

Eric Wengrowski

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EDUCATION

Rutgers University Piscataway, NJ
PhD, Electrical and Computer Engineering May 2019
Concentration in Computer Vision & Machine Learning
Thesis Title: *Methods For Photographic Steganography and Radar Object Shape Inference*
GPA: 3.9/4.0

Rutgers University, School of Engineering Piscataway, NJ
Bachelor of Science, Electrical and Computer Engineering May 2013
Concentration in Robotics & Computer Vision

WORK EXPERIENCE

Postdoctoral Researcher - NYU January 2020 - Now
Researching computational image forensics in collaboration with Professor Pawel Korus and Professor Nasir Memon.

Founder and CEO - Steg AI May 2019 - Now
Completed NSF I-Corps customer discovery program. Won the 2019 LDV summit Entrepreneurial Computer Vision Competition. Successfully raised \$225,000 in non-dilutive funding and \$25,000 in angel investments.

Computer Vision Research Intern - Siemens Summer 2017
Princeton, NJ
Member of medical imaging research team working on automated lymph-node detection under the leadership of Dr. Dorin Comaniciu and Dr. Bogdan Georgescu. Specific contribution were design and training of a fully-convoluted dense neural network trained with physician-annotated CT scans of mediastinal lymph-nodes.

Computer Vision Research Intern - Kitware Summer 2016
Clifton Park, NY
Member of computer vision research team working on DARPA project Medifor under the leadership of Dr. Anthony Hoogs and Dr. Zhaohui Harry Sun. Medifor is a multifaceted image forensics project lead by Kitware. Specific contributions include reflectance-based image authentication algorithms.

Research Intern - Microsoft Research Summer 2015
Redmond, WA
Interned with the Interactive Visual Media Group lead by Dr. Richard Szeliski, under the close mentorship of Krishnan Ramnath, Dr. Michael Cohen, and Dr. Neel Joshi.

Computer Vision Software Engineer - Startup Summer 2014
San Francisco, CA
Developed dense 3D reconstruction implementations for company's flagship product. Specific contributions include: SLAM improvements to Google Tango, Kinect 2.0 development, camera geometry, Android development, h.264 and MPEG compression, network and socket programming.

AT&T Labs - Technical Intern Summer 2012
Middletown, NJ
Contributed to OPNET implementation of an experimental layer 3 network simulation model for transient and steady-state analysis of virtual network traffic. This model was equipped to simulate single or multiple link and/or node failure across the AT&T Common Backbone IP network. Focus included porting the simulation to 64-bit operation, debugging memory leaks, and optimization of output data structures using BASH scripts.

United States Army Corps of Engineers - Coastal Engineering Intern Summer 2011
New Jersey Air National Guard Base, William J. Hughes FAA Technical Center, Philadelphia District, Pomona, NJ
Performed contract negotiations as a liaison between USACE and contractors. Designed coastal structures and inspected their construction, including dredging operations, as well as explosive munitions inspections.

SELECT PUBLICATIONS

Light Field Messaging with Deep Photographic Steganography

Published in CVPR 2019

Authors: **Eric Wengrowski**, Kristin Dana.

Light Field Messaging (LFM) is a process of embedding, transmitting, and receiving hidden information in video that is displayed on a screen and captured by a handheld camera. We created the Camera-Display 1M dataset of 1,000,000 camera-captured images collected from 25 camera-display pairs. The result of this work is a high-performance real-time LFM system using consumer-grade displays and smartphone cameras.

Deep Convolutional Neural Networks as a Method to Classify Rotating Objects based on Monostatic Radar Cross Section

Published in IET Radar, Sonar, and Navigation in 2019

Authors: **Eric Wengrowski**, Matthew Purri, Kristin Dana, and Andrew Huston.

We address the challenging problem of determining shape class using monostatic RCS estimates collected as a time series from a rotating object tumbling with unknown motion parameters under detectability limitations and signal noise. We constructed datasets containing over 100,000 simulated RCS signals belonging to different shape classes. We show that a feed-forward CNN can be trained to successfully classify object shape using only noisy monostatic RCS signals with unknown motion.

Reflection Correspondence for Exposing Photograph Manipulation

Published in IEEE ICIP 2017

Authors: **Eric Wengrowski**, Z. Harry Sun, Anthony Hoogs.

Modern photo editing software like Photoshop has made it difficult to trust the authenticity of digital images. In response, image forensic techniques have emerged to detect photo manipulations. When jpeg-based authentication methods fail, a photograph's integrity can be examined by checking if scene geometry is preserved in reflections.

