

# Jeremy Speth

University of Notre Dame  
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I am currently a 5th year PhD candidate at University of Notre Dame. My research spans camera-based physiology, biometrics, signal processing, machine learning, and computer vision. I have experience working all the way from data collection of large video datasets of human subjects to the estimation of physiological signals such as blood volume pulse and respiration from video. My applied interest is building robust algorithms for health monitoring for immediate and long-term diagnostics. My research interest is in machine learning for signal estimation and discovery.

## EDUCATION

<i>Ph.D. in Computer Science and Engineering</i>	July 2019 - Expected Fall 2023
University of Notre Dame - Computer Vision Research Lab	Notre Dame, Indiana, USA
Advisors: Dr. Adam Czajka and Dr. Patrick Flynn	

<i>M.S. in Computer Science and Engineering</i>	May 2022
University of Notre Dame - Computer Vision Research Lab	Notre Dame, Indiana, USA
Dissertation Proposal: Remote Vitals Estimation in an Open World	
Advisors: Dr. Adam Czajka and Dr. Patrick Flynn	

<i>B.S. in Computer Science and Engineering</i>	August 2016 - May 2019
University of Nevada, Reno - Computer Vision Lab	Reno, Nevada, USA
Magna Cum Laude, Recipient of Senior Scholar Award	

## PROFESSIONAL EXPERIENCE

<i>Research Intern</i>	May 2023 - September 2023
Digital Health Lab, Samsung Research America (SRA)	Remote (Mountain View, California, USA)
Camera-based physiological monitoring in the presence of motion.	

<i>Graduate Research Assistant</i>	July 2019 - Present
University of Notre Dame	Notre Dame, Indiana, USA
Research in remote vitals estimation using deep learning and signal processing. Collected multiple large-scale video datasets with simultaneous recordings of physiological signals. Trained multiple 3D-CNN models to improve pulse estimation in unconstrained setting.	

<i>Research Intern</i>	September 2021 - December 2021
Philips	Cambridge, Massachusetts, USA
Evaluated multiple algorithms for remote pulse estimation on compressed videos, and developed a novel video compression method with minimal damage to the signal quality. This work led to a patent application.	

<i>Undergraduate Researcher</i>	August 2018 - July 2019
University of Nevada, Reno	Reno, Nevada, USA
Worked with Dr. Emily Hand to develop weakly supervised models for improving facial attribute recognition. Developed and published a method called verification filtering for finding noisy labels in the multi-label setting.	

<i>Undergraduate Researcher</i>	May 2018 - July 2018
University of Notre Dame	Notre Dame, Indiana, USA
Worked with Dr. Peter Kogge to develop scale-free bipartite graph generators, and used them as a benchmark for graph processing with the Hopcroft-Karp algorithm.	

## PATENT APPLICATIONS

**Jeremy Speth**, Patrick Flynn, Adam Czajka, Benjamin Sporrer, Lu Niu, Nathan Carpenter, Leandro Olie, “Trustworthy Anomaly-Aware Remote Pulse Estimation,” U.S. Patent Application No. 63/388,984, July 13, 2022

**Jeremy Speth**, Patrick Flynn, Adam Czajka, Kevin Bowyer, Nathan Carpenter, Leandro Olie, “Video based detection of pulse waveform,” U.S. Patent Application No. 17/591,929, February 3, 2022

## JOURNAL PUBLICATIONS - PEER-REVIEWED

Aidan Boyd\*, **Jeremy Speth\***, Lucas Parzianello\*, Kevin Bowyer, Adam Czajka, “Comprehensive Study in Open-Set Iris Presentation Attack Detection,” *IEEE Transactions on Information Forensics and Security (TIFS)*, 2023.

Nathan Vance, **Jeremy Speth**, Siamul Karim Khan, Adam Czajka, Kevin Bowyer, Diane Wright, Patrick Flynn, “Deception Detection and Remote Physiological Monitoring: A Dataset and Baseline Experimental Results,” *IEEE Transactions on Biometrics, Behavior, and Identity Science (TBIOM)*, 2022.

**Jeremy Speth**, Nathan Vance, Patrick Flynn, Kevin Bowyer, Adam Czajka, “Unifying frame rate and temporal dilations for improved remote pulse detection,” *Computer Vision and Image Understanding (CVIU)*, 2021.

