# PROF. DR. FRANK BREITINGER

**◆ Echandens, CH**

## EDUCATION

**PhD - Computer Sciences**                               March 2011 - June 2014
*Technical University Darmstadt*                                      *Germany*
· Emphasis on cyber forensics and cybersecurity.
· Member of da/sec - biometrics and internet-security research group.
· Member of Center for Advanced Security Research Darmstadt (CASED).

**MSc. - Computer Sciences**                          March 2009 - February 2011
*University of Applied Sciences Darmstadt*                            *Germany*
· Emphasis on cyber forensics and cybersecurity.

**BSc. - Computer Sciences**                        October 2005 - February 2009
*University of Applied Sciences Mannheim*                             *Germany*
· Emphasis on software development.
· Practical semester at the University of Maryland (USA). Sept. 2007 to Mar. 2008.
· Thesis at sobedi GmbH Mannheim with a focus on software development. Aug. 2008 to Feb. 2009.

## WORK EXPERIENCE

**University of Lausanne**                                April 2021 - present
*Associate Professor (tenured)*                         *Lausanne, Switzerland*
*Faculty of Law, Criminal Sciences and Public Administration*
· Co-leading the Group Trace Numerique and supervising BSc, MSc, & PhD students.
· Academic representative in the Technological and Digital Transformations hub of the CIVIS alliance.
· Research and education in digital forensics including incident response as well as organizing training for Armasuisse (military).

**University of Liechtenstein**                          June 2019 - April 2021
*Assistant Professor (non-tenure track)*                 *Vaduz, Liechtenstein*
*Hilti Chair for Data and Application Security*
· Responsible for the competence center in cybersecurity and digital innovation.
· Organizing events for the Liechtensteinische Landesverwaltung (LLV, State Administration).
· Building strategic partnerships with several universities and successfully applying for funding.

**University of New Haven**                       September 2014 - August 2019
*Assistant Professor (tenure track)*                     *West Haven, CT, USA*
*Co-Director of the Cyber Forensics Research and Education Laboratory*
· Member of the faculty senate and engineering LLC advisor.
· Coaching the hacking team to various successes.
· Started developing the PhD in engineering / applied sciences.
· Student recruitment during open houses, accepted students' days and other events.

**University of Applied Sciences Darmstadt**                    March 2011 - March 2014
*Research Assistant*                                             *Darmstadt, Germany*
· Research in cybersecurity and digital forensics.
· Teaching and supporting classes cybersecurity.
· Working on the indexing problem of similarity digests (a.k.a. fingerprints) for the European passport funded by the EU (FIDELITY Grant ID 284862).

**National Institute of Standards and Technology (NIST)**       October 2013 - December 2013
*NIST, Visiting Researcher*                                      *Gaithersburg, MD, USA*
· Developed NIST Special Publication 800-168 named Approximate Matching: Definition and Terminology.

**IT-fuer-jedermann.de**                                         September 2009 - August 2014
*Self-Employed*                                                  *Beerfelden, Germany*
· Security assessment and maintenance of the IT-Infrastructure for companies.
· Webdesign, Internet/network, consultation, education, and sale.
· Designed and implemented several web pages (e.g., WordPress, customized using PHP).

### TEMPORARY WORK EXPERIENCES

· Adjunct **Bern University of Applied Sciences** (Switzerland): Teaching the one-week module *Cyber Investigation Fundamentals* module (MSc level, 3 ECTS) – 1 course yearly since 2020.

· Adjunct **Albstadt-Sigmaringen University** (Germany): Teaching *Network and System Security* (BSc level, 5 ECTS) – 2020 winter semester.

### DEVELOPMENT AND OTHER ACTIVITIES*

*Some selected activities.

1. 2017: **Research Fellowship** (two weeks) at Brno university of technology with the NES@FIT - Networked and embedded systems research group. Supported researchers on various projects as well as gave presentations.

2. 2017: Supported organizing the **National Workshop on Redefining Cyber Forensics** (NWRCF, two days) in Hartford (CT) which was NSF sponsored. A blue-ribbon panel to stimulate the needed intellectual exchange of ideas and discussions on the future of cyber forensics.

3. 2016: **Master Teacher Seminar** (two days) with Dr. Harvey Brightman, sponsored by the College of Business at the University of New Haven.

4. 2016: **KEEN ICE Workshop** (three days) featuring activities and presentations covering the important aspects of Entrepreneurially Minded Learning (EML), Active and Collaborative Learning (ACL), and Problem/Project Based Learning (PBL) and how to integrate them into your own courses.

### AWARDS & HONORS

1. 2022: Best Paper Award for *A forensic analysis of rclone and rclone's prospects for digital forensic investigations of cloud storage*, Digital Forensics Research Conference APAC, Adelaide, Australia.

2. 2019: Best Paper Award for *Understanding the effects of removing common blocks on Approximate Matching scores under different scenarios for digital forensic investigations*, Simpósio Brasileiro em Segurança da Informação e de Sistemas Computacionais, Sao Paula, Brazil.

3. 2018: Best Paper Award for *If I Had a Million Cryptos: Cryptowallet Application Analysis and A Trojan Proof-of-Concept*, International Conference on Digital Forensics and Cyber Crime, New Orleans, United States.

4. 2018: Student hacking team received Forth place in the northeast qualifiers of the Collegiate Penetration Testing Competition (CPTC) at the University of Pennsylvania.

5. 2017: University Research Scholar – (the scholar receives a partial teaching workload release for 3 academic years + a modest budget).

6. 2017: Best Paper award for *Expediting MRSH-v2 Approximate Matching with Hierarchical Bloom Filter Trees*, International Conference on Digital Forensics and Cyber Crime, Prague, Czech Republic.

7. 2017: Student hacking team received Second place at CyberSEED, University of Connecticut.

8. 2017: Student hacking team received Third place in the northeast qualifiers of the Collegiate Penetration Testing Competition (CPTC) at the University of Pennsylvania.

9. 2016: Merit Award – University of New Haven (in recognition of individual strong performance, and support of students in experiential education opportunities, as well as to acknowledge the overall contribution).

10. 2015: FBTI Award of Excellence – Fachbereichstag Informatik for my dissertation in Computer Science at a German Universities of Applied Science.

