William Frederick **Koch III**

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Summary

Expert in machine learning with applications in flight control and forecasting performance. Creator of the world's first neural network supported flight control firmware. Experienced software engineer with over six years in the aerospace industry developing software to monitor and support aircraft health. Skilled multicopter pilot, designer and builder. Accomplished cyber security researcher with a focus in network security and moving target defense.

Education

Boston University
Boston, MA

PHD IN COMPUTER SCIENCE
Sept. 2014 - Sept. 2019

Thesis: Flight Controller Synthesis via Deep Reinforcement Learning
- Focused research and studies in the development of next generation intelligent flight control systems.
- Obtained strong background in cyber security including static and dynamic software analysis, network and web security, defenses and attacks, and moving target defense (MTD).
- Competed on BU's capture the flag (CTF) and hacking team, 0xBU.

Stevens Institute of Technology
Hoboken, NJ

M.S. IN COMPUTER ENGINEERING
Jan. 2012 - Dec. 2013

Thesis: A Framework for Assisting Learners by Incorporating Knowledge to Aid in Predicting Nerve Guidance Conduit Performance
- Studied machine learning with a focus in bioinformatics and training neural network models with limited data.
- Conducted research in forecasting nerve guidance conduit performance, protein structure prediction and intracellular virus trafficking.

University of Rhode Island
Kingston, RI

B.S. IN COMPUTER ENGINEERING, MINOR IN MATHEMATICS
Sept. 2003 - May 2008

- Pursued studies in artificial intelligence and robotics.
- Built a number of projects including a 16-bit CPU on an FPGA, modified Quake Engine to extend artificial intelligence capabilities of agents, Zigbee controlled hovercraft, and health monitoring system for a Honda Civic.

Research Experience

Boston University
Boston, MA

RESEARCH ASSISTANT
Sept. 2014 - Sept. 2019

- Developed novel training environment, GymFC, for synthesizing neural network based flight controllers, in simulation, for any aircraft.
- Created world's first neural network supported flight control firmware, Neuroflight, capable of high performance flight in the real world.
- Established methodologies for creating high fidelity aircraft models, a *digital twin*, for simulation training. Validated aircraft models via SITL.
- Researched trajectory generation methods, using genetic algorithms, for the PX4 fight control firmware communicating over MAVLink.
- Developed Real-time Automation to Discover, Detect and Alert of Ransomware (RADDAR) system to automatically obtain ransomware samples for testing our novel ransomware defense, PayBreak.
- Discovered new class of vulnerabilities we termed Server-based InFormation OvershariNg (SIPHON) in which the server overshares sensitive user data. Developed, HUSH, a semi-automatic system for discovering Android applications with SIPHON vulnerabilities.
- Applied moving target defense techniques to create invisible servers, reducing attack surface of web applications. Deployed system to EC2 instances within AWS.

MIT Lincoln Laboratory
Lexington, MA

CYBER SECURITY RESEARCH INTERN
Jan. 2016 - June 2016

- Conducted static and dynamic analysis of ARP, DHCP and DNS software to discover identifier binding exploits.
- Developed novel software defined network (SDN) attack called Persona Hijacking, to fool the network in believing the attack is a legitimate user.

Stevens Institute of Technology
Hoboken, NJ

RESEARCH ASSISTANT
Jan. 2012 - Dec. 2013

- Machine learning expert on multi-disciplinary team to advance nerve guidance conduit performance.
- Developed novel machine learning algorithms to predict nerve guidance conduit performance using expert knowledge and bootstrap aggregating predictors.

Teaching Experience

Boston University
Boston, MA

Teaching Fellow
Fall 2017, Spring 2019

- Designed lesson plans, taught discussion sections, and developed assignments for the class Fundamentals of Computing Systems which contained over 100 students.
- Integrated my own research into assignments such as SITL modelling of MAVLink communication channels for an aircraft running PX4 and analyzing the resource utilization of the Betaflight firmware.

Internal Drive Tech Camps
Princeton, NJ

Programming Instructor
June 2012 - Aug. 2012

- Created lesson plans for wide range of skill levels including object oriented fundamentals, polymorphism, exception handling and third-party library integration.
- Emphasized lessons on coding style and best practices not taught and enforced in academia.

