

# Zhenfei Zhang

Cryptography Engineer

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Algorand

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## 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;
- Coding: Product level **Rust** code for
  - **Pixel aggregatable signature**;
  - **BLS signature**;
  - Pointproofs: Aggregating Proofs for Multiple Vector Commitments (TBA);
- Standardization: **Internet draft** for BLS signature scheme, IETF/CFRG working group.

### Director of Cryptography Research, *Security Innovation* -> *OnBoard Security*, 2014-2018

- Homomorphic encryptions (IARPA project);
- Post-quantum cryptography;
- blockchain cryptography.

## Highlights

#### Standards

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

**LAC** won the first prize of **Chinese post-quantum cryptography competition**.

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 ACM CCS 2020, PKC 2020, 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.

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

**Python/Sage**: Proof of concept codes.

## Software

<b>Pixel</b>	A pairing based, forward-secure and aggregatable signature, written in python (PoC) and rust (product level). Improves existing (non-aggregatable) solution by 100x, open sourced and external audited. <a href="#">Source code</a> .
<b>Pointproofs:</b>	A pairing based, aggregatable prove system over multiple vector commitments, written in rust (product level). To be open sourced soon.
<b>Raptor</b>	A lattice based (linkable) ring signature, written in C as a PoC, aiming to protect user's anonymity against quantum adversaries. <a href="#">Source code</a> .
<b>NTRUEncrypt</b>	A C implementation of NTRUEncrypt, submitted to NIST PQC standardization process. <a href="#">Source code</a> .
<b>Ring multiplication</b>	A C library for fast ring multiplication using AVX-2; improving prior codes by a factor of 2.23. <a href="#">Source code</a>
<b>libgcrypt-ntru</b>	Enabling NTRUEncrypt for libgcrypt. <a href="#">Source code</a> .

## Education

<b>2010-2014</b>	<b>PhD, Computer Science</b> , <i>University of Wollongong, Australia</i> ; <i>Thesis title: Revisiting Fully Homomorphic Encryption Schemes and Their Cryptographic Primitives</i>
<b>2008-2009</b>	<b>Master of Engineering - Research</b> , <i>University of Wollongong, Australia</i> ;
<b>2007</b>	<b>Master of Internet Technology</b> , <i>University of Wollongong, Australia</i> ;
<b>2001-2005</b>	<b>Bachelor of Computer Science</b> , <i>BeiHang University, China</i> .

## Research Interest

- Practical aspects of lattice based cryptography;
- Cryptographic primitives for blockchains privacy, such as ring signatures, zero knowledge proofs;

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

## 2020

- **Pointproofs: Aggregating Proofs for Multiple Vector Commitments**
  - *Sergey Gorbunov, Leonid Reyzin, Hoeteck Wee, and Zhenfei Zhang*
  - ACM CCS 2020.
- **MPSign: A Signature from Small-Secret Middle-Product Learning with Errors**
  - *Shi Bai, Dipayan Das, Ryo Hiromasa, Miruna Rosca, Amin Sakzad, Damien Stehle, Ron Steinfeld, Zhenfei Zhang*
  - PKC 2020. [IACR eprint](#). [Source code](#)

## 2019

- **Modular Lattice Signatures, revisited**
  - *Dipayan Das, Jeffrey Hoffstein, Jill Pipher, William Whyte, Zhenfei Zhang*
  - Design, Codes and Cryptography. [IACR eprint](#)
- **Middle-Product Learning with Rounding Problem and its Applications**
  - *Shi Bai, Katharina Boudgoust, Dipayan Das, Adeline Roux-Langlois, Weiqiang Wen, Zhenfei Zhang*
  - Asiacrypt 2019. [IACR eprint](#)
- **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 and earlier

- **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](#).
- **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](#).