11. 2015: Best Paper award for *How Cuckoo Filter Can Improve Existing Approximate Matching Techniques*, International Conference on Digital Forensics and Cyber Crime, Seoul, Korea.

12. 2015: Siew-Sngiem Best Poster Award for *Towards Bloom Filter-based Indexing of Iris Biometric Data*, International Conference on Biometrics, Phuket, Thailand.

13. 2014: Best paper award for *File Detection On Network Traffic Using Approximate Matching*, International Conference on Digital Forensics and Cyber Crime, New Haven (CT), United States.

14. 2013: Best paper award for *Evaluating Detection Error Trade-offs for Bytewise Approximate Matching Algorithms*, International Conference on Digital Forensics and Cyber Crime, Moscow, Russia.

## FUNDING

Section only lists successful and pending applications; default duration 1 year or shorter

1. 2022, Source: Swiss National Funds (SNF), **Enhancing event reconstruction for digital forensics through applying incident response techniques**, PI: Frank Breitinger, Duration: 3 years, Amount: CHF 344'185 – under review.

2. 2021, Source: Armasuisse, **Title: Disclosed upon request** PI: Frank Breitinger, Co-PIs: Thomas Souvignet, Christophe Champod, Duration: 5 years, Amount: CHF 1'198'600 – funded.

3. 2020, Source: European Economic Area (EEA), **Title: Advancing human performance in cybersecurity**[1], General Project Lead (Vilnius University, LT): Agnė Brilingaitė (PI), Laima Ambrozaitytė and Linas Buauskas (Co-PIs); PIs of Project Partners: Frank Breitinger (University of Liechtenstein, LI), Stefan Sütterlin (Østfold University College, NO), Ricardo G. Lugo (Inland Norway University of Applied Sciences, NO) , Benjamin J. Knox (Norwegian University for Technology and Science, NO), Ginta Majore and Jānis Grabis (Vidzeme University of Applied Sciences, LV), Olaf Maennel (Tallinn University of Technology, EE), Aušrius Juozapavičius (General Jonas Zemais Military Academy of Lithuania, LT), Duration: 3 years Amount: €999'131 – funded.

4. 2020, Source: AIBA / ERASMUS KA2, **Title: Alliance for developing, teaching and training Digital Forensics and Incident Response students and practitioners**[1] **(# 2020-1-LI01-KA203-000185)**, PI: Frank Breitinger, Co-PIs: Holger Morgenstern (Albstadt-Sigmaringen University, DE), Ondřej Ryšavý (Brno University, CZ), John Sheppard (Waterford Institute of Technology, IRE), Amount: €273'280 – funded.

5. 2019, Source: NSA / NSF, **Title: University of New Haven's Cyber Agent Academy (Student camp)**, PI: Ibrahim Baggili, Co-PIs: Frank Breitinger, Liberty Page, Amount: $80'000 – funded.

6. 2018, Source: University of New Haven, **Title: Cryptowallet Application Analysis**, PI: Frank Breitinger, Amount: $3'250 – funded.

7. 2018, Source NSA / NSF, **Title: University of New Haven's Cyber Agent Academy (Student camp)**, PI: Ibrahim Baggili, Co-PIs: Frank Breitinger, Liberty Page, Amount: $64'099 – funded.

8. 2017, Source: Davis Educational Foundation, **Title: Development of the 'CyberWorld' Common Course at the University of New Haven**, PI: Frank Breitinger, Co-PIs: Kristen Przyborski, Ronald Harichandran, Ibrahim Baggili, Guy-Serge Emmanuel, Glenn McGee, Duration: 2 years, Amount $103'125 ($167'418 including cost sharing) – funded.

9. 2017, Source: NSF, **Title: Exploring cybersecurity & forensics of Virtual Reality systems and their impact on cybersecurity education**, PI: Ibrahim Baggili, Co-PI: Frank Breitinger, Duration: 2 years, Amount $179'409 – funded.

10. 2017, Source: University of New Haven, **Title: Availability of Datasets for digital forensics - and what is missing**, PI: Frank Breitinger, Amount: $3'250 – funded.

11. 2017, Source NSA / NSF, **Title: University of New Haven's Cyber Agent Academy (Student camp)**, PI: Ibrahim Baggili, Co-PIs: Frank Breitinger, Liberty Page, Amount: $53'029 – funded.

12. 2016, Source: NSF, **Title: National Workshop on Redefining Cyber Forensics (NWRCF)**, PI: Ibrahim Baggili, Co-PI: Frank Breitinger, Amount: $49'995 – funded.

13. 2016, Source: University of New Haven, **Title: A survey to enhance adult education in cyber security**, PI: Frank Breitinger, Amount: $3'250 – funded.

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[1]Grants are tight to the University of Liechtenstein and cannot be transfered; after job transition they have been transfered to a new PI.

14. 2014, Source: Purdue University sub-award through Department of Homeland Security, **Title: Artifact Genome Project**, PI: Ibrahim Baggili, Co-PIs: Frank Breitinger, Ted Markowitz, Amount: $140'000 – funded.

## PUBLICATIONS & PRESENTATIONS

### Books

1. Frank Breitinger and Ibrahim Baggili, eds. *Digital Forensics and Cyber Crime: 10th International EAI Conference, ICDF2C 2018, New Orleans, LA, USA, September 10–12, 2018, Proceedings*. Vol. 259. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering. Springer International Publishing, Dec. 30, 2018. ISBN: 978-3-030-05486-1.

2. Joshua I. James and Frank Breitinger, eds. *Digital Forensics and Cyber Crime: 7th International Conference, ICDF2C 2015, Seoul, South Korea, October 6-8, 2015, Revised Selected Papers*. Vol. 157. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering. Springer, Oct. 8, 2015. ISBN: 978-3-319-25511-8.

### Book Chapters

1. Joseph Ricci, Ibrahim Baggili, and Frank Breitinger. "Watch What You Wear: Smartwatches and Sluggish Security". In: *Managing Security Issues and the Hidden Dangers of Wearable Technologies*. Ed. by Andrew Marrington, Don Kerr, and John Gammack. IGI Global, Sept. 1, 2016, p. 47.

