

Zhenfei Zhang

Cryptography Engineer

Algorand

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Education

2010-2014

PhD, Computer Science, *University of Wollongong, Australia*;

Thesis title: Revisiting Fully Homomorphic Encryption Schemes and Their Cryptographic Primitives

Experience

Cryptography Engineer, *Algorand*, 2018-now

Identify, develop and standardize cryptographic tools to be used by Algorand blockchain protocol.

- Design: Identify suitable cryptography for Algorand blockchain from scratch;
- Coding: Product level **Rust** code for **Pixel aggregatable signature**;
- Standardization: **Internet draft** for BLS signature scheme, IETF/CFRG workgroup.

Director of Cryptography Research, *OnBoard Security* (Acquired by Qualcomm), 2016-2018

NTRU and post-quantum cryptography research and standardization.

Research Scientist, *Security Innovation*, 2014-2016

IARPA project on Fully Homomorphic Encryptions.

Highlights

Standards

Contribute to 4 out of 26 **2nd round candidates** of **NIST post-quantum standardization process: Falcon, LAC, NTRU and Round5**;

Internet draft: **BLS-signature**, Quantum safe hybrid for **TLS 1.2** and **TLS 1.3**;

Former member of ETSI **Quantum-safe Cryptography (QSC)** working group;

Former member of **ISO/SC27** working group.

Publication and patents

3 U.S. patents;

25+ peer reviewed paper at Asiacrypt 2019, Crypto 2019, Asiacrypt 2018, PKC 2018, IEEE Transaction on Computers, etc.;

See next pages for full list.

Programming Languages

Rust: Cryptographic library at product level; to be open sourced soon.

C: Cryptographic library, nearly product level code, submitted to NIST PQC competition.

Python/Sage: Prove of concept codes.

Software

Pixel	A pairing based, forward-secure and aggregatable signature, written in python (PoC) and rust (product level). Improves existing (non-aggregatable) solution by 100x, to be open sourced and deployed soon.
Raptor	A lattice based (linkable) ring signature, written in C as a PoC, aiming to protect user's anonymity against quantum adversaries. Source code .
NTRUEncrypt	A C implementation of NTRUEncrypt, submitted to NIST PQC standardization process. Source code .
Ring multiplication	A C library for fast ring multiplication using AVX-2; improving prior codes by a factor of 2.23. Source code
libgcrypt-ntru	Enabling NTRUEncrypt for libgcrypt. Source code .

Research Interest

- Fully homomorphic encryptions, with use cases such as smart contracts, machine learning;
- Lattice based signatures, with additional features such as aggregation, anonymity;
- Efficient zero knowledge proofs secure against quantum computers.

See next pages for the full list of patents, standards and publications.

Patents

- **Chameleon Hash technique and linkable ring signature technique**
 - *Zhenfei Zhang*
 - Provisional patent, 2018.
- **Digital signature technique**
 - *Jeffrey Hoffstein, Jill Pipher, William J Whyte, Zhenfei Zhang*
 - United States Patent Application, 2018.
- **Digital signature method and apparatus**
 - *Jeffrey Hoffstein, Jill Pipher, Joseph H Silverman, William J Whyte, Zhenfei Zhang*
 - United States Patent 15530762, 2017.

Standards

- **BLS Signature Scheme**
 - *D. Boneh, S. Gorbunov, R. Wahby, H. Wee, Z. Zhang*
 - Internet-Draft.
- **Quantum-Safe Hybrid (QSH) Ciphersuite for Transport Layer Security (TLS) version 1.2**
 - *J. M. Schanck, W. Whyte and Z. Zhang*
 - Internet-Draft.
- **Criteria for selection of public-key cryptographic algorithms for quantum-safe hybrid cryptography**
 - *J. M. Schanck, W. Whyte and Z. Zhang*
 - Internet-Draft.
- **Quantum-Safe Hybrid (QSH) Ciphersuite for Transport Layer Security (TLS) version 1.3**
 - *W. Whyte, Z. Zhang, S. Fluhrer and O. Garcia-Morchon*
 - Internet-Draft.
- **Efficient Embedded Security Standards (EESS) #1: Implementation Aspects of NTRUEncrypt**
 - *W. Whyte and Z. Zhang*
 - Consortium for Efficient Embedded Security
- **Quantum Safe Cryptography and Security; An introduction, benefits, enablers and challenges**
 - One of 22 contributors
 - European Telecommunications Standards Institute(ETSI) white paper

Publications

2019

- **Middle-Product Learning with Rounding Problem and its Applications**
 - Shi Bai, Katharina Boudgoust, Dipayan Das, Adeline Roux-Langlois, Weiqiang Wen, Zhenfei Zhang
 - Asiacrypt 2019.
- **Efficient Lattice-Based Zero-Knowledge Arguments with Standard Soundness: Construction and Applications**
 - Rupeng Yang, Man Ho Au, Zhenfei Zhang, Qiuliang Xu, Zuoxia Yu, William Whyte
 - Crypto 2019. [IACR eprint](#).
- **(Linkable) Ring Signature from Hash-Then-One-Way Signature**
 - Xingye Lu, Man Ho Au, Zhenfei Zhang
 - TrustCom 2019. [IACR eprint](#).
- **Ring Signatures based on Middle-Product Learning with Errors Problems**
 - Dipayan Das, Man Ho Au and Zhenfei Zhang
 - Africacrypt 2019.
- **Raptor: A Practical Lattice-Based (Linkable) Ring Signature**
 - Xingye Lu, Man Ho Au, Zhenfei Zhang
 - ACNS 2019. [IACR eprint](#). [Source code](#).
- **Round5: Compact and Fast Post-Quantum Public-Key Encryption**
 - Hayo Baan, Sauvik Bhattacharya, Scott Fluhrer, Oscar Garcia-Morchon, Thijs Laarhoven, Ronald Rietman, Markku-Juhani O. Saarinen, Ludo Tolhuizen, Zhenfei Zhang
 - PQCrypto 2019. [IACR eprint](#). [Website](#).
- **Cryptanalysis of an NTRU-based Proxy Encryption Scheme from ASIACCS'15**
 - Zhen Liu, Yanbin Pan, Zhenfei Zhang
 - PQCrypto 2019. [IACR eprint](#).

