Chi Zhang

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RESEARCH INTERESTS

Mobile & Ubiquitous Computing; Mobile & Ubiquitous Sensing;
Wireless Power Delivery; Wireless Networking;
Internet of Things (IoT); Ultra-low-power Computing & Communication Systems;
Cross-Layer Optimization; Software Hardware Co-design

EDUCATION

University of Wisconsin-Madison

M.S. & Ph.D. Electrical and Computer Engineering　　　　　　　　　　　　Sept. 2013 – Dec. 2017

　Minor: Computer Science

　Dissertation: Augmenting Mobile and Ubiquitous Interactions with Computational Light Sensing

　Advisor: Xinyu Zhang

University of California San Diego

Visiting Graduate Student　　　　　　　　　　　　　　　　　　　　　　Sept. 2017 – Dec. 2017

Huazhong University of Science and Technology

B.E. Optoelectronics Engineering　　　　　　　　　　　　　　　　　　　Sept. 2009 – Jul. 2013

SELECTED PUBLICATIONS

"*" marks co-primary authors.

Capttery: Scalable Battery-like Room-level Wireless Power
Chi Zhang*, Sidharth Kumar*, Dinesh Bharadia
ACM International Conference on Mobile Systems, Applications, and Services (*MobiSys*), 2019
Acceptance ratio: 22.7% (39 / 172)

Automating Visual Privacy Protection Using a Smart LED (LiShield)
Shilin Zhu*, **Chi Zhang***, Xinyu Zhang
ACM International Conference on Mobile Computing and Networking (*MobiCom*), 2017
Acceptance ratio: 18.8% (35 / 186)

Pulsar: Towards Ubiquitous Visible Light Localization
Chi Zhang, Xinyu Zhang
ACM International Conference on Mobile Computing and Networking (*MobiCom*), 2017
Acceptance ratio: 18.8% (35 / 186)

LiTell: Robust Indoor Localization Using Unmodified Light Fixtures
Chi Zhang, Xinyu Zhang
ACM International Conference on Mobile Computing and Networking (*MobiCom*), 2016
Acceptance ratio: 14.2% (32 / 226)

Towards a Visible Light Network Architecture for Continuous Communication and Localization (Starfish)
Jialiang Zhang, **Chi Zhang**, Xinyu Zhang, Suman Banerjee
ACM Workshop on Visible Light Communication Systems (*VLCS*), 2016

Extending Mobile Interaction Through Near-Field Visible Light Sensing (Okuli)
Chi Zhang, Joshua Tabor, Jialiang Zhang, Xinyu Zhang
ACM International Conference on Mobile Computing and Networking (*MobiCom*), 2015
Acceptance ratio: 18.4% (38 / 207)

Energy Efficient WiFi Display
Chi Zhang, Xinyu Zhang, Ranveer Chandra
ACM International Conference on Mobile Systems, Applications, and Services (*MobiSys*), 2015
Acceptance ratio: 13.2% (29 / 219)

SELECTED DEMOS

LiShield: Privacy Protection of Physical Environment Against Photographing
Shilin Zhu*, **Chi Zhang***, Xinyu Zhang
ACM International Conference on Mobile Computing and Networking (*MobiCom*), 2017

Visible Light Localization Using Incumbent Light Fixtures (preliminary version of Pulsar)
Chi Zhang, Shipei Zhou, Xinyu Zhang
ACM Conference on Embedded Network Sensor Systems (*SenSys*), 2016

LiTell: Indoor Localization Using Unmodified Light Fixtures
Chi Zhang, Xinyu Zhang
ACM International Conference on Mobile Computing and Networking (*MobiCom*), 2016

PATENTS

Visual Privacy Protection System
Xinyu Zhang, **Chi Zhang**, Shilin Zhu
US 10,469,763

Navigation System Tracking High-Efficiency Indoor Lighting Fixtures
Xinyu Zhang, **Chi Zhang**
US 10,251,027