### Journal Articles (peer-reviewed)

1. Frank Breitinger, Xiaolu Zhang, and Darren Quick. "A forensic analysis of rclone and rclone's prospects for digital forensic investigations of cloud storage". *Forensic Science International: Digital Investigation* 43 (Sept. 27, 2022). **Best Paper Award**, p. 301443. ISSN: 2666-2817.

2. Thomas Göbel, Frieder Uhlig, Harald Baier, and Frank Breitinger. "FRASHER – A framework for automated evaluation of similarity hashing". *Forensic Science International: Digital Investigation* 42.2022- (July 9, 2022). Proceedings of the Twenty-Second Annual DFRWS USA, p. 301407. ISSN: 2666-2817.

3. Saleh AlDaajeh et al. "The Role of National Cybersecurity Strategies on the Improvement of Cybersecurity Education". *Computers & Security* (May 18, 2022), p. 102754. ISSN: 0167-4048.

4. Jan Huck and Frank Breitinger. "Wake Up Digital Forensics' Community and Help Combating Ransomware". *IEEE Security & Privacy* 01 (Jan. 14, 2022), pp. 2–11. ISSN: 1558-4046.

5. Tina Wu, Frank Breitinger, and Stephen Niemann. "IoT network traffic analysis: Opportunities and challenges for forensic investigators?" *Forensic Science International: Digital Investigation* 38 (Nov. 23, 2021), p. 301123. ISSN: 2666-2817.

6. Xiaolu Zhang, Frank Breitinger, Engelbert Luechinger, and Stephen O'Shaughnessy. "Android application forensics: A survey of obfuscation, obfuscation detection and deobfuscation techniques and their impact on investigations". *Forensic Science International: Digital Investigation* 39 (Oct. 6, 2021), p. 301285. ISSN: 2666-2817.

7. Radek Hranický et al. "What do incident response practitioners need to know? A skillmap for the years ahead". *Forensic Science International: Digital Investigation* 37 (July 14, 2021), p. 301184. ISSN: 2666-2817.

8. Stephen O'Shaughnessy and Frank Breitinger. "Malware family classification via efficient Huffman features". *Forensic Science International: Digital Investigation* 37 (July 14, 2021), p. 301192. ISSN: 2666-2817.

9. Miguel Martín-Pérez, Ricardo J. Rodríguez, and Frank Breitinger. "Bringing order to approximate matching: Classification and attacks on similarity digest algorithms". *Forensic Science International: Digital Investigation* (Mar. 30, 2021), p. 301120. ISSN: 2666-2817.

10. Jan Pluskal, Frank Breitinger, and Ondřej Ryšavý. "Netfox detective: A novel open-source network forensics analysis tool". *Forensic Science International: Digital Investigation* 35 (Sept. 17, 2020), p. 301019. ISSN: 2666-2817.

11. Frank Breitinger, Ryan Tully-Doyle, Kristen Przyborski, Lauren Beck, and Ronald S. Harichandran. "First year students' experience in a Cyber World course – an evaluation". *Education and Information Technologies* (Sept. 11, 2020).

12. Tina Wu, Frank Breitinger, and Stephen O'Shaughnessy. "Digital forensic tools: Recent advances and enhancing the status quo". *Forensic Science International: Digital Investigation* 34 (Aug. 14, 2020), p. 300999. ISSN: 2666-2817.

13. David Palmbach and Frank Breitinger. "Artifacts for detecting timestamp manipulation in NTFS on Windows and their reliability". *Forensic Science International: Digital Investigation* 32 (June 4, 2020), p. 300920. ISSN: 2666-2817.

14. Vitor Hugo Galhardo Moia, Frank Breitinger, and Marco Aurélio Amaral Henriques. "The impact of excluding common blocks for approximate matching". *Computers & Security* 89 (Nov. 28, 2019), p. 101676. ISSN: 0167-4048.

15. Frank Breitinger, Ryan Tully-Doyle, and Courtney Hassenfeldt. "A survey on smartphone user's security choices, awareness and education". *Computers & Security* 88 (Oct. 11, 2019), p. 101647. ISSN: 0167-4048.

16. Peter Casey, Rebecca Lindsay-Decusati, Ibrahim Baggili, and Frank Breitinger. "Inception: Virtual Space in Memory Space in Real Space – Memory Forensics of Immersive Virtual Reality with the HTC Vive". *Digital Investigation* 29 (July 14, 2019), S13–S21. ISSN: 1742-2876.

17. Kristen Przyborski, Frank Breitinger, Lauren Beck, and Ronald S Harichandran. "'CyberWorld' as a Theme for a University-wide First-year Common Course". *2019 ASEE Annual Conference & Exposition (Presented at Cyber Technology)* (June 18, 2019).

18. Lorenz Liebler, Patrick Schmitt, Harald Baier, and Frank Breitinger. "On efficiency of artifact lookup strategies in digital forensics". *Digital Investigation* 28 (Apr. 24, 2019), S116–S125. ISSN: 1742-2876.

19. Joseph Ricci, Ibrahim Baggili, and Frank Breitinger. "Blockchain-Based Distributed Cloud Storage Digital Forensics: Where's the Beef?" *IEEE Security & is Privacy* 17.1 (Jan. 1, 2019), pp. 34–42. ISSN: 1540-7993.

20. Mark Debinski, Frank Breitinger, and Parvathy Mohan. "Timeline2GUI: A Log2Timeline CSV parser and training scenarios". *Digital Investigation* 28 (Dec. 31, 2018), pp. 34–43. ISSN: 1742-2876.

21. Cinthya Grajeda, Laura Sanchez, Ibrahim Baggili, Devon Clark, and Frank Breitinger. "Experience constructing the Artifact Genome Project (AGP): Managing the domain's knowledge one artifact at a time". *Digital Investigation* 26 (July 15, 2018), S47–S58. ISSN: 1742-2876.

22. Joseph Ricci, Frank Breitinger, and Ibrahim Baggili. "Survey results on adults and cybersecurity education". *Education and Information Technologies* (July 11, 2018), pp. 1–19. ISSN: 1360-2357.

23. Devon R. Clark, Christopher Meffert, Ibrahim Baggili, and Frank Breitinger. "DROP (DRone Open source Parser) your drone: Forensic analysis of the DJI Phantom III". *Digital Investigation* 22, Supplement (Aug. 5, 2017), S3–S14. ISSN: 1742-2876.

