Schuckers, 03/13/23

STEPHANIE A. C. SCHUCKERS, PH.D.

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I. PROFESSIONAL BACKGROUND

A. Education

May 1997 **Ph.D.,** Electrical Engineering: Systems
The University of Michigan, Ann Arbor, Michigan
Dissertation: *Reliable Signal Detection of Ventricular Fibrillation in Intracardiac Electrograms for Precision of Therapeutic Choice*
Advisor: Prof. Janice M. Jenkins
Major: Signal Processing
Minor: Biosystems

May 1994 **M.S.E.,** Electrical Engineering and Computer Science
The University of Michigan, Ann Arbor, MI

May 1992 **B.S.E.,** Electrical Engineering (Honors)
The University of Iowa, Iowa City, Iowa

B. Professional Experience

2015-pres **Paynter-Krigman Endowed Professor in Engineering Science**
Clarkson University, Potsdam, NY

2012-pres **Full Professor,** *Electrical and Computer Engineering*
Clarkson University, Potsdam, NY

2011-pres **Director,** *Center for Identification Technology Research*
National Science Foundation Industry University Cooperative Research Center
Lead University Site: Clarkson University, Potsdam, NY
University Sites: West Virginia U, U of Arizona, U at Buffalo

2005-2017 **CEO, NexID Biometrics, LLC**, Co-owners, Lawrence Hornak, Bojan Cukic, Michael Schuckers, Mark Cornett, Aaron Lewicke, Ed Harcourt, Founded December 2005. Sold to Precise Biometrics in 2017.

2004-2012 **Associate Professor,** *Electrical and Computer Engineering*
Clarkson University, Potsdam, NY. (04-07 part time ~50%, 07-pres 100%, tenured Feb 2009)

2007 **Sabbatical**, University of Cagliari, Italy, Feb-June, 2007

2004-2006 **Interim Director of Rehabilitation Engineering,** *Coulter College of Engineering*
Clarkson University, Potsdam, NY. (part time included in above)

2004 **Consultant**, *Biometric Fusion Center, Department of Defense*, Bridgeport, WV
Developed biometric testing framework for sensors and algorithms. (part-time ~10%)

2002-2004 **Research Associate Professor,** *Electrical and Computer Engineering*
Clarkson University, Potsdam, NY. (part-time ~20%)

2002-2005 **Research Assistant Professor,** *Computer Science and Electrical Engineering*
West Virginia University, Morgantown, WV. (part-time ~10%)

1997-2002 **Assistant Professor,** *Computer Science and Electrical Engineering*
West Virginia University, Morgantown, WV. (2001-2002 part-time 25%)

C. Honors and Awards

International

2023 **Fellow**, IEEE
2017 **Women in Biometrics Winner**, Security Industry Association
2015 **Panelist**, The National Academies, Panel on Review of the Information Technology Laboratory at the National Institute of Standards and Technology, June 2015.
2010-2011 **Consultant,** Army Science Board, Scientific Advisory Board to the Secretary of the Army
1997 **Finalist,** International Society of Computerized Electrocardiology Young Investigator Competition
1996 **Winner**, Rosanna Degani Computers in Cardiology Young Investigator Paper/Presentation Competition
1993-1997 **Fellow**, Whitaker Foundation

Clarkson University

2015 **Paynter-Krigman Endowed Professor in Engineering Science,** Clarkson U
2014 **Research Excellence Award**, Clarkson University
Honors one tenured faculty member within five years of tenure for efforts in research (shared with one other faculty member in 2014)
2014 **Multi-Million Dollar Club**, Clarkson University (>$5M)
2008 **John W. Graham Award**, Clarkson University
Honors one untenured faculty member per year for efforts in research
2007 **Teaching Excellence**, Coulter School of Engineering
2005 **Million Dollar Club**, Clarkson University

West Virginia University

2000 *Nominated for* **Harriet B. Rigas Award**, IEEE Education Society
1999 **Young Researcher of the Year**, College of Engineering and Mineral Resources
1998 **Young Researcher of the Year**, College of Engineering and Mineral Resources

II. INSTRUCTION

A. Courses Taught

Clarkson University

EE261 Introduction to Programming & Software Design
EE529/ME529 Stochastic Processes in Engineering
BR400/500 Intro to Biomedical Engineering
EE423/523 Introduction to Biometrics
EE622 Advanced Biometrics
EE321 Systems and Signal Processing
EE522 Advanced Signal Processing
BR100 Biomedical and Rehabilitation Seminar
ES100 Introduction to Matlab

West Virginia University

EE126 Signals and Systems II
EE291E Bioengineering
EE 124 Signals and Systems I
EE127 Signals and Systems Lab
EE 291C/391F Biomedical Instrumentation
EE391J Advanced Signal Processing Spring

B. Graduate Students

Major Professor

Completed Ph.D.

Dec 2022 **Keivan Bahmani**, *Deep Learning in Biometrics: Impact of Demographics*, Ph.D.

Dec 2022 **Priyanka Das**, *Advancing the State-of-the-Art in Iris Biometrics: Permanence, Individuality and Security*, Ph.D.

Dec 2019 **David Yambay**, *Security and Stability of Fingerprint and Iris Biometric Recognition Systems*, Ph.D.

May 2015 **Fang Hua**, *Stand-off Face and Iris Recognition in Unconstrained Environments*, Ph.D.

Dec 2014 **Yazan Al-Issa**, *Bioelectronics Tongue: Pattern Recognition For Analyte Concentration Estimation In A Multisensor System*, PhD.

Aug 2013 **Peter Johnson,** *A Study of Quality Degradation and Circumvention on Biometric System Performance*, Ph.D., Clarkson University.

July 2011 **Daniel Rissacher,** *Estimation of Pain from the EEG*, Ph.D. Thesis, off-campus, Clarkson University.

Dec 2010 **Daniel Stevens,** *Detection and Parameter Extraction of Low Probability of Intercept Radar Signals Using the Reassignment Method and the Hough Transform*, Ph.D. Thesis, off campus, Clarkson University.

May 2009 **Bozhao Tan,** *Assessing And Reducing Spoofing Vulnerability For Multimodal And Fingerprint Biometrics,* Ph.D. Thesis, Clarkson University.

June 2009 **Pisut Raphisak,** *Abnormal ECG search in long-term electrocardiographic recordings from an animal model of heart failure*, Ph.D. Thesis, West Virginia University.

May 2008 **Umasankar Kandaswamy,** *World Of Color-Texture: Unified Solution For Enhancement, Invariance, And Recognition*, Ph.D. Thesis, Clarkson University.

Jan 2006 **Aditya Abhyankar,** *Wavelet Integration for Iris and Fingerprint Liveness Biometric Applications*, Ph.D Thesis, Clarkson University.

Dec 2005 **Aaron Lewicke,** *Prediction of Life-Threatening Events in Infants*, Ph.D Thesis, Clarkson University.

Aug 2004 **Reza Derakhshani,** *Biologically-Inspired Evolutionary Temporal Neural Circuits*, Ph.D Thesis, WVU.

May 2002 **Xu Xueyan,** *Prediction of Life-Threatening Event in Infants Using Heart Rate Variability Measurements*, Ph.D. Thesis, West Virginia University. (Winner of the International Society of Computerized Electrocardiology Jos Willems Young Investigator Competition)

Completed Master's

April 2022 **Alex Cartier**, Advancing Synthetic Fingerprints through Demographic Evaluation, Master's Thesis, Clarkson (distance)

May 2018 **Ben Schilling**, Validation of Biometric Identification of Dairy Cows based on Udder Vein Images, Master's Project, Clarkson.