Work Experience

Boston Drone Racing
Boston, MA

Founder
Jan. 2017 - Present

- Responded to growing demand for a drone racing community in Boston by establishing a first-person-view (FPV) drone racing and hacking club which hosts weekly races and monthly hack nights.
- Mentor and advisor for building custom multicopters, from fabrication to software tuning.

Capsules, LLC
Madison, CT

Co-Founder/CEO
June 2013 - Aug. 2014

- Led team to create a geo-location based augmented reality mobile app.
- Lead Android developer responsible for overall architecture, design and implementation.

Sikorsky Aircraft (subcontracted through AIS Consulting and Sila SG)
Shelton, CT

Software Engineer
Jun. 2006 - Jan. 2012

- Lead developer for applications supporting the Sikorsky CH-53K Integrated Support System (ISS) for fleet management and IVHM.
- Responsible for integration between the Sikorsky CH-53K Integrated Support System (ISS) and Goodrich ground support software (GSS).
- Designed and implemented continuous integration environment.

CT Hackerspace
Watertown, CT

Co-founder/Chairman
Aug. 2010 - Aug. 2011

- Established Connecticut's first and oldest hackerspace. Contributed to the development of bylaws, identity, physical and web presence.
- Ran monthly board meetings to facilitate in the growth and direction of the hackerspace.

Select Publications

2019 **Neuroflight: Next Generation Flight Control Firmware**, **William Koch**, Renato Mancuso, and Azer Bestavros, *arXiv.org*

2019 **Reinforcement Learning for UAV Attitude Control**, **William Koch**, Renato Mancuso, Richard West, and Azer Bestavros, *ACM Transactions on Cyber-Physical Systems*

2018 **S3B: Software-Defined Secure Server Bindings**, **William Koch**, and Azer Bestavros, *IEEE International Conference on Distributed Computing Systems (ICDCS)*

2017 **Semi-automated discovery of server-based information oversharing vulnerabilities in Android applications**, **William Koch**, Abdelberi Chaabane, Manuel Egele, William Robertson, and Engin Kirda, *ACM SIGSOFT International Symposium on Software Testing and Analysis*

2017 **PayBreak: defense against cryptographic ransomware.**, Eugene Kolodenker, **William Koch**, Gianluca Stringhini, and Manuel Egele, *ACM on Asia Conference on Computer and Communications Security*

2017 **Identifier Binding Attacks and Defenses in Software-Defined Networks**, Samuel Jero, **William Koch**, Richard Skowyra, Hamed Okhravi, Cristina Nita-Rotaru, and David Bigelow, *USENIX Security Symposium*

2016 **Markov modeling of moving target defense games**, Hoda Maleki, Saeed Valizadeh, **William Koch**, Azer Bestavros, and Marten van Dijk, *In Proceedings of the 2016 ACM Workshop on Moving Target Defense*

2016 **Provide: Hiding from automated network scans with proofs of identity**, **William Koch**, and Azer Bestavros, *IEEE Workshop on Hot Topics in Web Systems and Technologies (HotWeb)*

Select Projects

Neuroflight

https://github.com/wil3/neuroflight

Neuroflight is the first world's first neural network supported flight controller software (firmware) for remotely piloting multicopter and fixed wing aircraft. Neuroflight's focus is in providing optimal flight control.

GymFC

https://github.com/wil3/gymfc

GymFC is a universal flight controller tuning framework for synthesizing neural network based flight controllers using reinforcement learning, as well as providing a SITL environment to tune traditional control methods, for any aircraft.

Skills

Web Development	HTML, CSS, JavaScript, MongoDB, MySQL
Security Tools	Cuckoo Sandbox, Wireshark, iptables, scapy, scrapy, snort
Languages	Python, Java, C/C++, Go
Aircraft Control Development	MultiWii Serial Protocol (MSP), MAVLink, Betaflight, PX4, SITL/HITL testing, sensor and motor modelling

Interests

Drone Racing | 3D Modeling and Printing | Backpacking | Camping | Cooking | Snowboarding | Surfing | Music