2018

- **LAC: Practical Ring-LWE Based Public-Key Encryption with Byte-Level Modulus**
 - Xianhui Lu, Yamin Liu, Zhenfei Zhang, Dingding Jia, Haiyang Xue, Jingnan He, Bao Li
 - Pre-print. [IACR eprint](#). [Source code](#)
- **Shorter Messages and Faster Post-Quantum Encryption with Round5 on Cortex M**
 - Markku-Juhani O. Saarinen, Sauvik Bhattacharya, Oscar Garcia-Morchon, Ronald Rietman, Ludo Tolhuizen, Zhenfei Zhang
 - Cardis 2018. [IACR eprint](#).
- **On the Hardness of the Computational Ring-LWR Problem and its Applications**
 - Long Chen, Zhenfeng Zhang, Zhenfei Zhang
 - Asiacrypt 2018. [IACR eprint](#).
- **A signature scheme from the finite field isomorphism problem.**
 - Jeffrey Hoffstein, Joseph H. Silverman, William Whyte, Zhenfei Zhang
 - MathCrypt 2018. [IACR eprint](#), [Slides](#).
- **Practical Signatures from the Partial Fourier Recovery Problem Revisited: A Provably-Secure and Gaussian-Distributed Construction.**

- Xingye Lu, Zhenfei Zhang, Man Ho Au
- ACISP 2018. [Manuscript](#).
- **Optimizing polynomial convolution for NTRUEncrypt.**
 - Wei Dai, William Whyte, Zhenfei Zhang
 - IEEE Transaction on Computers. [IACR eprint](#), [Source code](#).
- **Fully Homomorphic Encryption from the Finite Field Isomorphism Problem.**
 - Yarkin Doröz, Jeffrey Hoffstein, Jill Pipher, Joseph H. Silverman, Berk Sunar, William Whyte, Zhenfei Zhang:
 - PKC 2018. [IACR eprint](#).

2017

- **Choosing parameters for NTRUEncrypt**
 - Jeffrey Hoffstein, Jill Pipher, John M. Schanck, Joseph H. Silverman, William Whyte, Zhenfei Zhang
 - CT-RSA 2017. [IACR eprint](#).
- **Round2: KEM and PKE based on GLWR.**
 - Hayo Baan, Sauvik Bhattacharya, Óscar García-Morchón, Ronald Rietman, Ludo Tolhuizen, Jose Luis Torre-Arce, Zhenfei Zhang
 - NIST PQC submission. [IACR eprint](#).
- **A signature scheme from Learning with Truncation.**
 - Jeffrey Hoffstein, Jill Pipher, William Whyte, Zhenfei Zhang
 - Pre-print. [IACR eprint](#).
- **Anonymous Announcement System (AAS) for Electric Vehicle in VANETs.**
 - Man Ho Au, Joseph K. Liu, Zhenfei Zhang, Willy Susilo, Jin Li
 - The Computer Journal. [Manuscript](#).

2016

- **Circuit-extension handshakes for Tor achieving forward secrecy in a quantum world.**
 - John M. Schanck, William Whyte, Zhenfei Zhang
 - PoPETs 2016. [IACR eprint](#), [Tor feature request](#), [Source code](#), [Slides](#).
- **NTRU modular lattice signature scheme on CUDA GPUs.**
 - Wei Dai, Berk Sunar, John M. Schanck, William Whyte, Zhenfei Zhang
 - HPCS 2016. [IACR eprint](#).

2015

- **LLL for ideal lattices: re-evaluation of the security of Gentry-Halevi's FHE scheme.**
 - Thomas Plantard, Willy Susilo, Zhenfei Zhang
 - Design, Codes and Cryptography. [Manuscript](#).
- **DA-Encrypt: Homomorphic Encryption via Non-Archimedean Diophantine Approximation.**
 - Jeffrey Hoffstein, Jill Pipher, John M. Schanck, Joseph H. Silverman, William Whyte, Zhenfei Zhang
 - Pre-print. [IACR eprint](#).

2014 and earlier

- **Fully Homomorphic Encryption Using Hidden Ideal Lattice.**
 - Thomas Plantard, Willy Susilo, Zhenfei Zhang
 - IEEE Transation on Information Forensics and Security. **Manuscript.**
- **Adaptive Precision Floating Point LLL.**
 - Thomas Plantard, Willy Susilo, Zhenfei Zhang
 - ACISP 2013. **Manuscript.**
- **On the CCA-1 Security of Somewhat Homomorphic Encryption over the Integers.**
 - Zhenfei Zhang, Thomas Plantard, Willy Susilo
 - ISPEC 2012. **Manuscript.**
- **Lattice Reduction for Modular Knapsack.**
 - Thomas Plantard, Willy Susilo, Zhenfei Zhang
 - SAC 2012. **Manuscript.**
- **Reaction Attack on Outsourced Computing with Fully Homomorphic Encryption Schemes.**
 - Zhenfei Zhang, Thomas Plantard, Willy Susilo
 - ISPEC 2012. **Manuscript.**