CURRICULUM VITAE

TOMÁŠ FILLER

CONTACT INFORMATION

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RESEARCH INTERESTS

Information assurance – steganography, steganalysis in digital images, information theory, watermarking, coding theory.

EDUCATION

April 2011 **Ph.D.** in **Electrical and Computer Engineering**

Dep. of Electrical and Computer Engineering, State University of New York at Binghamton
Specialization in Information Assurance.

Thesis: Imperfect Stegosystems - Asymptotic Laws and Near-optimal Practical Constructions
Advisor: Prof. Jessica Fridrich

May 2007 **Dipl.-Ing.** (equivalent to **M.Sc.**) in **Computer Science**

School of Nuclear Science and Physical Engineering, Czech Technical University

Honors: Award by Czech Technical University for Academic Excellence
Best Master Thesis in Computer Science (Czech Republic)

Thesis: Minimizing Embedding Impact in Steganography using Low Density Codes
Advisor: Prof. Jessica Fridrich

AWARDS, and SCHOLARSHIPS

April 2011	Outstanding PhD Researcher 2010 – 2011, Binghamton University
January 2011	Best Paper Award (1st price) for paper “Minimizing Embedding Impact in Steganography using Trellis-Coded Quantization” coauthored with J. Fridrich and J. Judas. Award given by Digital Watermarking Alliance.
March 2010	Graduate Student Award for Excellence in Research, Binghamton University.
January 2010	Best Paper Award (1st price) for paper “The Square Root Law of Steganographic Capacity for Markov Covers” coauthored with J. Fridrich and A. D. Ker. Award given by Digital Watermarking Alliance.
April 2009	Outstanding PhD Researcher 2008 – 2009, Binghamton University
Sept 2007	Winner of the Best Master Thesis in Computer Science in Czech Republic Awarded of $5000 given by private IT company Profinit (www.profinit.eu).
May 2007	Award for Academic Excellence by Czech Technical University
2005 – 2006	Merit scholarship for academic excellence from Czech Technical University
2002 – 2004	Merit scholarship for academic excellence from Czech Technical University

EXPERIENCE

Research experience

2011 - present **Research Engineer** at Digimarc

2007 - 2011 **Research Assistant** at SUNY Binghamton
Interest in steganography and digital forensics.

Steganography

Designed and implemented a framework for constructing new steganographic schemes by minimizing arbitrary distortion function. Described connection between data embedding in steganography and statistical physics which lead to new algorithms for data hiding. Practical part of the framework is based on new syndrome codes called Syndrome-Trellis Codes which present very flexible and close-to-capacity solution for data hiding. All current embedding methods and many new ones can benefit from this framework. Published in 2 journal and 3 conference papers.

Pioneered the concept of capacity of imperfect stegosystems. Used Markov Chains to model cover objects and show that the secure capacity scales as the square root of the number of cover elements (secure capacity is not linear) if the embedding is probabilistic mapping applied independently. Gave the first formal proof (spanning 30 pages) of this phenomenon which was called the Square Root Law. This analysis resulted in several other papers and reports including the description of all perfectly secure cover distributions based on ergodic classes of the embedding operation. This work has been awarded by the Best Paper Award given by Digital Watermarking Alliance.

Proposed to measure secure capacity based on Fisher information rather than based on KL divergence. Coined a new term for this – the “root-rate”. This presents the correct way of measuring secure capacity, i. e. with respect to square root of the number of elements. Based on the Markov model of images, I showed that ±1 embedding is asymptotically the best method for spatial domain steganography.

Digital Forensics

Created a methodology for classifying the camera model based on its fingerprint estimate. Machine learning approach based on SVM and proposed feature set was used to distinguish camera models without knowing the EXIF header. Obtained 1TB image database from Flickr.com by using Python scripts and MySQL database. Processing were done on Linux cluster by using Matlab and Python scripts. Further improved this database for large scale testing of camera identification.

June – September 2010 **Research Internship** at Digimarc Corp.

I worked on various topics in digital watermarking for print-and-scan (PS) environment. My main focus was on comparing side-informed techniques such as QIM, Dirty Paper codes and new modifications of Rational Dither Modulation with classical spread-spectrum approach for digital watermarking in PS environment. I was also involved in research and development of watermarking methods for mobile applications.