24. George Denton, Filip Karpisek, Frank Breitinger, and Ibrahim Baggili. "Leveraging the SRTP protocol for over-the-network memory acquisition of a GE Fanuc Series 90-30". *Digital Investigation* 22, Supplement (Aug. 5, 2017), S26–S38. ISSN: 1742-2876.

25. Cinthya Grajeda, Frank Breitinger, and Ibrahim Baggili. "Availability of datasets for digital forensics – And what is missing". *Digital Investigation* 22, Supplement (Aug. 5, 2017), S94–S105. ISSN: 1742-2876.

26. Xiaolu Zhang, Ibrahim Baggili, and Frank Breitinger. "Breaking into the vault: privacy, security and forensic analysis of android vault applications". *Computers & Security* 70 (Aug. 2, 2017), pp. 516–531. ISSN: 0167-4048.

27. Jason Moore, Ibrahim Baggili, and Frank Breitinger. "Find Me If You Can: Mobile GPS Mapping Applications Forensics Analysis & SNAVP The Open Source, Modular, Extensible Parser". *Journal of Digital Forensics, Security and Law (JDFSL)* 12.1 (June 13, 2017), p. 7.

28. Vikram S. Harichandran, Frank Breitinger, and Ibrahim Baggili. "Bytewise Approximate Matching: The Good, The Bad, and The Unknown". *Journal of Digital Forensics, Security and Law* 11.2 (Dec. 26, 2016), pp. 59–78.

29. Samer Al-khateeb, Kevin J. Conlan, Nitin Agarwal, Ibrahim Baggili, and Frank Breitinger. "Exploring Deviant Hacker Networks (DHN) On Social Media Platforms". *Journal of Digital Forensics, Security and Law* 11.2 (Dec. 26, 2016), pp. 7–20.

30. Doowon Jeong, Frank Breitinger, Hari Kang, and Sangjin Lee. "Towards Syntactic Approximate Matching-A Pre-Processing Experiment". *The Journal of Digital Forensics, Security and Law: JDFSL* 11.2 (Dec. 26, 2016), pp. 97–110.

31. Kevin Conlan, Ibrahim Baggili, and Frank Breitinger. "Anti-forensics: Furthering digital forensic science through a new extended, granular taxonomy". *Digital Investigation* 18 (Aug. 7, 2016), pp. 66–75. ISSN: 1742-2876.

32. Vikram S. Harichandran, Daniel Walnycky, Ibrahim Baggili, and Frank Breitinger. "CuFA: A more formal definition for digital forensic artifacts". *Digital Investigation* 18 (Aug. 7, 2016), pp. 125–137. ISSN: 1742-2876.

33. Christopher S. Meffert, Ibrahim Baggili, and Frank Breitinger. "Deleting collected digital evidence by exploiting a widely adopted hardware write blocker". *Digital Investigation* 18 (Aug. 7, 2016), pp. 87–96. ISSN: 1742-2876.

34. Xiaolu Zhang, Frank Breitinger, and Ibrahim Baggili. "Rapid Android Parser for Investigating DEX files (RAPID)". *Digital Investigation* 17 (Mar. 25, 2016), pp. 28–39. ISSN: 1742-2876.

35. Vikram S. Harichandran, Frank Breitinger, Ibrahim Baggili, and Andrew Marrington. "A cyber forensics needs analysis survey: Revisiting the domain's needs a decade later". *Computers & Security* 57 (Nov. 10, 2015), pp. 1–13. ISSN: 0167-4048.

36. Filip Karpisek, Ibrahim Baggili, and Frank Breitinger. "WhatsApp network forensics: Decrypting and understanding the WhatsApp call signaling messages". *Digital Investigation* 15 (Oct. 10, 2015), pp. 110–118. ISSN: 1742-2876.

37. Daniel Walnycky, Ibrahim Baggili, Andrew Marrington, Jason Moore, and Frank Breitinger. "Network and device forensic analysis of Android social-messaging applications". *Digital Investigation* 14, Supplement 1 (Aug. 9, 2015). The Proceedings of the Fifteenth Annual DFRWS Conference, pp. 77–84. ISSN: 1742-2876.

38. Christian Rathgeb, Frank Breitinger, Christoph Busch, and Harald Baier. "On application of bloom filters to iris biometrics". *IET Biometrics* 3.4 (Dec. 18, 2014), pp. 207–218. ISSN: 2047-4938.

39. Frank Breitinger, Christian Rathgeb, and Harald Baier. "An Efficient Similarity Digests Database Lookup - A Logarithmic Divide & Conquer Approach". *Journal of Digital Forensics, Security and Law (JDFSL)* 9.2 (Sept. 1, 2014), pp. 155–166.

40. Frank Breitinger, Georgios Stivaktakis, and Harald Baier. "FRASH: A Framework to Test Algorithms of Similarity Hashing". *Digit. Investig.* 10 (Aug. 3, 2014), S50–S58. ISSN: 1742-2876.

41. Frank Breitinger, Georgios Stivaktakis, and Vassil Roussev. "Evaluating Detection Error Trade-offs for Bytewise Approximate Matching Algorithms". *Digital Investigation* 11.2 (June 8, 2014). **Best Paper Award @ ICDF2C'13**, pp. 81–89. ISSN: 1742-2876.

42. Frank Breitinger and Ibrahim Baggili. "File Detection On Network Traffic Using Approximate Matching". *Journal of Digital Forensics, Security and Law (JDFSL)* 9.2 (May 22, 2014). **Best Paper Award**, pp. 23–36.

43. Frank Breitinger, Harald Baier, and Douglas White. "On the database lookup problem of approximate matching". *Digital Investigation* 11, Supplement 1.0 (Mar. 13, 2014). Proceedings of the First Annual DFRWS Europe, S1–S9. ISSN: 1742-2876.

44. Frank Breitinger and Vassil Roussev. "Automated evaluation of approximate matching algorithms on real data". *Digital Investigation* 11, Supplement 1.0 (Mar. 13, 2014). Proceedings of the First Annual DFRWS Europe, S10–S17. ISSN: 1742-2876.

**Conference Proceedings (peer-reviewed)**

1. Peter Coates and Frank Breitinger. "Identifying document similarity using a fast estimation of the Levenshtein Distance based on compression and signatures". In: *Proceedings of the Digital Forensics Research Conference Europe (DFRWS EU)*. Mar. 31, 2022.