## CONFERENCE PUBLICATIONS - PEER-REVIEWED

**Jeremy Speth**, Nathan Vance, Patrick Flynn, Adam Czajka, “Non-Contrastive Unsupervised Learning of Physiological Signals from Video,” in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2023; pre-print available at <https://arxiv.org/pdf/2303.07944> (**highlight paper award - top 10% of accepted**)

Lu Niu, **Jeremy Speth**, Nathan Vance, Benjamin Sporrer, Adam Czajka, Patrick Flynn, “Full-Body Cardiovascular Sensing with Remote Photoplethysmography,” in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshop (CVPRW) on Computer Vision for Physiological Monitoring (CVPM)*, 2023; pre-print available at <https://arxiv.org/pdf/2303.09638> (**best paper award**)

Nathan Vance, **Jeremy Speth**, Benjamin Sporrer, Patrick Flynn, “Promoting Generalization in Cross-Dataset Remote Photoplethysmography,” in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshop (CVPRW) on Computer Vision for Physiological Monitoring (CVPM)*, 2023; pre-print available at <https://arxiv.org/pdf/2305.15199>

**Jeremy Speth**, Nathan Vance, Benjamin Sporrer, Lu Niu, Patrick Flynn, Adam Czajka, “Hallucinated Heartbeats: Anomaly-Aware Remote Pulse Estimation,” *The 16th International Joint Conference on Biomedical Engineering Systems and Technologies: BIOSIGNALS*, ISBN 978-989-758-631-6, pp. 106-117, 2023; pre-print available at <https://arxiv.org/pdf/2303.06452> (**shortlisted for best student paper award**)

**Jeremy Speth**, Nathan Vance, Patrick Flynn, Kevin Bowyer, Adam Czajka, “Remote Pulse Estimation in the Presence of Face Masks,” in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshop (CVPRW) on Computer Vision for Physiological Monitoring (CVPM)*, 2022; pre-print available at <https://arxiv.org/pdf/2101.04096>

**Jeremy Speth**, Nathan Vance, Patrick Flynn, Kevin Bowyer, Adam Czajka, “Digital and Physical-World Attacks on Remote Pulse Detection,” in *Proceedings of the IEEE Winter Conference on Applications of Computer Vision (WACV)*, 2022; pre-print available at <https://arxiv.org/pdf/2110.11525>

**Jeremy Speth**, Nathan Vance, Adam Czajka, Diane Wright, Kevin Bowyer, Patrick Flynn, “Deception Detection and Remote Physiological Monitoring: A Dataset and Baseline Experimental Results,” *International Joint Conference on Biometrics (IJCB)*, 2021; pre-print available at <https://arxiv.org/abs/2106.06583>

**Jeremy Speth**, Emily M. Hand, “Automated label noise identification for facial attribute recognition,” *The IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*, 2019.

## RESEARCH PRESENTATIONS

*Invited Talk: Unsupervised Learning from Video*

August 2023

Tidal Team at Google X

Presented SiNC, an unsupervised learning method for estimating periodic signals from video, with applications in camera-based physiology. (Hosts: Sophia Abraham and Cory Schillaci)

*Presentation: Unsupervised Learning of Physiological Signals from Video*

May 2023

2nd MSU-ND Computer Vision and Biometrics Workshop

East Lansing, Michigan, USA

Presented non-contrastive unsupervised learning methods for estimating the blood volume pulse and respiration from video.

*Poster Presentation*

March 2020

University of Notre Dame 14<sup>th</sup> Annual Poster Contest

Notre Dame, Indiana, USA

Presented large-scale data collection and multimodal camera synchronization for remote pulse estimation from visible-light video.

*Tutorial Presentation*

March 2019

University of Nevada, Reno Computer Vision Lab

Reno, Nevada, USA

Presented general tensor processing pipelines in TensorFlow v1 for model creation and training.

## MAJOR COLLABORATORS

- Nathan Vance, University of Notre Dame
- Lu Niu, University of Notre Dame
- Benjamin Sporrer, University of Notre Dame
- Caitlin Coverstone, University of Notre Dame
- Dr. Adam Czajka, University of Notre Dame
- Dr. Patrick Flynn, University of Notre Dame
- Dr. Kevin Bowyer, University of Notre Dame
- Dr. Thomas O’Sullivan, University of Notre Dame

## REVIEWS

- IET Biometrics
- IEEE Transaction on Circuits and Systems for Video Technology (TCSVT)
- Elsevier Pattern Recognition (PR)
- IEEE Transactions on Information Forensics and Security (TIFS)
- IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)
- IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)
- IEEE/CVF International Conference on Computer Vision (ICCV)
- IEEE International Joint Conference on Biometrics (IJCB)
- IEEE Transactions on Biometrics, Behavior, and Identity Science (TBIOM)
- IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)