Reading Between the Pixels: Photographic Steganography for Camera Display Messaging

Authors: **Eric Wengrowski**, Kristin Dana, Marco Gruteser, Narayan Mandayam. *Published in IEEE ICCP 2017*

We exploit human color metamers to send light-modulated messages decipherable by cameras, but camouflaged to human vision. These time-varying messages are concealed in ordinary images and videos. We learn an ellipsoidal partitioning of the 6-dimensional space of base colors and color gradients. This partitioning creates metamer sets defined by the base color of each display pixel and the corresponding color gradient for message encoding. Ordinary displays and cameras are used, so there is no need for high speed cameras or displays.

Optimal Radiometric Calibration for Camera-Display Communication

Published in IEEE WACV 2016

Authors: **Eric Wengrowski**, Wenjia Yuan, Kristin Dana, Ashwin Ashok, Marco Gruteser, Narayan Mandayam.

We present a novel method for communicating between a moving camera and an electronic display by embedding and recovering hidden, dynamic information within an image. Detecting and decoding the message requires careful photometric modeling for computational message recovery. The key innovation of our approach is an algorithm that performs simultaneous radiometric calibration and message recovery in one convex optimization problem. By modeling the photometry of the system using a camera-display transfer function (CDTF), we derive an *optimal online radiometric calibration (OORC)* for robust computational messaging as demonstrated with nine different commercial cameras and displays.

High-Rate Flicker-Free Screen-Camera Communication with Spatially Adaptive Embedding

Authors: Viet Nguyen, Yaqin Tang, Ashwin Ashok, Marco Gruteser, Kristin Dana, Wenjun Hu, **Eric Wengrowski**, Narayan Mandayam. *Published in IEEE INFOCOM 2016*

We investigate a new visible light communication method, in which messages are embedded inside high frame rate videos and decoded by high speed cameras. This method preserves the quality of original videos, while offering a high information-transferring capability. We propose a video content adaptive encoding method that produces videos which have near-zero flicker while being decodable by high speed cameras.

GRANTS

NSF SBIR Phase 1

Under Review

PI for National Science Foundation (NSF) Small Business Innovation Research (SBIR) Phase 1 proposal *Novel photographic steganography to reduce digital piracy on live streaming platforms*. For the development of photographic steganography algorithms for Steg AI.

Invisible Light Field Messaging

Award Amount: \$50,000.00

Entrepreneurial Lead for NSF I-Corps Grant; Award Number: 1907550; Principal Investigator: Kristin Dana, Rutgers University, New Brunswick; NSF Organization: IIP; Start Date: 12/01/2019

Nvidia Academic Hardware Grant

Award: Titan X GPU

Awarded in August 2015.

TEACHING

Part-Time Lecturer for “Robotics and Computer Vision”

Fall 2013

Lead the teaching of the joint undergraduate and graduate-level computer vision class along with Professor Peter Meer. Designed lessons, lectured for 3 hours weekly, held 3+ hours weekly of office hours, administered exams and projects, and was responsible for grading.

Teaching Assistant for “Principles of Electrical Engineering I”

Spring 2014, 2015

Lead lab instruction for 100+ undergraduate students for 3+ hours weekly. Focused on RLC circuit design, SPICE simulation, and implementation. Graded weekly lab reports and practicals.

Teaching Assistant for “Robotics and Computer Vision”

Spring 2016

Assisted Professor Kristin Dana in joint undergraduate and graduate instruction of 35 students. Responsible for holding 2+ hours of weekly office hours, grading weekly assignments, and evaluating final projects.

Teaching Assistant for “Programming Methodology I”

Fall 2017

Lead lab instruction for 100+ undergraduate students in introductory C++ programming. Responsible for designing lessons and assignments, grading, and supervising exams. Managed 2 assistant graders per lecture.

Guest Lecturer Planned deep learning lessons for Robotics and Computer Vision in Spring 2016, 2017, and 2018.

Guest lectured Capstone Design meetings to provide feedback to undergraduate students for their final design project in Fall 2015, 2016, 2017, 2018, and 2019.

SELECT LARGE PROJECTS

National Science Foundation Innovation Corps (NSF I-Corps)

Silicon Valley Cohort - Winter 2019

Participated in the national I-Corps program to explore commercialization around Light-Field Messaging technology. Created a 3-person team named Stegosaurus Software which included Professor Kristin Dana and Mr. Rone Baldwin. We participated in the Silicon Valley cohort and conducted over 105 customer discovery interviews in a 7-week period, presented weekly progress reports, and completed a business model canvas.

Lockheed Martin Research Collaboration

2016-2018

Full tuition support with research grant from Lockheed Martin. Solving non-traditional classification problems using deep learning. Our findings have been compiled into a journal paper out for submission. Finding have been published in *IET Radar, Sonar, and Navigation*.