2. Jenny Ottmann, Frank Breitinger, and Felix Freiling. "Defining Atomicity (and Integrity) for Snapshots of Storage in Forensic Computing". In: *Proceedings of the Digital Forensics Research Conference Europe (DFRWS EU)*. Mar. 31, 2022.

3. Vitor Hugo Galhardo Moia, Frank Breitinger, and Marco Aurélio Amaral Henriques. "Understanding the effects of removing common blocks on Approximate Matching scores under different scenarios for digital forensic investigations". In: *XIX Brazilian Symposium on information and computational systems security*. **Best Paper Award**. Brazilian Computer Society (SBC) SÃ£ o Paulo-SP, Brazil. Sept. 5, 2019.

4. Tina Wu, Frank Breitinger, and Ibrahim Baggili. "IoT Ignorance is Digital Forensics Research Bliss: A Survey to Understand IoT Forensics Definitions, Challenges and Future Research Directions". In: *Proceedings of the 14th International Conference on Availability, Reliability and Security*. ARES '19. Canterbury, CA, United Kingdom: ACM, Aug. 25, 2019, 46:1–46:15. ISBN: 978-1-4503-7164-3.

5. Trevor Haigh, Frank Breitinger, and Ibrahim Baggili. "If I Had a Million Cryptos: Cryptowallet Application Analysis and a Trojan Proof-of-Concept". In: *Digital Forensics and Cyber Crime*. Ed. by Frank Breitinger and Ibrahim Baggili. **Best Paper Award**. Cham: Springer International Publishing, Dec. 30, 2018, pp. 45–65. ISBN: 978-3-030-05487-8.

6. Robert Schmicker, Frank Breitinger, and Ibrahim Baggili. "AndroParse - An Android Feature Extraction Framework and Dataset". In: *Digital Forensics and Cyber Crime*. Ed. by Frank Breitinger and Ibrahim Baggili. Cham: Springer International Publishing, Dec. 30, 2018, pp. 66–88. ISBN: 978-3-030-05487-8.

7. Laoise Luciano, Ibrahim Baggili, Mateusz Topor, Peter Casey, and Frank Breitinger. "Digital Forensics in the Next Five Years". In: *Proceedings of the 13th International Conference on Availability, Reliability and Security*. ARES 2018. Hamburg, Germany: ACM, Aug. 30, 2018, 46:1–46:14. ISBN: 978-1-4503-6448-5.

8. Lorenz Liebler and Frank Breitinger. "mrsh-mem: Approximate Matching on Raw Memory Dumps". In: *2018 11th International Conference on IT Security Incident Management IT Forensics (IMF)*. May 9, 2018, pp. 47–64.

9. Brandon Knieriem, Xiaolu Zhang, Philip Levine, Frank Breitinger, and Ibrahim Baggili. "An Overview of the Usage of Default Passwords". In: *Digital Forensics and Cyber Crime*. Ed. by Petr Matoušek and Martin Schmiedecker. Cham: Springer International Publishing, Jan. 6, 2018, pp. 195–203. ISBN: 978-3-319-73697-6.

10. David Lillis, Frank Breitinger, and Mark Scanlon. "Expediting MRSH-v2 Approximate Matching with Hierarchical Bloom Filter Trees". In: *Digital Forensics and Cyber Crime*. Ed. by Petr Matoušek and Martin Schmiedecker. **Best Paper Award**. Cham: Springer International Publishing, Jan. 6, 2018, pp. 144–157. ISBN: 978-3-319-73697-6.

11. Christopher Meffert, Devon Clark, Ibrahim Baggili, and Frank Breitinger. "Forensic State Acquisition from Internet of Things (FSAIoT): A General Framework and Practical Approach for IoT Forensics Through IoT Device State Acquisition". In: *Proceedings of the 12th International Conference on Availability, Reliability and Security*. ARES '17. Reggio Calabria, Italy: ACM, Sept. 1, 2017, 56:1–56:11. ISBN: 978-1-4503-5257-4.

12. Vikas Gupta and Frank Breitinger. "How Cuckoo Filter Can Improve Existing Approximate Matching Techniques". English. In: *Digital Forensics and Cyber Crime*. Ed. by Joshua I. James and Frank Breitinger. Vol. 157. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering. **Best Paper Award**. Springer International Publishing, Dec. 25, 2015, pp. 39–52. ISBN: 978-3-319-25511-8.

13. Ibrahim Baggili, Jeff Oduru, Kyle Anthony, Frank Breitinger, and Glenn McGee. "Watch What You Wear: Preliminary Forensic Analysis of Smart Watches". In: *Availability, Reliability and Security (ARES), 2015 10th International Conference on*. Aug. 27, 2015, pp. 303–311.

14. Christian Rathgeb, Frank Breitinger, Harald Baier, and Christoph Busch. "Towards Bloom filter-based indexing of iris biometric data". In: *Biometrics (ICB), 2015 International Conference on*. **Siew-Sngiem Best Poster Award**. IEEE. May 22, 2015, pp. 422–429.

15. Gurjar Satyendra, Ibrahim Baggili, Frank Breitinger, and Alice Fischer. "An empirical comparison of widely adopted hash functions in digital forensics: does the programming language and operating system make a difference?" In: *Proceedings of the Conference on Digital Forensics, Security and Law*. May 19, 2015, pp. 57–68.

16. Ibrahim Baggili and Frank Breitinger. "Data Sources for Advancing Cyber Forensics: What the Social World Has to Offer". In: *AAAI Spring Symposium Series*. Mar. 12, 2015.

17. Frank Breitinger et al. "Towards a Process Model for Hash Functions in Digital Forensics". English. In: *Digital Forensics and Cyber Crime*. Ed. by Pavel Gladyshev, Andrew Marrington, and Ibrahim Baggili. Vol. 132. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering. Springer International Publishing, Dec. 23, 2014, pp. 170–186. ISBN: 978-3-319-14288-3.

