CLEMSON UNIVERSITY RESEARCH FOUNDATION
curf.clemson.edu

Optical Physical Unclonable Function for Cyber Security Applications (2020-021)

Physical unclonable function (PUF) from photonic integrated circuits for cybersecurity applications.

Market Overview

This robust optical physical unclonable function (PUF) features a novel optical architecture, as well as an integrated form factor, enabling it to achieve true integration and demonstrate stability in a variety of conditions. The global market for cyber security is projected to grow from $113.4 billion in 2019 to $220.2 billion by 2024, with a CAGR of 14.2%. PUF is an emerging security factor for modern systems and devices, acting as a tamper-resistant security method. Unlike other types of PUFs, optical PUFs are especially advantageous owing to the large data capacity and wave dominated nature of photonic devices that further provides enhanced signature complexity and passive operation. Optical PUFs, however, are limited by their sensitivity to initial conditions, temperature, and power. Clemson researchers have developed a highly visible, random, and easily measurable approach to overcome the limitations associated with conventional optical PUFs for a secure, stable integration into modern systems.

Technical Summary

This technology uses a novel quasi-crystal interferometer (QCI) made with standard single-mode silicon photonic components operating in the near infrared to achieve a robust, integrated silicon physical unclonable function (PUF). The PUF includes a unique integrated photonic form factor and single mode waveguides, rather than multimode waveguides, in primary aspects of the structure. Additionally, the use of a high sensitivity resonator and/or interferometer configuration enables near uniform optical confinement factors with the waveguide core. These features are achieved by using small modulations on a waveguide, rather than air holes or photonic crystals that would yield variable confinement factors. This optical PUF is the first to achieve true integration and demonstrate stability in a variety of environmental and thermal conditions.

Application

Cyber Security, Information & Hardware Security, Data Authentication, Encryption, Identity & Access Management, Cryptographic Mechanisms

Development Stage

Proof of Concept

Advantages

- High sensitivity resonator and/or interferometer configuration
- Probes spatially distributes randomness in a highly integrated fashion
- Feature extraction and correlation analysis achieve computationally efficient means for analyzing optical PUFs

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
N/A	United States	N/A	N/A	2020-021	Dr. Judson Ryckman Dr. Yingje Lao Farhhan Bin Tarik Azadeh Famill

About the Inventors

Dr. Judson Ryckman

Assistant Professor of Electrical and Computer Engineering at Clemson University

Dr. Judson Ryckman received the B.E. and Ph.D. degrees in electrical engineering in 2008 and 2013, respectively, from Vanderbilt University. Through his dissertation work, entitled 'Porous and Phase Change Nanomaterials for Photonic Applications', he has tackled problems in photonics spanning areas in nanofabrication, sensing, and integrated optics. Dr. Ryckman serves on the committee of technical conferences such as IEEE Optical Interconnects and is a reviewer for numerous journals published by IEEE and OSA. Dr. Ryckman's research interests lie in the development and application of photonic platforms to solve problems in areas of sensing, biomedicine, security, and computing/communications.

Dr. Yingjie Lao

Assistant Professor of Electrical and Computer Engineering at Clemson University

Dr. Yingjie Lao received the B.S. degree from Zhejiang University, China, in 2009, and the Ph.D. degree from the Department of Electrical and Computer Engineering at University of Minnesota, Twin Cities in 2015. His research interests include hardware security, VLSI architectures for machine learning and emerging cryptographic systems, cybersecurity, adversarial machine learning, robotics, and machine learning for security. Dr. Lao received a Best Paper Award from International Symposium on Low Power Electronics and Design (ISLPED), and an IEEE Circuits and Systems Society Very Large Scale Integration Systems (TVLSI) Prize Paper Award for his works on hardware security.

For more information on this technology contact:

curf@clemson.edu

Please put technology ID in subject line of email.