May 2016 **Brian Walczak**, Iris Liveness Using Texture And Frequency Analysis, Master's Thesis, Clarkson.

Dec 2013 **David Yambay**, LivDet-Liveness Detection Competitions, Master's Thesis, Clarkson.

May 2010 **David Illig,** *Electrocardiogram Features for Short-Term Prediction of Spontaneous Abnormal Cardiac Events,* Master's Thesis, Clarkson.

Aug 2008 **Katherine Bellor,** *Exploring QT Interval Changes as a Precursor to the Onset of Ventricular Fibrillation/Tachycardia*, Master's Thesis, Clarkson.

Aug 2008 **Brian DeCann,** *A New Region Based Liveness Detection Algorithm for Biometric Fingerprint Scanners*, Master's Thesis, Clarkson.

May 2008 **Dave Donegan,** *Integration of Audio and Visual Speech Recognition for Liveness Detection in a Biometric Verification System*, Master's Thesis, Clarkson.

Dec 2006 **Amith Vijayat,** *Vulnerability Assessment for a Secure On-line Biometric Authentication System Based on Dynamic Representations***,** Master's Thesis, Clarkson.

May 2006 **Nilesh Kulkarni,** *A Comparitive Study of Fingerprint Image Quality and its Correlation with Matching Performance,* Master's Thesis, Clarkson.

Aug 2004 **Dave Sonner,** *A Preliminary Investigation into the Addition of Speech Recognition to a Multi-Modal Biometric System*, Master's Thesis, Clarkson.

Dec 2003 **Aditya Abhyankar**, *A Wavelet-Based Approach to Detecting Liveness in Fingerprint Scanners*, Master's thesis, Clarkson.

Dec 2003 **Sujan Parthasardhi**, *Comparison of Classification Methods for Perspiration-Based Liveness Algorithm*, Master's thesis, West Virginia University.

Dec 2002 **Tieling Yan,** *Visualization of long-term time series Electrocardiographic data*, Master's Problem Report, West Virginia University.

Dec 2000 **Simona Crihalmeanu,** *Representative Ways to Analyze and Survey Changes in Long-Term Electrocardiographic Recordings*, Master's Thesis, West Virginia University.

Dec 2000 **Sherry Kratsas,** *Parallelization of ECG Template-Based Abnormality Detection*, Master's Thesis, co-chair with Bojan Cukic, West Virginia University.

Dec 2000 **Lan Guo,** *Development of a Web-based Multimedia Database for Collection, Organization, and Analysis of Biomedical Signals,* Master's Problem Report, West Virginia University.

May 2000 **Meiyan Zeng,** *Web-based JAVA ECG Viewer For An Oracle Biomedical Signal Database*, Master's Problem Report, West Virginia University

Dec 1999 **Amit Diggikar,** *Development of a Method for Calculation of Cardiac Output using Doppler Ultrasound*, Master's Thesis, West Virginia University.

Dec 1999 **Reza Derakhshani,** *Determination of Vitality from a Non-Invasive Biomedical Measurement for Use in Integrated Biometric Devices*, Master's Thesis, West Virginia University.

Dec 1999 **Pisut Raphisak,** *Study of the Kalman Filter for Arrhythmia Detection with Intracardiac Electrograms*, Master's Thesis, West Virginia University.

Dec 1999 **Chuayin Dong,** *Building an Electrocardiogram Signal Database with Oracle 8*, Master's Problem Report, West Virginia University.

Dec 1999 **Zhenhuan (Jane) Chi,** *Building a Web-Based Oracle Front-End Application for a Biomedical Signal Database*, Master's Problem Report, West Virginia University.

Aug 1999 **Limin Wang,** *ECG Signal Processing by DSP-21062 Digital Signal Processor*, Master's Thesis, West Virginia University.

Dec 1998 **Wei Huang,** *Building a Signal Database with Oracle 8*, Master's Problem Report, West Virginia University.

In Progress

Sandip Purnapatra, *Liveness Detection,* PhD, Clarkson, expected Dec 2023.
Richard Plesh, *Time series liveness detection,* PhD, Clarkson, expected Dec 2023.
Joseph Drahos, *Skin reflectance for mitigating bias in face recognition,* Master's, Clarkson, expected Dec 2023.

Lambert Igene, *Creation of 3D spoof molds for fingerprint attacks,* Master's, Clarkson, expected December 2023.

Surendra Singh, *Homomorphic encryption for iris recognition,* PhD, Clarkson, expected May 2024.
Afzal Hussain, *Face recognition in children,* PhD, Clarkson, expected May 2024.
Ibrahim Moubarak, *Bioelectronic tongue for dopamine detection for closed loop deep brain stimulation,* PhD, Clarkson, expected May 2025.

Member of Committee

Completed

Aug 2022 **Sushma Venkatesh**, Robust Algorithms for Face Morphing Attack Detection Database, Vulnerability and Detection, PhD, Norwegian University of Science and Technology

April 2022 **Michel Saguy**, Anticipating the next generation of fingerprints spoofing materials: Molecular design and biometric performance, PhD, University of Lausanne, Switzerland

July 2021 **Chinmay Sahu**, Localization Based Algorithms for Biomedical, Geo-hazard Applications & Behavioral Biometrics, PhD, Clarkson

May 2020 **Xuan Qi***, A Deep Dive into Face in Video Recognition: Approaches and Applications,* PhD

Dec 2019 **Tianqi Yang**, *Optimal Sensor Localization in Noise*, PhD

May 2019 **Guchuan Sun**, *Enabling Secure and Privacy Preserving Identity Management via Smart Contract*, Master's

Aug 2018 **Jiaju Huang**, Keystroke Dynamics Based User Authentication Using Long, Uncontrolled Text, PhD

May 2018 **Eli Dow**, Applications of Machine Learning to Virtual Machine Management for Cloud Computing Environments, PhD

May 2018 **Maryam Pouryazdanpanah**, Effective Incentives To Maximize Trustworthy Participation In Mobile Crowdsensing, PhD

May 2018 **Fazel Anjomshoa**, Behavioral User Profiling and Energy Efficient Incentives in Crowdsensing, PhD

Aug 2017 **Joel Miles Canino**, The Development and Experimental Characterization of a Haptic Feedback Array to Enhance User-Perception of Locomotor Function and Motor Control of an EMG-Controlled Prosthetic Limb, PhD

Aug 2017 **Natalie Kurgan Canino**, Calculating Pulse Transit Times and Pulse Wave Velocities using Novel Processing of Surface Peri-Arterial Accelerometric Data, PhD

May 2014 **Jonathon Gacioch**, Optimal Ankle Prosthesis Adaptation for Transfemoral Amputee Users: Gait Data Acquisition, Master's

May 2014 **Joshua White**, Social Network Analysis Approach and Applications, Ph.D.

Aug 2014 **Tao Yang**, Image Enhancement on Non-Ideal Iris Recognition, PhD.

Aug 2013 **Kehinde Dunsin,** *Algorithm-Independent Pattern Classification Techniques for Improved Broadband Chemometrics for Laser-Induced Breakdown Spectroscopy,* Ph.D. Dissertation.

May 2013 **Mark Southcott,** *Characterization of an Implantable Biofuel Cell for Powering Implantable Medical Devices,* Master's Thesis.