18. Frank Breitinger, Christian Winter, York Yannikos, Tobias Fink, and Michael Seefried. "Using Approximate Matching to Reduce the Volume of Digital Data". English. In: *Advances in Digital Forensics X*. Ed. by Gilbert Peterson and Sujeet Shenoi. Vol. 433. IFIP Advances in Information and Communication Technology. Springer Berlin Heidelberg, Jan. 1, 2014, pp. 149–163. ISBN: 978-3-662-44951-6.

19. Frank Breitinger, Georg Ziroff, Steffen Lange, and Harald Baier. "Similarity Hashing Based on Levenshtein Distances". English. In: *Advances in Digital Forensics X*. Ed. by Gilbert Peterson and Sujeet Shenoi. Vol. 433. IFIP Advances in Information and Communication Technology. Springer Berlin Heidelberg, Jan. 1, 2014, pp. 133–147. ISBN: 978-3-662-44951-6.

20. Frank Breitinger and Harald Baier. "Similarity Preserving Hashing: Eligible Properties and a New Algorithm MRSH-v2". English. In: *Digital Forensics and Cyber Crime*. Ed. by Marcus Rogers and KathrynC. Seigfried-Spellar. Vol. 114. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering. Springer Berlin Heidelberg, Nov. 1, 2013, pp. 167–182. ISBN: 978-3-642-39890-2.

21. Christian Rathgeb, Frank Breitinger, and Christoph Busch. "Alignment-free cancelable iris biometric templates based on adaptive bloom filters". In: *Biometrics (ICB), 2013 International Conference on*. Sept. 30, 2013, pp. 1–8.

22. Frank Breitinger, Knut Astebøl, Harald Baier, and Christoph Busch. "mvHash-B - A New Approach for Similarity Preserving Hashing". In: *IT Security Incident Management and IT Forensics (IMF), 2013 Seventh International Conference on*. July 25, 2013, pp. 33–44.

23. Frank Breitinger and Kaloyan Petrov. "Reducing the Time Required for Hashing Operations". English. In: *Advances in Digital Forensics IX*. Ed. by Gilbert Peterson and Sujeet Shenoi. Vol. 410. IFIP Advances in Information and Communication Technology. Springer Berlin Heidelberg, Jan. 1, 2013, pp. 101–117. ISBN: 978-3-642-41147-2.

24. Frank Breitinger and Harald Baier. "Performance Issues About Context-Triggered Piecewise Hashing". English. In: *Digital Forensics and Cyber Crime*. Ed. by Pavel Gladyshev and MarcusK. Rogers. Vol. 88. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering. Springer Berlin Heidelberg, Dec. 1, 2012, pp. 141–155. ISBN: 978-3-642-35514-1.

25. Frank Breitinger and Harald Baier. "Properties of a similarity preserving hash function and their realization in sdhash". In: *Information Security for South Africa (ISSA)*. Oct. 4, 2012, pp. 1–8.

26. Frank Breitinger, Harald Baier, and Jesse Beckingham. "Security and implementation analysis of the similarity digest sdhash". In: *First International Baltic Conference on Network Security & Forensics (NeSeFo)*. Aug. 1, 2012.

27. Frank Breitinger and Harald Baier. "A fuzzy hashing approach based on random sequences and hamming distance". In: *Proceedings of the Conference on Digital Forensics, Security and Law*. May 1, 2012, pp. 89–100.

28. Harald Baier and Frank Breitinger. "Security Aspects of Piecewise Hashing in Computer Forensics". In: *IT Security Incident Management and IT Forensics (IMF), 2011 Sixth International Conference on*. June 17, 2011, pp. 21–36.

29. Frank Breitinger and Claudia Nickel. "User Survey on Phone Security and Usage". In: *BIOSIG*. Ed. by Arslan Brömme and Christoph Busch. Vol. 164. LNI. GI, June 1, 2010, pp. 139–144. ISBN: 978-3-88579-258-1.

**Other major Publications**

1. Frank Breitinger. "On the utility of bytewise approximate matching in computer science with a special focus on digital forensics investigations". PhD thesis. Technical University Darmstadt, June 30, 2014.

2. Frank Breitinger, Barbara Guttman, Michael McCarrin, Vassil Roussev, and Douglas White. *Approximate Matching: Definition and Terminology*. Special Publication 800-168. National Institute of Standards and Technologies, May 1, 2014.

3. Frank Breitinger. "Security Aspects of fuzzy hashing". MA thesis. University of Applied Sciences Darmstadt, Mar. 1, 2011.

**Pre-prints, ePrints, etc. (not peer-reviewed)**

1. Leo Irudayam and Frank Breitinger. *Teaching Blockchain in K9-12: Instruction materials and their assessment*. Nov. 8, 2022. arXiv: 2211.05933 [cs.CY].

2. Johannes Schneider and Frank Breitinger. *AI Forensics: Did the Artificial Intelligence System Do It? Why?* May 27, 2020. arXiv: 2005.13635 [cs.AI].

**Workshops, Presentations, and Invited Talks**   *This section only includes items that have not been listed under journals or conferences (i.e., a conference presentation that also resulted in a journal publication is not listed).

1. Pavel Laskov and Frank Breitinger. *Blockchain-Technologien und deren Anwendungen im öffentlichen Sektor*. Workshop Liechtensteinische Landesverwaltung. Vaduz, Liechtenstein. Feb. 2020.

2. Frank Breitinger. *IT-Sicherheit im Finanzsektor*. 7. Sorgfaltspflichttag Liechtenstein. Schaan, Liechtenstein. Oct. 2019.

3. Trevor Haigh and Frank Breitinger. *Android Forensics and Reverse Engineering*. Workshop at the Digital Forensics Research Conference (DFRWS USA). Providence, Rhode Island. July 2018.

4. Frank Breitinger. *State-of-the-art in Cyber Forensics: Now & Tomorrow*. Presentation at KAIST. Daejeon, South Korea. Aug. 2017.

5. Frank Breitinger and Ibrahim Baggili. *Five Presentations including IoT, Drones, Similarity matching, mobile applications and PLCs*. National Training on Crime Scene Management in cases of terrorism related offences organized by **United Nations Office on Drugs and Crime (UNODC)**. Amman, Jordan. Jan. 2017.

6. Frank Breitinger. *Reducing data for forensic investigations using approximate matching*. Presentation at University New Haven. Feb. 2014.

