, E. (2010). The speaker partitioning problem. *Proceedings of Odyssey 2010: The Speaker and Language Recognition Workshop*, Brno, Czech Republic, pp. 194–201.

†Villalba, J. & Brümmer, N. (2011). Towards fully Bayesian speaker recognition: Integrating out the between-speaker covariance. *Proceedings of the Twelfth Annual Conference of the*

International Speech Communication Association (Interspeech), Florence, Italy, pp. 505–508.

- \*Curran JM, Buckleton JS, Triggs CM, Weir BS (2002). Assessing uncertainty in DNA evidence caused by sampling effects. *Science & Justice*, 42, 29–37. doi:10.1016/S1355-0306(02)71794-2
  - \*Gill PD, Curran JM, Neumann C, Kirkham A, Clayton T, Whitaker J, Lambert JA (2008). Interpretation of complex DNA profiles using empirical models and a method to measure their robustness, *Forensic Science International Genetics*, 2, 91–103. doi:10.1016/j.fsigen.2007.10.160
  - \*Abraham J, Champod C, Lennard C, Roux C (2012) Spatial analysis of corresponding fingerprint features from match and close non-match populations, *Forensic Science International*, X, xx–xx. doi:10.1016/j.forsciint.2012.10.034
- Aitken, Lucy (2004a,b) Evaluation of trace evidence in the form of multivariate data
- Aitken, C., Lucy, D., Zadora, G. & Curran, J. (2006). Evaluation of trace evidence for three-level multivariate data with the use of graphical models. *Computational Statistics and Data Analysis*, 50, 2571–2588.
- Aitken, C., Zadora, G. & Lucy, D. (2007). A two-level model for evidence evaluation. *Journal of Forensic Sciences*, 52(2), 412–419.
- Zadora, G. & Neocleous, T. (2009). Likelihood ratio model for classification of forensic evidence. *Analytica Chimica Acta*, 642, 266–278.
- Zadora, G., Neocleous, T. & Aitken, C. (2010). A two-level model for evidence evaluation in the presence of zeros. *Journal of Forensic Sciences*, 55, 371–384.
- Hasan, Hansen (2012) Factor analysis of acoustic features using a mixture of probabilistic principal component analyzers for robust speaker verification. In *Proceedings of Odyssey 2012: The Language and Speaker Recognition Workshop*, Singapore (pp. 243–247). International Speech Communication Association.