May 2013 **Xiaoxi Dong,** *Determining Psychophysical Detection Thresholds and Lower Limb EMG Activation during Seated VS Standing Subtle Anterior Translations of Blindfolded or Eyes Restricted Subjects,* Ph.D. Dissertation.

May 2013 **Tiantian Zhao,** *Can Topic Modeling be used to Identify Hot Topics and Retrieve More Pertinent Online Help for API Usage Problems? A Case Study with Java Servlet,* Master's Thesis.

Dec 2012 **Wei Zhang**,*Bio-Radar for Cardiopulmonary Signal Detection,* Master's Thesis.

Dec 2010 **Viprali Bhakar,** *Innovative strategies for investigating postural control during threshold translations*, Ph.D. Thesis, Clarkson University.

May 2010 **Paulo Lopez,** *Automatic detection and classification of food intake,* Ph.D. Thesis, Clarkson University.

Dec 2009 **David McNamara,** *Speech processing and modeling using a non-linear time-frequency algorithm*, Ph.D. Thesis, Clarkson University.

Dec 2009 **Peter Johnson,** *A Novel Vocoder For Cochlear Implants*, Master's Thesis, Clarkson University.

Dec 2009 **Ryan LeBouf,** *Development of a rapid sampling and analysis methodology to measure microbially generated volatile organic compounds for the assessment of indoor mold contamination*, Ph.D. Thesis, Clarkson University.

May 2008 **Asghar Goli,** *Multi-component Non-stationary Signal Processing*, Ph.D. Thesis, Clarkson University.

May 2006 **Tim McAuley,** *Heart Rate Variability In Adolescents Exposed To Ultrafine Particles Downwind Of A Major Trade Bridge In Buffalo,* Ph.D. Thesis, Clarkson University.

Jan 2006 **Liyang Xu,** *Error Resilient and Scalable Video Coding Technique*, Ph.D. Thesis, Clarkson University.

Nov 2005 **Jonathan P. Majo, B***lood-flow measurement by Doppler Effect utilizing a non-stationary signal processing technique*, Master's Thesis, Clarkson University.

Dec 2004 **Mark Fitzpatrick,** *Real-Time Implementation of a Hearing Testing Technique*, Master's Thesis, Clarkson University.

Aug 2004 **Rohin Govindarajan,** *Feature Level Fusion In Multimodal Biometrics*, Master's Thesis, WVU.

May 2002 **Lisa Lowell,** *Signal Processing of Bird Calls*, Master's Problem Report, WVU.

May 2001 **Xiaoqiang Si**, *Porting a CORBA Component to EJB*, Master's Problem Report, WVU.

May 2001 **Diaa Eldin Nassar,** *A Prototype Automatic Dental Identification System (ADIS),* Master's Thesis, WVU.

Dec, 2000 **Praveen Soora,** *CMOS Fingerprint Sensor Electrostatic Modeling*, Master's Thesis, WVU.

May, 2000 **Qiang Zheng,** *Web Based Distributed System Application*, Master's Problem Report, WVU.

Dec, 1999 **Brian Taylor,** *Regressive Model Approach to the Generation of Test Trajectories*, Master's Thesis, WVU.

Dec, 1999 **Xuhui Zhen,** *The Development of a Web-Based Test Bed for Fingerprint Image Comparison*, Master's Problem Report, WVU.

Dec, 1999 **Yongyi Tao,** *Fingerprint Registration Using Genetic Algorithms*, Master's Problem Report, WVU.

Dec, 1999 **Lixin Wu,** *XML Representation of EKG*, Master's Problem Report, WVU.

Aug, 1998 **Xuemin Wang,** *Evaluation of Impact of Cooperative Medical Informatics Laboratory on the Performance of the Data Network of R. C. Byrd Health Sciences Center*, Master's Thesis, WVU.

In Progress

Aratrika Ray, *Evaluating Multi-Modality Mobile Behavioral Biometric Fusion Using Public Datasets,* PhD

C. Undergraduate Students (& Other)

2020 **Nic Smalt, Heidi Walko, Nick Wentworth, Yufei Liu, Jenny Liu, Matt Rosser, Zachary Chapman, Myrna Gonzalez,** REU and other funding sources

2019 **Benjamin Ellis, Nic Smalt, Heidi Walko, Declan Grant, Nick Wentworth, Robert Kline, Lexie Stoyell, Josh Gilette, Yufei Liu, Jenny Liu, Nicole Seaver, Matt Rosser,** REU and other funding sources

2019 **Morgan Johnson,** *A Longitudinal Study of Iris and Footprints in Children*, Honor's Thesis.

2019 **Thomas Conroy,** *Detection of Atrial Fibrillation Using an Ear Photoplethysmographic Sensor and Prototype Implementation into a Hearing Aid*, Honor's Thesis.

2018 **Cabral, Elisabeth M; Cary, Jacob Carlton; Davis, Andrew K.; Denning, Samantha; Grant, Declan; Guarnizo, Orlando J.; Johnson, Morgan; Lowit, Benjamin Paul; Tetzlaff, Samantha J; Walko, Heidi R; Wentworth, Nicholas S;** REU and other funding sources

2017 **Adam Cunningham, Samantha Denning, Benjamin Lowit, Andrew Davis, Jacob Carey, Morgan Johnson,** REU and other funding sources

2016 **Alysa Leong, Adam Cunningham, Samantha Denning, Alex Macri,** REU and other funding sources

2015 **Mat Sherry, Nicholas Short, Alex Roberge, Alysa Leong, Cleann Davis, Kevin Cave, Collard, Benjamin, Daniel Galy,** REU and other funding sources

2014 **Cleann Davis, Matt Sherry, Kevin Cave, Nicholas Short, Dan Galy,** REU and other funding sources.

2013 **Megan Rolewicz, Gerald Brennan, Haley Swanson, Cleann Davis, Matt Sherry, Kevin Cave, David Denini,** REU and other funding sources.

2013 **Joe Camilo,** *Mobile Biometrics: A Study of Speaker Recognition on Mobile Devices*, Honor's Thesis Reader.

2012 **Greg Mesagna, Megan Rolewicz, Raymond Phillips, Samantha Kemerer, Muneeb Arshad, Gerald Brennan, Jon Gacioch, Stephanie Bauer, Samantha Longdaue, Faraz Qureshi, Matt Mullin, Asma Arshad,** REU and other funding sources.

2011 **Greg Mesagna, Megan Rolewicz, Richard Taggart, Raymond Phillips, Samantha Kemerer, Muneeb Arshad, Gerald Brennan, Jon Gacioch, Stephanie Bauer, Michael Giordano,** REU and other funding sources.

2010 **Nicholas Polanco,** *Development of spoofing techniques for fingerprint scanners*, McNair.

2009-2011 **Owen Manley,** *Development of spoofing techniques for fingerprint scanners*, REU.

2009-2011 **Joseph Sherry,** *Development of spoofing techniques for fingerprint scanners*, REU.

2008-2011 **David Yambay,** *Analysis of Multibiometric Data*, C-STEP Scholar, McNair.

2008 **Anthony Bishop,** *Electronic Tongue for differentiation of serotonin & dopamine*, McNair Scholar.

2008-2010 **Stanley Onyewuchi,** *Environmental changes of liveness measures in fingerprint*, Honors.

2008-2010 **Andrew Nadeau,** *Evaluation of Existing Iris Recognition Algorithms for Effects of Aging Subjects on Performance*, Honors.

2007-08 **David Illig,** *Respiration Changes during exposure to diesel exhaust in children*, Honors Thesis, 2007-2008.