7. Barbara Guttman, Frank Breitinger, Simson Garfinkel, Jesse Kornblum, and Clay Shields. *Approximate Matching of Digital Artifacts*. Panel discussion at 13th Digital Forensics Research Conference (DFRWS13). Monterey, California. Aug. 2013.

8. Frank Breitinger. *Similarity Preserving Hashing*. Presentation at 8. GI SIG SIDAR Graduate Workshop on Reactive Security (SPRING). Feb. 2013.

9. Frank Breitinger. *Similarity Preserving Hashing*. Presentation at CAST Workshop - Forensik und Internetkriminalitaet. Darmstadt, Germany. Dec. 2012.

10. Frank Breitinger and Harald Baier. *Security Aspects of Piecewise Hashing in Computer Forensics*. Abstract and Presentation at 6. GI SIG SIDAR Graduate Workshop on Reactive Security (SPRING). Mar. 2011.

## UNIVERSITY SERVICE

### University of Lausanne
· 10/2022 - today: Academic representative in the 'Technological and Digital Transformations' hub of the CIVIS alliance

### University of New Haven
· 09/2018 - 05/2019: Advisor for the Engineering Living Learning Community (LLC)
· 08/2017 - 05/2019: Member of the Academic Committee on Student Life
· 05/2016 - 05/2019: Member of the University of New Haven Faculty Senate

## PROFESSIONAL / PUBLIC SERVICE

### Advisory Committee Members
· 11/2017 - 07/2018: Member of the Advisory Committee for Project Lead the Way (PLTW) Cybersecurity

### Board Member
· since 2016: Forensic Science International: Digital Investigation (Formerly Digital Investigation)
· 2014 - 2019: Journal of Digital Forensics, Security and Law (JDFSL)

### Chair activities
· 2023: *Technical Program Chair*, Digital Forensics Research Conference (DFRWS USA), Baltimore, USA
· 2023: *General Co-Chair*, Digital Forensics Research Conference (DFRWS EU), Bonn, Germany
· 2022: *Technical Program Co-Chair*, Digital Forensics Research Conference (DFRWS USA), Virtual event
· 2022: *Keynote Chair*, Digital Forensics Research Conference (DFRWS EU), Oxford, UK
· 2021: *Technical Program Chair*, Digital Forensics Research Conference (DFRWS EU), Virtual event
· 2020: *Workshop Co-Chair*, Digital Forensics Research Conference (DFRWS EU), Virtual event
· 2018: *Technical Program Chair*, 10th International Conference on Digital Forensics & Cyber Crime (ICDF2C), New Orleans, US
· 2016: *General Co-Chair*, 8th International Conference on Digital Forensics & Cyber Crime (ICDF2C), Manhattan, US
· 2015: *Technical Program Chair*, 7th International Conference on Digital Forensics & Cyber Crime (ICDF2C), Seoul, South Korea
· 2014: *Technical Program Chair*, 6th International Conference on Digital Forensics & Cyber Crime (ICDF2C), New Haven (CT), US

### Program Committee Member
· 2023, 2022, 2021, 2020, 2019, 2018, 2017, 2016, 2015: Digital Forensics Research Conference Europe (DFRWS EU)
· 2023, 2022, 2021, 2020, 2019, 2018, 2017, 2016, 2015: Workshop on Digital Forensics (WSDF; workshop at the International Conference on Availability, Reliability and Security (ARES)
· 2023, 2022, 2020, 2019, 2018, 2017, 2016, 2015: Digital Forensics Research Conference (DFRWS USA)
· 2023: European Conference on Information Systems (ECIS) (Associate Editor for the General IS Track)
· 2020, 2019, 2018, 2017, 2016, 2015, 2014: International Conference on Digital Forensics (IFIP WG 11.9)
· 2017, 2016, 2015: Conference on Digital Forensics, Security and Law (ADFSL)
· 2018, 2017, 2016, 2015, 2014: International Conference on Digital Forensics & Cyber Crime (ICDF2C)
· 2016, 2014: Systematic Approaches to Digital Forensic Engineering (SADFE)

### Selected additional review activities
· 2022, 2021, 2020, 2019, 2018: Computers & Security
· 2022: Applied Computing and Informatics
· 2021, 2018: Journal of Forensic Sciences
· 2021, 2016: ACM Computing Surveys
· 2019: IEEE Access - The Multidisciplinary Open Access Journal
· 2018: IEEE Transactions on Dependable and Secure Computing
· 2017: IEEE Security & Privacy (magazine)
· 2017: IEEE Transactions on Information Forensics and Security

- 2017: Indian Journal of Science and Technology
- 2017: Journal of Information Security and Applications
- 2017: Information Systems
- 2015: Journal of Information Technology

## TEACHING EXPERIENCES

### University of Lausanne
- Cas pratiques transversaux (graduate)
- Criminalistique numérique pratique (undergraduate)
- Network and System Forensics (graduate) (will be taught in Spring 2023)
- Informatique et réseaux (undergraduate) (will be taught in Spring 2023)

### University of Liechtenstein
- Information Systems Development (graduate)
- System Analysis and Design (undergraduate)
- Data and Application Security (lab, graduate)

### University of New Haven
- Introduction to Network Security (graduate & undergraduate)
- Introduction to Scripting / Python (graduate & undergraduate)
- Reverse Engineering (Android / ARM) (graduate & undergraduate)
- Ethical Hacking (graduate & undergraduate).
- Topics in Cyber Security and Forensics (graduate & undergraduate)
- Introduction to Computer Security (graduate & undergraduate)
- Software Project Analysis and Design (graduate & undergraduate)
- Object oriented Design and Analysis (graduate & undergraduate)
- Senior Software Project (undergraduate)
- Life on Earth - CyberWorld (undergraduate (freshman))

### External, adjunct, and visiting teaching experiences
- Cyber Investigation Fundamentals (graduate) at the Berner Fachhochschule
- Network and system security (undergraduate) at the Albstadt-Sigmaringen University

### University of Applied Sciences Darmstadt (as PhD student)
- Selected Topics of IT-Security (graduate)
- IT-security seminar on Internet Security and Similarity Hashing (graduate)
- Theory-Seminar about Aspects of Fuzzy Hashing* (graduate) - Teaching assistant
- Cryptography (graduate) - Teaching assistant
- Computer Forensics (graduate) - Teaching assistant

### Additional
- Contributed to a 'letter of study' for an online lecture in *digital forensic*. 5 ECTS lecture for Master students including a practical (German).