Visual MIMO

Computer Vision Research – 2013-2019

Visual MIMO is a Visual-Light Communications (VLC) system that operates in real-time. In a traditional transmitter-receiver communications model, light-emitting arrays such as LCD screens serve as transmitters, while cameras serve as receivers. Messages are transmitted through modulated light, difficult for humans to see, but easy for cameras to detect. In this way, we are able to send invisible messages embedded in regular photo/video content. The current design utilizes ubiquitous, low-cost hardware (LCD monitors, Android phones, and Google Glass). This work was supported primarily by the National Science Foundation under NSF grant CNS-1065463.

DEMOS

- “Light Field Messaging with Deep Photographic Steganography,” *CVPR 2019*
- “Reading Between the Pixels: Photographic Steganography for Camera Display Messaging,” *CVPR Computational Cameras and Displays Workshop 2017*

POSTERS

- “Computational Sensor Fingerprints,” *ICCP 2020*
- “Light Field Messaging with Deep Photographic Steganography,” *ICCP 2019, CVPR 2019*
- “Deep Convolutional Neural Networks as a Method to Classify Rotating Objects based on Monostatic Radar Cross Section,” *ICCP 2018*
- “Reading Between the Pixels: Photographic Steganography for Camera Display Messaging,” *ICCP 2017, CVPR Computational Cameras and Displays Workshop 2017*
- “Optimal Radiometric Calibration for Camera-Display Messaging,” *WACV 2016, CVPR Computational Cameras and Displays Workshop 2016*
- “Remotely Processed Visual SLAM Using Open Source Software,” *Rutgers Capstone Design Day 2013*

AWARDS

LDV Summit Entrepreneurial Computer Vision Challenge (ECVC) Winner	May 2019
ECE Academic Achievement Award	May 2019
Siemens FutureMakers Hackathon - 2nd Place	May 2018
GAANN Fellowship - 5-Year Full PhD Funding Support	September 2017
IEEE Cybersecurity Symposium at Fairleigh Dickinson University - 2nd Place Poster	September 2016
Rutgers ECE Research Day - 2nd Place - Conference Travel Grant Prize	February 2016
Conference Travel Award sponsored by Rutgers Graduate School	November 2015
ECE Capstone Design - Top 10 Project	Fall 2013
New Jersey Beach Buggy Association Scholarship Award Winner	2012
WOBM Student of the Month	2009

SKILLS

Programming Languages: Python, Matlab, C++, Lua, C#

Favorite Python Libraries: PyTorch, TorchVision, PIL

Favorite C++ Libraries: OpenCV, Eigen, PugiXML, Boost, protobuf

Favorite MATLAB Libraries: CVX, VLFeat

Other Experience: Deep Learning with PyTorch, Torch, MatConvNet, .NET Environment (Visual Studios), Linux Development Environments, Windows Development Environments, Linux/Unix Shell, BASH Scripting, L^AT_EX, Unity, Vuforia, Kinect Development, OPNET, US Department of Defense Resident Management System (RMS)

SERVICES

Interviewed Dean Thomas Farris's invited guest Dev Ittycheria, CEO of MongoDB for Rutgers ECE Colloquium.	2018
Invited guest to Electrical and Computer Engineering Alumni Networking Event.	2018
Student host for Rutgers ABET Accreditation on-site visit.	2018
Judge for ECE Capstone senior design projects.	2017
Dean's invited speaker for Rutgers Medal of Excellence Awards dinner, honoring Dr. Dorin Comaniciu.	2016
Hosted and presented Rutgers 250th Fellow Awards to Dr. Thomas Kennedy.	2016
Rutgers CTY Program presenter to elementary school students and parents.	2016
Mentor for the Rutgers ECE-High Technology High School Program. Mentored a high school student each Friday of the semester for implementation of a cloud-based interactive camera program.	2016
Rutgers 4-H Club host for Science Saturday with Spy Technology.	2014
Presenter for Rutgers Day, ECE Open House, and prospective students & parents.	<i>Undergraduate</i>

RELEVANT COURSEWORK

Robust Computer Vision, Convex Optimization, Computer Vision, Pattern Recognition, Robotics & Computer Vision, Regression Analysis, Research in Human-Computer Interaction (HCI), Algorithms and Data Structures, Software Engineering, Control Systems Design, Probability and Stochastic Processes, Linear Algebra, Malware Analysis and Reverse Engineering, CTEC: Discovery to Business Model

FACTS (FUN and OTHERWISE)

Rutgers U. Mens Alpine Snowboard Racing Team - USCSA Mid-Atlantic Regionals - Giant Slalom - 3rd Place
Summited 11 Colorado 14ers
Improv comedy player
Completed 1 semester of college ballet in Rutgers Mason Gross School of the Arts (with a B+)
Created)'(art pieces "Self Portrait" and "Dancing" using style-transfer computer vision algorithms