2006-07 **John Bartholomay,** *Vulnerability Assessment of Biometric Fingerprint Liveness*, McNair Scholar, 2006-2007.

2006-07 **Kate Bellor,** *Analysis of Respiration in CHIME Infant Data*, Honors Thesis, 2006-2007.

2004-06 **Joshua Smith,** *Liveness Detection in Biometric Devices*, Honors Thesis, 2004-06.

2004-06 **Piyushee Jha,** *Combination of lip reading with face and voice recognition for biometric authentication*, Research Experience for Undergraduates (NSF REU), June 04-June 06.

2000-01 **Steve Hudson,** *Automatic Calculation of the QT interval*, Research Experience for Undergraduates (NSF REU), May 2000-Dec 2001.

2000-01 **Eric Olness,** *Biology Honors Project*, Project Reader, May 2000-May 2001.

2000 **Janet Klinkhachorn,** *Separation of Ventricular Tachycardia and Fibrillation*, High School Research Assistant, May - August 2000.

2000 **Jason Stanley,** *Development of a Web-Based Front-End for Data Insertion in an Oracle Database*, Research Experience for Undergraduates (NSF REU), May 2000-Dec 2000.

1999-01 **William Gerken,** *Separation of Ventricular Tachycardia and Fibrillation*, Research Experience for Undergraduates (NSF REU), September 1999-May 2001. Now in graduate school at Georgia Tech.

1999 **Vebjorn Kristensen,** *Sensing and Recognition of Finger Vitality Using the Veridicom CMOS Fingerprint Sensor*, Undergraduate Research Assistant (unfunded), January 99 - May 99. Now in graduate school at Stanford.

1999 **John Nozum,** *Musical ECG*, Undergraduate Independent Project, January 99 - December 99, Finalist for EMBS/BMES Student Project Contest.

1999 **Senior Design Group: Paul Kritschgau, Alan Orbeta, Robert Berry, John Grilli,** *Stay-Awake Drowsy Driver*, Sponsor, January 99 - December 99.

1998-9 **Senior Design Group: Dwayne Bender, Carlos Iga, Kim Stalnaker, Erin Hogbin,** *Sensing and Recognition of Finger Vitality Using the Veridicom CMOS Fingerprint Sensor*, Sponsor, August 98 - May 99.

1998-9 **Senior Design Group: Sherry Poe, Eric Bolton, Jason Lehosit,** *Data Storage and Signal Processing of Electrocardiograms in Laboratory Animals*, Sponsor, August 98 - May 99.

1998-9 **Erin Hogbin,** *Sensing and Recognition of Finger Vitality Using the Veridicom CMOS Fingerprint Sensor*, Undergraduate Research Experience through EG&G scholarship and GE Faculty of the Future Award, Summer 1998-May 1999.

1997-8 **Senior Design Group: Pete Fritsch, Darin Markus, Todd Welch, Matt Wolfe**, *Development of an Implantable Cardioverter Defibrillator Research Development Tool,* Sponsor, Aug 97 – May 98.

Table of Employers for PhD/Postdoc Graduates

Jang, Ganghee	Korea Institute of Science and Technology
Hua, Fang	Aware
Johnson, Peter	Precise Biometrics
al-Issa, Yazan	Yarmouk University
Raphisak, Pisut	Kasetsart University
Stevens, Daniel	Air Force Research Laboratory
Kandaswamy, Umasankar	Lawrence Technological University
Xueyan, Xu	National Institute for Occupational Safety and Health
Derakhshani, Reza	University of Missouri-Kansas City; Eyeverify, now ZOLOZ
Lewicke, Aaron	Abbott
Abhyankar, Aditya	Pune University
Tan, Bozhao	Amazon
Vural, Esra	Qualcomm
McGregor, Ralph	Bridgewater University

II. RESEARCH

- Statistical signal processing, pattern recognition, algorithm development and evaluation, artificial intelligence, and image processing
- Biomedical signals: electrocardiogram, seismocardiogram, and respiration
- Biometrics: fingerprint, iris, voice, face, liveness

Google Scholar Profile

https://scholar.google.com/citations?hl=en&user=vkveeWEAAAAJ

	All	Since 2015
Citations	5573	3033
h-index	41	31
i10-index	98	77

A. Publications (*italics for students*)

1. Journal Papers

1. *Wahab, A.A*., Hou, D., **Schuckers, S**. and Barbir, A., 2022. Securing account recovery mechanism on desktop computers and mobile phones with keystroke dynamics. SN Computer Science, 3(5), p.360.
2. *Ketola, E.C., Barankovich, M.*, **Schuckers, S**., *Ray-Dowling, A.,* Hou, D. and Imtiaz, M.H., 2022. Channel Reduction for an EEG-Based Authentication System While Performing Motor Movements. Sensors, 22(23), p.9156.
3. *Sahu, C*., Banavar, M. and **Schuckers, S**., 2022. A novel non-linear transformation based multi user identification algorithm for fixed text keystroke behavioral dynamics. IEEE Transactions on Biometrics, Behavior, and Identity Science.
4. *Ray-Dowling, A*., Hou, D., **Schuckers, S**. and Barbir, A., 2022. Evaluating multi-modal mobile behavioral biometrics using public datasets. Computers & Security, 121, p.102868.
5. *Priyanka Das*, Laura Holsopple, Dan Rissacher, Michael Schuckers and **Stephanie Schuckers**, Iris Recognition Performance in Children: A Longitudinal Study, IEEE Transactions on Biometrics, Behavior, and Identity Science (T-BIOM), 2021.
6. *Ayotte, B*., Banavar, M., Hou, D. and **Schuckers, S**., 2020. Fast Free-text Authentication via Instance-based Keystroke Dynamics. IEEE Transactions on Biometrics, Behavior, and Identity Science.