## STUDENTS ADVISING / HOSTED

Note, this section does not list any internships, senior design projects, independent studies, or projects.

### PhD thesis (on going)
- 2027: Céline Vanini - Event reconstruction (working title)
- 2026: Gaëtan Michelet - Automation for Digital Forensics (working title)
- 2023: Thomas Göbel (extern, 2nd advisor) - Data for digital forensics (working title)
- 2023: Jenny Ottmann (extern, 2nd advisor) - Bringing Science to mobile forensics (working title)
- 2022: Miguel Martín Pérez (Committee member) - Effectiveness of Similarity Digest Algorithms for Binary Code Similarity in Memory Forensic Analysis

### Master thesis
- 2023: Charlotte Merceron - Electronic Signatures in PDF Documents: An analysis of embedded artefacts in PDFs generated by scanners and selected software

- 2022: Léo Giannardi - Windows Server forensics and incident response for the ProxyShell Exploit
- 2021: Leo Irudayam - Integrating Blockchain Technology into an upper secondary school curriculum
- 2021: Karoline Leo - Bringing Cybersecurity into High School Curricula: Gender-based Differences in the Perception and Understanding of Cybersecurity
- 2021: Stephen Niemann - Challenges and Opportunities for Consumer Cybersecurity Insurances
- 2020: Jan Huck - Ransomware countermeasures in Switzerland and Liechtenstein: A comparative analysis of companies' implemented ransomware strategies
- 2017: Vikram Harichandran - Cyber forensics needs analysis and solutions entailing artifact formalization and approximate matching
- 2016: Lorenz Liebler - Approximate matching for malware detection in memory
- 2015: Tobias Huppertz - Indexing similarity hashes using Bloom filters
- 2013: Vikas Gupta - File fragment detection on network traffic using similarity hashing
- 2013: Simon Thurner - Methods for identification of encryption data and its application in digital forensics
- 2012: Tim Völpel - Forensic-Chatlog-Parser
- 2012: Knut Petter Åstebøl - mvHash - a new approach for fuzzy hashing
- 2012: Jesse Beckingham - Security analysis of sdhash

### Bachelor thesis
- 2022: Sofya Yokoyama - Anonymization of data within Digital Forensics
- 2022: Alexia Schmid - Cryptocurrencies usage in illegal financial activities and money laundering : emerging tendencies, impact and countermeasure
- 2022: Gaëlle Barth - Les méthodes de Géolocalisation d'un Appareil de Téléphonie mobile
- 2020: Florin Schädler - Einfluss von App-Berechtigungen auf nutzergenerierte App-Ratings und -Rezensionen
- 2012: Dario Cundari - Software tools for testing similarity preserving algorithms
- 2012: Georg Ziroff - Approaches for similarity-preserving hashing

### Hosted guests
- 2019: Vitor Moia; University of Campinas, São Paulo, Brazil; research on PhD thesis (3 months)
- 2018: Patrick Schmitt; Technical University Darmstadt; research on master thesis (1 month)
- 2017: Dr. David Lillis; University College Dublin; research on a Fulbright scholarship (1 month)
- 2016: Lorenz Liebler; University of Applied Science Darmstadt; research on master thesis (1.5 month)

### Hacking Team
- 2015-2018: Supervising hack@UNHcFREG (3 times finalist for Collegiate Penetration Testing Competition (CPTC) Nationals; 2nd place at CyberSeed 2017 (price money $7'500); tied for 1st in TAMUCTF 2017)

## MEDIA CONTRIBUTIONS

Note, this is not a complete list but some selected contributions.

### Television
- FOX61: Staying save during Christmas shopping (Live on Good morning Connecticut) (Dec. 8, 2017).
- WTNH - News8: Keeping your kids safe on social media (Aug. 8, 2017).
- WTNH - News8: Social Media Security: Beware the urge to "over-share" (Feb. 6, 2017).
- WTNH - News8: Study: Banks have weak password handling (Mar. 1, 2016).
- FOX-CT: FBI director: Apple encryption dispute "hardest question" seen in government (Feb. 25, 2016).
- CBS Chicago: Is Your Smartwatch Safe From Hackers? (Feb. 9, 2016).
- WTNH - News8: Facebook threat sends schools named 'Lincoln' on high alert, including Meriden (Jan. 26, 2016).
- WTNH - News8: Things you should NOT buy online (Dec. 16, 2015).
- WTNH - News8: How to protect your identity from being stolen this holiday season (Dec. 2, 2015).
- WTNH - News8: Experts reveal how ISIS is using the dark web to stay undetected (Nov. 19, 2015).
- Local10: Researchers on smartwatch concerns (Dec. 16, 2015).
- Local10: Watch what you wear: Smartwatches vulnerable to attack (Aug. 3, 205).
- FOX-CT: Thinking like 'bad guys' to protect the interwebs (Jun. 30, 2015).

### Internet / Magazines
- Digital Gurdian: Insider vs. Outsider Data Security Threats: What's the Greater Risk? (Apr. 6, 2018).
- PR Newswire and picked up by several others: University of New Haven Hacking Team Competes Nationally After Winning Regional, Connecticut Competitions (Oct. 31, 2017).

- Hartford Courant: From Manchester Office, Digital Police Detectives Track Down Child-Porn Viewers (continued: Massachusetts Man Faces Glastonbury Voyeurism Charges (Oct. 13, 2016)).
- Bulletin of the Academy of Science and Engineering: Cybersecurity: Implications and Prevention What Can We Learn from the NIST Framework? (Sept. 1, 2016).
- Digital Guardian: Insider vs. Outsider Data Security Threats: What's the Greater Risk? (Jul. 26, 2016).
- Company Dime: Sabre's Silence On Security 'Incident' Isn't Unusual, But It's Still Making Travel Managers Nervous (Sept. 3, 2015).
- CNET: Samsung, LG smartwatches give up personal data to researchers (Jun. 10, 2015).

## REFERENCES

References available upon request.

## MORE INFORMATION

More information and auxiliary documents can be found at
- `https://www.FBreitinger.de`
- `https://www.linkedin.com/pub/frank-breitinger/87/65/496`