Spatial Location Indoors Using Standard Fluorescent Fixtures
Xinyu Zhang, **Chi Zhang**
US 2017/0346558; WO 2017/205020

Location Aware Communication System Using Visible Light Transmission
Xinyu Zhang, Suman Banerjee, Jialiang Zhang, **Chi Zhang**
US 9,712,234

Touch Surface for Mobile Devices Using Near Field Light Sensing
Xinyu Zhang, **Chi Zhang**, Joshua Tabor, Jialiang Zhang
US 10,156,901

EXPERIENCE & PROJECTS

Google, LLC   San Diego, CA
    Embedded Software Engineer   Nov. 2019 – present
University of California San Diego   San Diego, CA
    Postdoctoral Researcher   Aug. 2019 – Nov. 2019

Validating functionalities of Wi-Fi Backscatter test chip through bench-top equipment & end-to-end setup; designing portable hardware prototype for the test chip; designing realtime packet injection & wake-up pattern generation system on commercial laptops.

Designing & implementing high-precision AoA-based localization algorithm for UWB; implementing signal processing & hardware interfacing software in Python; characterizing sources of minuscule errors in UWB localization systems.

Drafting & revising 2 proposals for industrial research awards; supervising multiple undergraduate, M.S., & Ph.D. students.

Bitinno Technologies, Inc.   San Diego, CA

Senior System Engineer   Jan. 2019 – Jul. 2019

Defining MAC timing requirements for Wi-Fi/Bluetooth/BLE transceivers; designing transceiver testbeds.

Defining Bluetooth/BLE/audio SoC; budgeting for power/area/memory/pins; estimating resource requirements from firmware & application perspective; estimating interface & power-rail requirements from board-level system; designing coordination & synchronization mechanisms; evaluating baseband/DSP/audio/voice/codec/peripheral IPs.

University of California San Diego   San Diego, CA

Postdoctoral Researcher   Mar. 2018 – Jan. 2019

Developing *Capterry*, a human-safe, uninterrupted, scalable capacitive wireless power transfer (CPT/WPT) system for IoT devices, which delivers milliwatt-level power at 4.4 m distance & to 10+ devices simultaneously; prototyping high-speed, MCU-controlled half-bridge inverter with tunable frequency; modeling & formulating design guidelines for TX compensation/matching networks; designing & implementing *Capterry* RX & battery-powered measurement instruments; running TX/RX simulations with LTSpice; designing & implementing showcase applications (UWB localization & BLE sensing station) hardware & firmware.

Prototyping ultra-low-power 802.11-compatible TX with off-the-shelf ICs on 4-layer PCB with meandered delay lines; developing baseband firmware for the TX on low-power MCU; verifying the TX with WARP SDR & Wi-Fi card's monitor mode.

Developing ultra-wide-band (UWB) array targeting VR-grade localization & tracking; prototyping hardware for the array on 4-layer PCB with SPI, USB, clock distribution & reworking UWB modules to feed external synchronized clocks; developing firmware for controlling 10s of UWB transceivers as tags/monitors while reporting to PC via USB, on top of a single MCU; analyzing channel impulse response (CIR) information & deriving angle-of-arrival (AoA) to complement time-of-flight (ToF).

Prototyping *PRel*, a massive scalable backscatter antenna array for enhancing 5-GHz Wi-Fi signal, which doubles MIMO throughput; designing reflector array's circuit for selecting each unit & latching reflector phase state; developing MCU firmware for controlling the arrays & communicating via a UART bus; prototyping the reflector array on 4-layer PCBs with delay lines, CMOS RF switches & patch antennas.

University of Wisconsin-Madison   Madison, WI

Research & Project Assistant   Sept. 2014 – Dec. 2017

Developing *LiShield*, a system exploiting characteristics of smartphones camera sensors to block unauthorized photo/video capture while working like regular lighting; modeling & analyzing CMOS camera sensor exposure under flickering light source; designing flicker waveform to mitigate potential attacks while being imperceptible to human eyes; prototyping multi-channel USB-controlled high-power LED drivers, which takes waveform data from MATLAB; designing evaluation methods & metrics (PSNR & CW-SSIM). ACM SIGMOBILE Research Highlights for MobiCom'17 (1 out of 35), media coverage in 7+ languages, about to be licensed to a major film production company.

