Erik M. Ferragut, Ph.D.

Research Interests

I am interested in applications of combinatorial and probabilistic modeling to the analysis of complex systems, especially those related to cybersecurity. Two main foci of recent research include (1) mathematical underpinnings of anomaly detection, and (2) scalable probabilistic algorithms. I have fourteen years of experience in theoretical and applied cryptology involving the extensive development and application of probabilistic, combinatorial, group-theoretic, and computational methods. Related work has also involved machine learning, risk assessment, and coding theory.

Publications

1. **Erik M. Ferragut**, Jason Laska, Robert A. Bridges, "A New, Principled Approach to Anomaly Detection," International Conference of Machine Learning Applications Special Session on Machine Learning in Information and System Security Issues, December 2012.

2. **Erik M. Ferragut**, Jason Laska, "Randomized Sampling for Large Data Applications of SVM," International Conference of Machine Learning Applications, December 2012.

3. **Erik M. Ferragut**, Jason Laska, Alex Melin, Bogdan Czejdo, "Addressing the Challenges of Anomaly Detection for Cyber Physical Energy Grid Systems," 8th Annual Cyber Security and Information Intelligence Research Workshop, October 2012.

4. Czejdo, B., **Ferragut, E.**, Goodall, J., Laska, J., "Network Intrusion Detection and Visualization using Aggregations in a Cyber Security Data Warehouse," to appear in International Journal of Communications, Network and System Sciences, (IJCNS).

5. Abercrombie, R., **Ferragut, E.**, Boone, S., "Hidden Markov Modeling for Weigh-In Motion Estimation," 6th International Conference on Weigh-In-Motion (ICWIM6), Dallas, Texas, June 2012.

6. Czejdo, B., **Ferragut, E**., "Time Analysis of Probabilistic Workflows," Proceedings of 2012 International Conference on Future Communication and Computer Technology (ICFCCT 2012), pp. 62–66.

7. Czejdo, B., Bhattacharya, S., **Ferragut E.**, "Query Processing for Probabilistic State Diagrams Describing Multiple Robot Navigation in an Indoor Environment," International Journal of Digital and Wireless Communications (IJDIWC), 1(2), 554–572, 2012.

8. **Erik M. Ferragut**, E. Nicole Braden, "System Log Summarization via Semi-Markov Models of Inter-Arrival Times," 7th Annual Cyber Security and Information Intelligence Research Workshop, October 2011.

9. Anita N. Zakrzewska, **Erik M. Ferragut**, "Enhanced Cyber Security Modeling Using an Extended Petri Net Formalism," IEEE Symposium on Computational Intelligence in Cyber Security (SSCI), April 2011.

10. David M. Darmon, **Erik M. Ferragut**, Stephen Kelly, Craig A. Shue, "Application of Latent Dirichlet Allocation to the Determination of Normal Client/Server Behavior and the Detection of Anomalies," IEEE Symposium on Computational Intelligence in Cyber Security (SSCI), April 2011.

11. R. K. Abercrombie, **E. M. Ferragut**, F. T. Sheldon, and M. R. Grimaila, "Addressing the Need for Independence in the CSE Model," IEEE Symposium on Computational Intelligence in Cyber Security (SSCI), April 2011.

12. Craig A. Shue, Stephen Kelley, Brent J. Lagesse, Andrew J. Kalafut, **Erik M. Ferragut**, Minaxi Gupta, "Toward An Internet Neighborhood Watch for Authenticity," 2010.

13. Craig A. Shue, **Erik M. Ferragut**, "Dead Phish: An Examination of Deactivated Phishing Sites," Collaboration, Electronic Messaging, Anti-Abuse and Spam Conference (CEAS), Jul. 2010.

14. **Erik M. Ferragut** 2009. "A dynamic erasure code for multicasting live data." In *Proceedings of the 5th Annual Workshop on Cyber Security and information intelligence Research: Cyber Security and Information Intelligence Challenges and Strategies* (Oak Ridge, Tennessee, April 13 - 15, 2009). F. Sheldon, G. Peterson, A. Krings, R. Abercrombie, and A. Mili, Eds. CSIIRW '09. ACM, New York, NY, 1-4.

Classified Papers

1. Authored 16 peer-reviewed classified papers in applied cryptology and related fields, available upon request. Received several competitive paper awards.

Education

December 2003	Ph.D. in Mathematics University of Michigan, Ann Arbor Dissertation: "*Detection of Epistatic Effects in Genetic Data*" Advisor: Phil Hanlon
August 1999	M.S. in Mathematics University of Michigan, Ann Arbor
May 1997	B.S. in Mathematics, *Summa Cum Laude* Highest honors in Mathematics, Physics, and Philosophy Ursinus College, Collegeville, PA

Work Experience

- 6/2009 – Present: Oak Ridge National Laboratory. Cyber Security Research Scientist, Cyberspace Sciences and Information Intelligence Research Group.

- 8/2007 – 6/2009: Institute for Defense Analyses (FFRDC), Center for Communications Research, Princeton. Applied Research Mathematician.

- 8/2006 – 8/2007: Oak Ridge National Laboratory. Cyber Security Research Scientist, Cyberspace Sciences and Information Intelligence Research Group.

- 10/2005 – 8/2006: Johns Hopkins University, Applied Physics Laboratory (UARDC). Applied Research Mathematician.

- 8/1993 – 10/2005: National Security Agency. Applied Research Mathematician.

Patents

- "Weigh-In-Motion Estimation via Probabilistic Hidden Variable Modeling," R. K. Abercrombie and E. M. Ferragut, US Patent Pending, (May 2, 2012).

- "Weight and Piece-Wise Analysis for Weigh-In-Motion," R. K. Abercrombie, E. M. Ferragut, and L. M. Hively, US Patent Pending, (May 3, 2012).

- "Cyberspace Security Econometrics System (CSES) Expansion to Address Dependent Events," R. K. Abercrombie and E. M. Ferragut, U.S. Patent Pending (February 15, 2011).

Awards and Fellowships

- 2009, Honorable Mention, Theoretical Category, Crypto-Mathematics Institute

- 2003, Best Paper, KRYPTOS, First Prize

- 2003, Best Paper, Theoretical Category, Crypto-Mathematics Institute

- 2003, Honorable Mention, Theoretical Category, Crypto-Mathematics Institute

Professional Membership and Service

- Member, American Mathematical Society (AMS)

- Member, Society for Industrial and Applied Mathematics (SIAM)

- Reviewer, HICSS 2009

- Reviewer, IEEE Network Magazine

- Reviewer, ACM Transactions on Modeling and Computer Simulation Journal (ACM TOMACS)

- Reviewer, Cyber Security and Information Intelligence Research Workshop (CSIIRW) 2010–2012

Languages, Programming, and Clearances

- Fluent in English and Spanish

- Programming skills in C, C++, Python, PERL, Mathematica, Matlab, SAGE, and Magma

- Citizenship: USA

- Clearances: Q, TS//SI