2006 - 2007 **Visiting Research Scholar** at SUNY Binghamton

Proposed to use Low Density Generator Matrix codes for minimizing embedding impact in steganography. Such codes leaded to near-optimal practical embedding schemes with Survey Propagation based binary quantizer.

Developed new algorithm for LDGM based binary quantization based on pure Belief Propagation. This algorithm was shown to have the same performance but much faster implementation than the approach based on Survey Propagation. These codes are used to

obtain practical schemes for minimizing embedding impact in steganography able to achieve the best embedding efficiency to date (April 2009).

Teaching assistant (Czech Technical University)

Sep 2005 – Dec 2005	Calculus B2
Sep 2005 – Dec 2005	Introduction to programming, Prof. Miroslav Virius
Jan 2005 – Jun 2005	Algorithm design, Prof. Miroslav Virius

Software Developer

Jun 2000 – Dec 2005 Software developer and analyst, Baud, Prague, Czech Republic (www.baud.cz)

Developed and designed several custom business solutions for major Czech banks and organizations. Main goal was to integrate company data flows by using MS Exchange and MS SQL servers along with MS Office. Lead small teams of programmers or worked independently for the customer. Worked as Visual Basic consultant for OMV (www.omv.cz).

Sep 2005 – Jun 2006 team leader - Software project at Czech Technical University

Lead team of 4 students to developed application for study of airplane models when exposed to wind. Application is used as a teaching aid by university students to study the airplane design. Whole project written in C++ consisted of numerical simulations (Lapack), user interface (Fox Toolkit) and results presentation (OpenGL).

SPECIAL TECHNICAL SKILLS

Programming languages

C++	(6 years experience) Experience with application development under Windows (MFC) or Linux (Fox toolkit, GTK), numerical libraries (Lapack, Intel's MKL and IPP) and optimization using SSE.
.NET (C#)	(4 years experience) Developed several web sites (ASP.NET 2.0) and client applications. Presented a talk on disassembling .NET applications with .Net Reflector at Czech Technical University.
Python	(3 years experience) Used as scripting language for Linux cluster, numerical computing (SciPy) and image retrieval. Used for obtaining 1TB image database of images from Flickr.com for research purposes.
Assembler	(4 years experience) Used at high school for 2 years and used to develop simple operating system for educational purposes for I386 architecture. Later used with C++ to optimize numerical algorithms needed for my research.
Matlab	(5 years experience) Used for running scientific simulations. Combined with C++ code (MEX files) for more intensive algorithms. Used as programming language for all university courses.
Latex	(6 years experience) Consultant for book "Steganography in Digital Media: Principles, Algorithms, and Applications" to be published by Cambridge University Press. Used for typesetting all research papers, presentations (Beamer) and figures (PGF).

Operating systems

Linux	(advanced level) I am using several variants of Linux OS for my research.
Windows	(advanced level) I have been developing windows application for 5 years.

Languages: Czech (native), English (fluent, GRE), German (passive).

PUBLICATIONS

Journal and fully refereed papers

1. P. Bas, T. Filler and T. Pevny, "Break Our Steganographic System" - the ins and outs of organizing BOSS, 13th Information Hiding, Prague, Czech Republic, May 18-20, 2011.
2. T. Filler, J. Judas and J. Fridrich, "Minimizing Additive Distortion in Steganography using Syndrome-Trellis Codes", IEEE Transactions on Information Forensics and Security, 2011.
3. T. Pevny, T. Filler and P. Bas, "Using High-Dimensional Image Models to Perform Highly Undetectable Steganography", 12th Information Hiding, Calgary, Alberta, Canada, June 28-30, 2010.
4. T. Filler and J. Fridrich, "Gibbs Construction in Steganography", IEEE Transactions on Information Forensics and Security, 2010.
5. T. Filler and J. Fridrich, "Fisher Information Determines Capacity of ε-secure Steganography," 11th Information Hiding Workshop, Darmstadt, Germany, June 7–10, LNCS, Springer-Verlag, 2009.