7. Stevens, D.L. and **Schuckers, S.A.,** 2018. Low Probability of Intercept Frequency Hopping Signal Characterization Comparison Using the Wigner Ville Distribution and the Choi Williams Distribution. Global Journal of Research In Engineering.
8. Stevens, D.L. and **Schuckers, S.A.**, 2018. Discrete-Time, Discrete-Frequency Reassignment Method. Global Journal of Research In Engineering.
9. *Ghiani, Luca*, *David A. Yambay*, *Valerio Mura*, Gian Luca Marcialis, Fabio Roli, and **Stephanie A. Schuckers**. "Review of the Fingerprint Liveness Detection (LivDet) competition series: 2009 to 2015." *Image and Vision Computing*, vol. 58, pp. 110-128, 2017.
10. D L. Stevens, **S A. Schuckers,** Low Probability of Intercept Frequency Hopping Signal Characterization Comparison using the Spectrogram and the Scalogram, Global Journal of Research in Engineering,vol 16, 2016
11. **Schuckers, S**, Presentations and Attacks, and Spoofs, Oh My, Journal of Image and Vision Computing, Available online 8 April 2016.
12. *Sharpe, E*, *Hua F***, S Schuckers**, Silvana Andreescu, and Ryan Bradley. "Effects of brewing conditions on the antioxidant capacity of twenty-four commercial green tea varieties." Food chemistry 192 (2016): 380-387.
13. *D Stevens*, **S Schuckers**, Detection and Parameter Extraction of Low Probability of Intercept Radar Signals using the Hough Transform, Global Journal of Researches in Engineering: J General Engineering, Volume 15 Issue 6, 2015.
14. *McGuffey, C*., Liu, C., & **Schuckers, S**. Hardware Accelerator Approach Towards Efficient Biometric Cryptosystems for Network Security. CIT. Journal of Computing and Information Technology, 23(4), 329-340, 2015.
15. *Al-Issa, Y., Njagi, J.,* **Schuckers, S. C.,** & Suni, I. I. (2015). Amperometric Bioelectronic Tongue for glucose determination. Sensing and Bio-Sensing Research, 3, 31-37. 2015.
16. *Juan M. Fontana*, Janine A. Higgins, **Stephanie C. Schuckers**, France Bellisle, *Zhaoxing Pan*, Edward L. Melanson, Michael R. Neuman, Edward Sazonov, Energy intake estimation from counts of chews and swallows, Appetite, Volume 85, 1 February 2015.
17. *G Torres*, C Liu, *J Chang, F Hua*, and **S Schuckers**, An Auto-tuning Assisted Power-Aware Study of Iris Matching Algorithm on Intel's SCC, The Journal of Signal Processing Systems, 1-16, 2014.
18. *O Makeyeva, P Lopez-Meyer*, **S Schuckers**, W Besio, E Sazonov, Automatic food intake detection based on swallowing sounds, Biomedical Signal Processing and Control 7, pp. 649– 656, 2012
19. *P. Lopez-Meyer*, **S Schuckers**, *O Makeyev, J M. Fontana*, E Sazonov, Automatic identification of the number of food items in a meal using clustering techniques based on the monitoring of swallowing and chewing, Biomed. Signal Process. Control, Volume 7, Issue 5, Pages 474–480, 2012.
20. *A. Lewicke*, **S. Schuckers**, Analysis of Heart Rate Variability for Predicting Cardiorespiratory Events in Infants, *Biomedical Signal Processing & Control*, vol 7, pp 325– 332, 2012.
21. *Umasankar Kandaswamy***, Schuckers S,** Don Adjeroh , Robust Color Texture Features Under Varying Illumination Conditions, IEEE Transactions on Systems, Man, and Cybernetics: Part B, vol 42, pp. 58-68, 2012.
22. *Umasankar Kandaswamy***, Schuckers S,** Don Adjeroh, Comparison of Texture Analysis Schemes Under Non-ideal Conditions, IEEE Transactions on Image Processing, Vol. 20 Issue:8 pp: 2260 – 2275, 2011.
23. *Sazonova NA*, DasBanerjee T, Middleton FA, Gowtham S, **Schuckers S**, Faraone SV, Transcriptome-Wide Gene Expression in a Rat Model of Attention Deficit Hyperactivity Disorder Symptoms: Rats Developmentally Exposed to Polychlorinated Biphenyls, American Journal of Medical Genetics Part B: Neuropsychiatric Genetics, Volume 156, Issue 8, pages 898–912, December 2011
24. *Abhyankar, A*.; **Schuckers, S**., "Towards integrating level-3 Features with perspiration pattern for robust fingerprint recognition," *Image Processing (ICIP), 2010 17th IEEE International Conference on* , vol., no., pp.3085,3088, 26-29 Sept. 2010

25. *Sazonov, E.,* **Schuckers S.**, The Energetics of Obesity: A Review: Monitoring Energy Intake and Energy Expenditure in Humans, *Engineering in Medicine and Biology Magazine, IEEE,* Volume 29, Issue 1, Pages 31-35, February 2010
26. *P Lopez-Meyer, O Makeyev*, **S Schuckers**, E L Melanson, M R Neuman and E Sazonov, Detection of Food Intake from Swallowing Sequences by Supervised and Unsupervised Methods, *Annals of Biomedical Engineerin*g, Volume 38, Number 8, August, 2010
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5. Keynotes

- *Biometric Recognition: Challenges and Possibilities*, Third Workshop On Applied Multimodal Affect Recognition, August 21, 2022
- *The Coming of Age of Presentation Attack Detection*, Keynote, Biometrics Special Interest Group (BioSIG), Darmstadt, Germany, Sept. 28, 2018.
- *Who You Are – Research Challenges in Biometrics*, Academy of Finland, Computational Sciences Workshop, December 4, 2013.

6. Invited Talks (Recent and Selected)

- *Deep Dive on Biometrics*, Authenticate2020, December 8, 2020.
- *Biometrics in children study*, Biometrics Institute Congress, Oct. 13, 2020.
- *Longitudinal performance of iris recognition in children*, Iris Experts Group, NIST, June 25, 2020.
- *Are Spoof-Proof Biometrics Really Possible?* RSA, Mar 08, 2019.
- *Advances in Biometrics: Current Capabilities and Future Possibilities*, Canadian Security Intelligence Service, Ottawa, Canada, Dec. 10, 2019.
- *Introduction to Biometric Recognition and Biometrics in Children*, NAPHSIS Identity & Security Conference, Nov. 5, 2019.
- *Thought-leader conversation – Face in Focus*, Stephanie Schuckers, Patrick Grother (NIST), Biometrics Institute, March 2019.
- *How robust is your system?* Vulnerabilities Workshop, Biometrics Institute, London, Oct. 28, 2019.
- *Fido Certification – what does this really mean?*, Biometrics Institute, London, Oct. 28, 2019.

- *Spoofs, Presentation Attack Detection, and Liveness: Where are We?*, Interdepartmental Biometrics Community of Practice, Quarterly Meeting, Ottawa, Canada, Sept. 30, 2019.
- *FIDO Biometric Certification*, EMVCo Meeting, Montreal, Canada, October 9, 2018.
- *Biometric Certification for Consumer Electronics*, Security, Infrastructure and Trust Working Group Meeting, World Bank, April 19, 2018.
- *Security of Biometric Recognition Systems: Beyond FAR*, Android Security Day, Google, Sunnyvale, CA, Oct. 28, 2018.
- *Iris—State of Industry*, Invited presentation at NIST Workshop: Improving Biometric and Forensic Technology: The Future of Research Datasets, January 26, 2015.
- *Mitigating biometric vulnerabilities*, Biometrics London 2015, Oct. 15, 2015.
- *Cyberspace 2025: Biometrics in Support of Trusted Identities*, NSF Workshop on Cyberspace 2025, April 2014.
- *Who You Are – Research Challenges in Biometrics*, Cyber Research Institute, Rome, New York, July 2014.
- *Liveness Detection*, International Fingerprint Research Group, Hosted by Israeli Police, Jerusalem, Israel, June 10, 2013.
- *Biometric Spoofing—Threats and Countermeasures*, Joint Research Center, European Commission, Ispra, Italy, October 24, 2013.

B. Research Grants

1. *Research Grants In Progress*

NSF, *RAPID: Collaborative Research: Covid-19 Hotspot Network Size and Node Counting using Consensus Estimation, #2032106,* Mahesh Banavar (PI), Stephanie Schuckers (co-PI), $99,995, 6/15/2020-5/31/2023.

NSF, *STEM Leadership, Equity, and Advancement for Faculty,* 1936144, Robyn Hannigan (PI); Co-Princ3pal Investigator, Stephanie Schuckers, William Jemison, Laura Ettinger, Jennifer Ball (co-PIs), $999,934, 10/1/2019-9/30/2023.