Developing *Pulsar*, a high-precision (10 cm) angle-of-arrival (AoA) based 3D indoor localization system with photodiodes instead of power-hungry cameras; prototyping sensor hardware (including transimpedance amplifiers based on op-amps), which streams continuous dual-channel light intensity data via USB & DMA; designing specialized signal processing algorithm to reliably separate multiple light sources that have spurious frequency components; developing Android App that streams samples from USB OTG & processes the signals in real-time (including JNI & native libraries).

Developing *LiTell*, an accurate & robust indoor localization system reusing existing fluorescent lights as landmarks; modeling flicker frequency distribution (due to manufacturing error in fluorescent ballasts) & recognition accuracy; characterizing & modeling smartphones' rolling-shutter cameras for sensing high-frequency flicker of fluorescent lights; designing signal processing algorithm to extract weak & aliased frequency components from camera images & implementing corresponding OpenCV-powered Android App; designing & implementing USB to dual-rail power supply (boost + charge-pump) for high-speed light sensor, and later a single-rail version of the sensor. Wisconsin Alumni Research Foundation (WARF) Innovation Awards 2016 Finalist (6 out of 400+).

Developing *Okuli*, a light-weight infrared-based touch sensing system with 2 low-cost light sensors & 1 cm 2D localization accuracy; modeling accurate light propagation & reflection channel with imperfections of light sensors & LEDs; designing algorithm for mitigating interference & background signal; designing & implementing MCU (Arduino) & PC software for evaluation, & a test apparatus where *Okuli*'s performance can be compared with capacitive touchscreens in real-time.

Improving energy efficiency of Miracast (Wi-Fi Display) on top of Android 4.2, achieving up to 60% power savings through cross-layer optimization; identifying & profiling opportunities for power savings under different scenarios; designing & implementing measurement apparatus for smartphone power consumption; modifying Wi-Fi kernel driver to allow forcing power-saving modes from user-space; patching Android framework to eliminate transcoding overhead & unnecessary screen updates; patching RTP/RTCP implementation to allow switching between different H.264 streams; designing & implementing Android App for benchmarking, which emulates map navigation & slide shows with predefined timing.

Developing *Starfish*, a visible light communication (VLC) network assisted by localization for better hand-off, which is the first few research works for VLC at network-level; Designing & implementing localization system for visible light communication (VLC), including interfacing IMU (accelerometers/gyroscopes/magnetometers on I^2C bus) from Linux user-space on an ARM single-board computer.

Prototyping real-time network emulator for 60-GHz millimeter-wave (802.11ad/WiGig) networks on top of 10-gigabit-Ethernet (10GE); developing kernel driver module with kernel-mode networking for separating emulator control & payload data traffic over 10GE; developing lossless video streaming application for evaluating the emulator.

Prototyping software-defined, MATLAB-controlled heart-rate monitoring wrist watch, with specialized photoplethys-mography (PPG) optical sensor array attempting to mitigate motion artifacts.

Developing Android App that dumps RAW capacitive touchscreen values (capacitance image) from smartphones with Synaptics touchscreen controllers; modifying Android kernels to add/expose test interface for exporting capacitance image.

Designing & implementing a isolated power-line injector for injecting arbitrary signal generated by instruments into AC outlets for sensing research.

Teaching Assistant   Sept. 2015 – Dec. 2015

Mobile Computing Lab (cloud-enabled, context-aware Android App development for undergraduate students)

Service

Reviewer:
IEEE Transaction on Mobile Computing **(TMC)**
IEEE Transaction on Knowledge and Data Engineering **(TKDE)**
IEEE Sensors Journal
IEEE/ACM International Symposium on Quality of Service **(IWQoS)**
IEEE International Conference on Computer Communications **(INFOCOM)**