Conference papers

6. T. Filler, and J. Fridrich, "Design of Adaptive Steganographic Schemes for Digital Images", SPIE, Electronic Imaging, Media Forensics and Security XIII, San Jose, CA, January, 2011.
7. T. Filler and J. Fridrich, "Minimizing Additive Distortion Functions With Non-Binary Embedding Operation in Steganography", 2nd IEEE Workshop on Information Forensics and Security, December 2010.
8. T. Filler and J. Fridrich, "Steganography Using Gibbs Random Fields", 12th ACM Workshop on Multimedia and Security, Rome, Italy. September 9-10 2010.
9. T. Filler, J. Judas and J. Fridrich, "Minimizing Embedding Impact in Steganography using Trellis-Coded Quantization", SPIE, Electronic Imaging, Media Forensics and Security XII, San Jose, CA, January 17–21, 2010.
10. M. Goljan, J. Fridrich and T. Filler, "Managing a Large Database of Camera Fingerprints", accepted SPIE, Electronic Imaging, Media Forensics and Security XII, San Jose, CA, January 17–21, 2010.
11. T. Filler and J. Fridrich, "Wet ZZW Construction for Steganography", First IEEE International Workshop on Information Forensics and Security, December 6-9, 2009, London, UK.
12. T. Filler and J. Fridrich, "The Square Root Law of Steganographic Capacity", IEEE Summer School of Information Theory, Evanston, IL, August 10-13, 2009.
13. T. Filler and J. Fridrich, "Complete Characterization of Perfectly Secure Stego-systems with Mutually Independent Embedding Operation", accepted to IEEE International Conference on Acoustics, Speech, and Signal Processing, Taipei, Taiwan, April 19-24, 2009.
14. M. Goljan, T. Filler, and J. Fridrich, "Camera Identification – Large Scale Test," Proc. SPIE, Electronic Imaging, Security and Forensics of Multimedia Contents XI, San Jose, CA, January 18–22, pp. 0I 1–0I 12, 2009.
15. T. Filler, J. Fridrich, and A. D. Ker, "The Square Root Law of Steganographic Capacity for Markov Covers," Proc. SPIE, Electronic Imaging, Security and Forensics of Multimedia Contents XI, San Jose, CA, January 18–22, pp. 08 1–08 11, 2009.
16. T. Filler and J. Fridrich, "Using Sensor Pattern Noise for Camera Model Identification," Proc. ICIP' 08, San Diego, California, October 12–15, 2008.
17. T. Filler and J. Fridrich, "Binary Quantization using Belief Propagation with Decimation over Factor Graphs of LDGM Codes," Proc. 45th Allerton Conference on Coding, Communication, and Control, September 26–28, 2007.
18. J. Fridrich and T. Filler, "Practical methods for Minimizing Embedding Impact in Steganography", Proc. SPIE, Electronic Imaging, Security, Steganography, and Watermarking of Multimedia Contents IX, vol. 6505, San Jose, CA, January 28–February 2, pp. 02–03, 2007.

Thesis

- T. Filler, "Imperfect Stegosystems: Asymtotic Laws and Optimal Near-Optimal Constructions", Dissertation, SUNY Binghamton, April 2011.

- T. Filler, “Minimizing Embedding Impact in Steganography using Low Density Codes”, Master Thesis, Czech Technical University in Prague, June 2007.

Further information about my list of publications is available at http://dde.binghamton.edu/filler/publications.php.

PROFESSIONAL ACTIVITIES AND MEMBERSHIPS

Program chair and co-organizor of 13th Information Hiding in Prague 2011 (www.ihconference.org).

Reviewer for

- IEEE Transactions on Information Forensic and Security
- IEEE Transactions on Image Processing
- IEEE Transactions on Circuits and Systems for Video Technology
- IEEE Journal on Selected Areas in Communications
- IEEE Signal Processing Letters
- IEEE Communications Letters
- Journal of Electronic Imaging
- ETRI Journal (http://etrij.etri.re.kr)
- IET Information Security Journal

I am a member of IEEE.

Organizer of the public steganographic contest “BOSS – Break Our Stegosystem” (www.agents.cz/boss).

TEACHING EXPERIENCE

I developed and taught a graduate-level course ECE 580B “Modern Coding Theory”.

I supervised one master student in the field of coding theory and steganography.

During my master studies I lead several labs (similar to teaching assistant) for groups of first and second year students in programming, algorithm design and calculus.

REFERENCES

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