NSF*, I/UCRC Phase II: I/UCRC for Identification Technology Research,* 1650503, Schuckers (PI), $ 1,249,387 (to date), 3/1/2017-2/28/2024.
Additionally CITeR Affiliate fees collected (~$10/$50K each per year) from DHS, Precise Biometrics, Aware, Integrated Biometrics, DFSC, Defense Research Development Canada, Aetna, Infineon, HID, Veridium. *Funds are awarded in projects approved by affiliates and listed as CITeR below.*

CITeR, *Performance Evaluation and Demographic Analysis of Biometric Cryptosystems*, Daquing Hou (CU), Stephanie Schuckers (CU), $50K, 1/1/2023-12/31/2023

CITeR, Scenario Testing for Presentation Attack Detection: Test Design and Requirements for Government Applications 22F-08C Stephanie Schuckers (CU) 1/1/2023-12/31/2023

CITeR, Towards the Creation of a Large Dataset of High-Quality Face Morphs - Phase II Nasrabadi (WVU), Dawson (WVU), Li (WVU), Liu (CU), Schuckers (CU), Doermann (UB), Setlur (UB), Lyu (UB), $60K (Clarkson portion), 1/1/2023-12/31/2023.

CITeR Biometric Aging in Children: Phase IV 22S-02C S. Schuckers, M. Imtiaz, L. Holsopple, 7/1/2022-6/30/2023.

CITeR Biometric Recognition in Newborns, Infants and Toddlers (Gateway) 22S-06C-G Stephanie Schuckers (CU), Masudul Imtiaz, Kathleen Terrnce (CPH), Anil Jain (MSU), 7/1/2022-6/30/2023.

CITeR Evaluation of Equity in Remote Identity Proofing Solutions (Gateway Project) 22S-08C-G Daqing Hou (CU), Stephanie Schuckers (CU), Michael Schuckers (SLU), 7/1/2022-6/30/2023.

2. *Past Research Grants*

CITeR A Deep End-to-End Iris Matcher for Simultaneous Segmentation and Matching. Stephanie Schuckers (CU), Soumyabrata Dey (CU)

Facebook, *Behavioral Biometrics for Post-password Authentication*, Banavar M (PI), Hou D, Schuckers S (co-PI), $75,000, 8/31/2018-8/31/2021.

Clarkson Ignite, *Next Generation Behavioral Biometrics*, Daqing Hou, Stephanie Schuckers, Mahesh K. Banavar, 7/1/2017-2021, Funding for one GRA.

CITeR, *Toolkit for Explainable AI in Biometric Recognition*, Stephanie Schuckers (CU), Mahesh Banavar (CU), $50K, 1/1/2021-12/31/2021

CITeR, *LivDet 2021*, Stephanie Schuckers (CU), Thirimachos Bourlai $50K, 7/1/2020-6/30/2021

CITeR, *Uniqueness and permanence of iris*, Stephanie Schuckers (CU), Natalia Schmid (WVU), Joseph Scufka (CU), Matt Valenti (WVU), $50K, 7/1/2020-6/30/2021

CITeR, *Fingerprint Segmentation for Juveniles and Adults*, Stephanie Schuckers (CU), $50K, 7/1/2020-6/30/2021

CITeR, *Biometric Aging in Children Phase III*, Stephanie Schuckers (PI), Priyanka Das, Laura Holsopple (co-PIs), $50K, 7/1/2019-6/30/2021

CITeR, *Biometric Recognition Technology Under Scrutiny: Public Outreach on Technology Fundamentals* (DHS Special Project) Stephanie Schuckers (PI), Laura Holsopple, Daqing Hou, Mahesh Banavar (co-PIs), $100,000, 1/1/2020-12/31/2021

IARPA, *ODIN Presentation Attack Detection,* Arun Ross (PI), Schuckers (co-PI), $1.2M (Clarkson portion), 3/1/2017-3/2021.

NSF, *MRI: Acquisition of a Heterogeneous Computing Platform for Biometrics Research,* 1626360, Chen Liu (PI), Schuckers, Skufca (co-PI), 397,354.00, 10/1/2016-9/30/2020.

CITeR, Mitigation of Demographic Variability in Face Recognition using Relative Skin Reflectance Trained with a Direct Measure of Skin Reflectance (DHS Special Project) Stephanie Schuckers (PI), Mahesh Banavar, Keivan Bahmani (co-PIs), $60,000, 1/1/2020-12/31/2020

CITeR, Leveraging Biometrics and Smart Contracts to Control Access to Internet of Things, Yaoqing Liu (PI), Stephanie Schuckers (co-PI), 40K, 7/1/2019-6/30/2020

CITeR, Non-Contact Fingerprint Presentation Attacks and Detection, Stephanie Schuckers (PI), $20,000, 1/1/2020-12/31/2020

CITeR, Age Invariant Face Recognition in Children, Stephanie Schuckers (PI), Xin Li (WVU), Chen Liu, Keivan Bahmani (co-PIs), $40,000, 1/1/2020-12/31/2020

CITeR, Faster and more accurate mobile touch dynamics via feature selection and sequence learning Daqing Hou (PI), Mahesh Banavar, Stephanie Schuckers (co-PIs), $50,000, 1/1/2020-12/31/2020

CITeR, Adversarial Learning Based Approach Against Face Morphing Attacks (DHS Special Project) Chen Liu (PI), Stephanie Schuckers, Zander Blasingame (co-PIs), $60,000, 1/1/2020-12/31/2020

CITeR, Estimation of Age of Children Based on Fingerprint Images, Stephanie Schuckers (PI), Jeremy Dawson (co-PI), 50K, 7/1/2019-6/30/2020

SRC, *Heterogeneous Compute Architecture Design Towards Embedded Real Time Environment*, C. Liu (PI), Schuckers (co-PI), $130,502, 10/1/2018-9/30/2020.

CITeR, *Usage Scenario Oriented, Continuous User Authentication on Mobile Devices*, Banavar, Hou, Schuckers (co-PI), $40,000, 1/1/2019-12/31/2019.

CITeR, *Enabling Secure and Privacy Preserving Authentication via Blockchain Smart Contract and Biometrics*, Y. Liu (PI), Schuckers (co-PI), $40,000, 5/18/2018-8/31/2019

CITeR, *Light weight Machine Learning for Biometric Tasks on IoT Devices*, C. Liu (PI), Schuckers (co-PI), $43,000, 7/1/2018- 6/30/2019

CITeR, *Practical Evaluation of Free-text Keystroke Dynamics*, Hou (PI), Banavar, Schuckers (co-PIs), $40,000, 2/15/2018-6/30/2019

CITeR, *Biometric Aging in Children: Phases I and II*, Rissacher (PI), Schuckers, $100,000, 7/1/14-6/30/19.

Easy Dynamics, *Presentation Attack Detection Testing and False Accept Rate False Reject Rate Analysis*, Schuckers (PI), $30,000, 5/1/2018-12/31/2019.

DoD, *Demonstration of a Long-Term Sampling Approach for Distinguishing Sources of Volatile Organic Compounds in Indoor Air*, Rossner (PI), Crimi, Schuckers (co-PI), $481,681, 9/21/2015-3/20/2019.

NSF, *I/UCRC CGI: Collaborative Research - I/UCRC for Identification Technology Research*, PI with J Skufca, 3/1/2011-2/29/2018, $2,089,629.00 (NSF).

Additionally CITeR Affiliate fees collected (~$40K each per year) from DHS, Accenture, NIST, NSA, FLIR (6/2011), DACA, DHS OBIM, NexID Biometrics, Aware, StopSo. *Funds are awarded in projects approved by affiliates and listed as CITeR above and below.*

NSF, *AIR Option 2: Research Alliance- Identification Technology Transition Readiness and Accelerated Innovation Network (IT-TRAIN)*, Schuckers (PI) Bojan Cukic (former PI), $233,332, 2/23/2015-2/28/2018.

NSF, *TWC: Medium: Collaborative: Long-term Active User Authentication Using Multi-modal Profiles*, Venugopal Govindaraju (PI), Ifeoma Nwogu, Shambhu J. Upadhyaya, Schuckers (co-PI), Hou, $430,000, 9/15/2013-8/31/2018.

CITeR, *Validation of Biometric Identification of Dairy Cows based on Udder Vein Images*, Schuckers, Banerjee S, Banerjee N, $40.000 1/1/2017- 7/1/2018.

CITeR, *LivDet 2017*, Schuckers (PI), $40,000, 1/1/17-12/31/17

NSF, *Impedance-based Bioelectronic Tongue that Incorporates Antibodies*, Suni (PI), Schuckers (co-PI), 2011-2013, ~$350,000, 2011-2013.

CITeR, *LivDet 2015: Liveness Detection Competition 2015*, Schuckers (PI), $45,000, 7/1/14-6/30/15.

CITeR, *Benefits of Cross-spectral (visible, NIR and LWIR) and Cross-Distance Face Recognition In Non-Ideal Environments*, Schuckers (PI), Bourlai, Fang Hua, $40,000, 7/1/13-6/30/14.

CITeR, *Fingerprint Texture Modeling for Synthetic Fingerprint Generation and Liveness Detection*, Johnson (PI) Schuckers (co-PI) $40,000, 7/1/13-6/30/14.

CITeR, *Biometric Identification with a Remote Microwave Thoracic Radar*, Rissacher (PI) Schuckers (co-PI), Jemison, $40,000, 1/1/13-12/31/13.

CITeR, *Image Enhancement for Iris Recognition from Incomplete and Corrupted Measurements*, Stahl (PI) Schuckers (co-PI), $40,000, 1/1/13-12/31/13.

CITeR, *LivDet III: Liveness Detection Competition 2013*, Schuckers (PI), $60,000, 7/1/12-6/30/13.

CITeR, *Experimental Analysis of Latent Fingerprint*, Schuckers (PI), $54,000, 7/1/12-6/30/13.

CITeR, *Image Enhancement for Iris Recognition from Incomplete and Corrupted Measurements*, Stahl (PI), Schuckers (co-PI), $58,000, 1/1/12-5/30/12.

CITeR, *Stand-off Speaker Recognition: Effects of Recording Distance on Audio Quality*, Remus (PI), Schuckers (co-PI), $54,600, 1/1/12-5/30/13.

CITeR, *Multimodal Fusion for Stand-off Identity and Intent for 10-25 meters*, Schuckers (PI), $85,000, 7/1/11-12/30/12.

Intelligence Community Postdoctoral Award, *Thoracic Biometrics - Investigations of the Human Heartbeat as a Biometric: Heart Sounds, Electrocardiogram, and Vibrometry,* Schuckers (PI) with J. Skufca, 7/12/2010 to 7/11/2013, ~$250,000.

NexID Biometrics, LLC, *Software-Based Liveness to Prevent Spoof ing Fingerprint Biometric Scanners*, Schuckers (PI), $40,000, 1/1/2011-12/30/11.

NIH, *Objective Monitoring of Energy Intake and Ingestive Behavior in a Free Living Population*, Sazonov (PI), my part $23,400, 9/1/2010-8/30/2011.

AFRL, *Achieving Mission focused security in Cyber-Physical systems*, Skufca (PI), many others, $422,124, my part ~$15,000, 8/30/2010-10/27/2011.

NSF, *Fundamental Research Challenges for Trustworthy Biometrics Workshop,* Schuckers (PI), 10/1/2010 to 9/30/2012, $49,999.

NIST, *Evaluation of Anti-spoof ing Approaches for Fingerprint Biometric Recognition Systems,* Schuckers (PI), with Arun Ross (WVU), $220,108, 9/2010-2/29/2012

Department of Homeland Security, *Upstate NY Cyber Initiative: Creating an Innovative, Diverse STEM Cyber Worksforce,* Schuckers (PI) with J. Skufca, J. deCoste, 7/1/2011 to 6/30/2012, $100,000.

Li Creative Technologies, *Identification based on individual scent (IBIS),* Subcontract on Army SBIR, Schuckers (PI) with Rossner, 2/24/2011-8/28/2011, $21,000.

Li Creative Technologies *,Continuous Biometric-based; Computer Authentication During Mission Oriented Protective Posture Scenarios,* Schuckers (PI) with Rossner, 3/2011-8/31/2011, $25,000.

AIS, *Cybersecurity computing activity monitoring for continual authentication* , PI (Schuckers) with J. Matthews, 11/15/2010-10/31/2011, $50,000.

AFRL, *Advanced subspace techniques for modeling channel and session variability in a speaker recognition system*, Remus (PI), 10/1/2010-9/30/2011,~$90,000.

Hewlett Packard, *Development and Assessment of a Wearable Ubiquitous Biometric Device based on the HP MEMS Accelerometer*, $106,860, 7/1/2011-7/1/2012.

CITeR (WVU), *Enhancement & Quality Assessment Schemes for Challenging DNA Sample Analysis Data*, Dawson (PI), my part , $19,032, 7/1/10-11/30/11.

CITeR (Clarkson), *Non-Cooperative Biometrics at a Distance*, Remus (PI), with Schuckers, $70,000, 6/1/2010-1/31/2012.

CITeR (Clarkson), *Optimizing the design of large scale biometric security systems*, B. Cukic (PI), with Schuckers, my part $10,000, 6/1/2010-12/31/2011.

CITeR (WVU), *LivDet II Fingerprint Liveness Detection Competition 2011,* PI, $80,000 , 1/1/2011-11/30/2011.

LCT, *Mitigation of Contact Lens, Eye Surgery, Pupil Dilation, and Other Challenges on Iris Recognition***,** Subcontract on DHS SBIR, $32,000, 5/15/2011-11/30/2011

New World Pharmaceuticals, *Transdermal Drug Delivery System with Feedback Mechanism***,,** I. Suni (PI), S. Schuckers, 2/10/2011-4/30/2011, my part, $6,000.

National Science Foundation *Planning Grant: I/UCRC for Identification Technology Research,* Stephanie Schuckers (PI) with Edward Sazonov, Joseph Skufca, 2/1/10-1/31/11, $13,000 ($13,000).

Li Creative Technologies, *Synthetic Biometrics with Life-Like Appearance*, subcontract on DHS SBIR, 5/17/2010-11/16/2010, $20,000.

National Science Foundation I/UCRC Center for Identification Technology *Impact of Aging on Iris Recognition and Multibiometric Fusion with Liveness,* Stephanie Schuckers (PI) with Arun Ross 1/1/10-3/30/2011, $146,800 ($78,450).

National Science Foundation, *ITR Collaborative Research: Biometrics – Performance, Security, and Societal Impact,* Two linked proposals, Hornak (lead PI), SAC Schuckers (PI-link), A Jain, M Schuckers, L Nelson, B Cukic, 2/1/04-1/31/09, $3,079,550 (CU link: $1,718,870, $723,023 my part). Also received an NSF REU supplement ($12,000).

National Science Foundation I/UCRC Center for Identification Technology *LivDet 2009—Liveness Detection Competition,* Stephanie Schuckers (PI), 1/1/09-12/31/09, $28,000.

National Science Foundation I/UCRC Center for Identification Technology *Phase 1—Participation in The MultiBiometric Grand Challenge,* Stephanie Schuckers (PI) with Natalia Schmidt, B. Abidi, U. Kandaswamy, 1/1/09-12/31/09, $84,000 ($28,000).

National Science Foundation, *STTR Phase I: Software-Based Liveness to Prevent Spoofing Fingerprint Biometric Scanners,* Aaron Lewicke (PI, NexID Biometrics), Stephanie Schuckers (PI, Clarkson University), $147,326 (CU subcontract--$66,726), 1/1/08-6/30/09.

Zoll Lifecor, *Analysis and Prediction of Spontaneous Arrhythmias*, Stephanie Schuckers (PI), 8/25/07-2/24/09, $39,750 ($39,750).

National Institute of Health, *Detection of Chewing and Swallowing to Estimate Eating Patterns and Energy Intake*,, E. Sazonov (PI), Stephanie Schuckers, 9/1/05-8/31/09, $217,756 ($108,878).

National Science Foundation I/UCRC Center for Identification Technology *Phase 0—Participation in The MultiBiometric Grand Challenge,* Stephanie Schuckers (PI) with Natalia Schmidt, B. Abidi, U. Kandaswamy, 7/1/08-12/31/08, $30,000 ($10,000).

Syracuse Center of Excellence in Environmental and Energy Systems CARTI, *Personal Exposures and Cardiopulmonary Responses of Children Riding Diesal Powered School Buses,* Peter Jaques (PI) with A. Ferro, A. Rossner, S. Schuckers, 8/1/06-11/30/07, $100,000 ($25,000).

National Science Foundation I/UCRC Center for Identification Technology *Quality Based Restitution of Iris Features in High Zoom Images for Less Constrained Iris Recognition System,* Stephanie Schuckers (PI) with Natalia Schmidt, L. Hornak, 1/1/07-6/30/08, $90,000 ($45,000).

Primonics, *Development of a Voice Recognition Algorithm for Vision R&D Fingerprint/Voice Scanner,* Stephanie Schuckers (PI), 12/22/07-2/22/08, $25,000 ($25,000).

National Science Foundation I/UCRC Center for Identification Technology *Encryption of Biometric Templates using Biometrics as the Key,* PI with Sunil Kumar, 1/1/06-6/30/07, $84,000 ($57,000).

National Science Foundation I/UCRC Center for Identification Technology *Non-Ideal Iris Recognition: Segmentation and Algorithms,* Natalia Schmidt (PI) with G. Fahmy, X. Li, L. Hornak, 7/1/05-12/31/06, $95,000 ($40,400).

National Science Foundation I/UCRC Center for Identification Technology Research Grant*, Interoperability, Performance, and Fusion Issues in Fingerprint Sensors*, PI with Sunil Kumar, Arun Ross, 1/1/05-6/30/06, $105,000 ($32,175).

West Virginia University (Department of Defense), *Research Support for DOD Multi-Modal Biometrics,* co-PI, 12/1/04-12/31/05, $23,000 ($23,000).

West Virginia University (NSF), *ITR Collaborative Research: Compressed Search and Retrieval for Very Large Text and Image Repositories,* co-PI , 9/15/05-12/31/05, $12,953 ($12,953).

National Science Foundation I/UCRC Center for Identification Technology Research Grant*, Acquisition and Understanding of Partial Iris Imagery*, With Lawrence Hornak (PI), X. Li, G. Fahmy, A. Realini N. Schmidt, 1/1/04-6/30/05, $122,000 ($33,000).

National Institute of Health, *Predicting Life-Threatening Events in CHIME Infant Data,* 7/1/02-6/30/05, $157,000 ($157,000).

National Science Foundation I/UCRC Center for Identification Technology Research Grant*, Solidifying CITeR's Liveness Testing Core Competency*, Principal Investigator with Lawrence Hornak, Tim Norman, 1/1/03-6/30/04, $75,000 ($51,255).

Cameron Health, *Analysis of Electrocardiogram, 7/1/02-9/30/02*, $7,806 ($7,806).

West Virginia University Grants

STS, International (prime for DOD), *Biometrics and IA Curriculum*, Co-PI with Larry Hornak, Bojan Cukic (PI), Michael Schuckers, 7/25/2001-7/24/2004, $262,443 ($65,610).

National Science Foundation I/UCRC Center for Identification Technology Research Grant*, Determination of Liveness in Biometric Devices*, Principal Investigator with Lawrence Hornak, Tim Norman, 8/16/01-12/31/02, $105,000 ($50,000).

National Science Foundation, REU Supplemental Funding: *Analysis of Spontaneous Arrhythmias in the Chronic Adriamycin Model of Heart Failure,* Principal Investigator, 7/1/00-12/31/02, $10,000 ($10,000).

National Science Foundation, POWRE: *Analysis of Spontaneous Arrhythmias in the Chronic Adriamycin Model of Heart Failure,* Principal Investigator, 7/1/99-12/31/02, $75,000 ($75,000).

National Science Foundation, REU Supplemental Funding: *Analysis of Spontaneous Arrhythmias in the Chronic Adriamycin Model of Heart Failure,* Principal Investigator, 7/1/99-12/31/02, $10,000 ($10,000).

American Heart Association, *Signal Processing for Prediction of Sudden Cardiac Death in Adriamycin Animal Model of Heart Failure,* Principal Investigator, 7/1/99-6/30/02, $60,000 ($60,000).

STS, International (prime for DOD), *West Virginia Army National Guard Quick Look Biometric Test and Evaluation of Biometric Systems*, Co-PI with Larry Hornak, Bojan Cukic, Michael Schuckers (PI), 1/801-8/17/01, $19,250 ($5,000).

West Virginia University Research Corporation, *Signal Processing in Biomedical Devices*, Principal Investigator, 7/1/98-6/30/01, $30,000 ($30,000).

NASA EPSCOR, *Exploration and Expansion of Identification Technologies Research*, Principal Investigator with Larry Hornak, 7/1/99-6/30/00, $38,970 ($20,000).

National Science Foundation I/UCRC Planning Grant, *Center for Identification Technology Research,* Participant with Lawrence Hornak (PI), 1/1/01-12/31/01, $10,000 (N/A).

WVU-ARTS, *Detecting Physiological Changse in Massive Temporal Datasets,* Co-PI with Michael Schuckers and Kris Krajnek, 7/1/00-6/30/01, $33,000 ($11,000).

ALCOA Faculty of the Future, *Research in Computers in Cardiology*, Principal Investigator, 8/1/99-12/31/99, $3,289 ($3,289).

West Virginia Space Grant Consortium Research Capability Enhancement Award, *Signal Processing for Prediction of Sudden Cardiac Death*, Principal Investigator, 3/31/99-8/1/99, $1,000 ($1,000).

University of Memphis, *Approximate Entropy and Other Analysis for CHIME*, Subcontract on NIH study, Principal Investigator, 9/8/98-8/15/99, $21,754 ($21,754).

Veridicom, Inc, *Sensing and Recognition of Finger Vitality Using the Veridicom CMOS Fingerprint Sensor*, Principal Investigator with Larry Hornak, Tim Norman, 9/17/98-8/15/99, $16,425 ($15,000).

Veridicom, Inc, *The Veridicom CMOS Fingerprint Sensor: Sensing Mechanisms Electrostatic Modeling*, Co-Investigator (unfunded) with Larry Hornak (PI), Tim Norman (unfunded), 9/17/98-8/15/99, $16,608 ($2,000).

West Virginia Space Grant Consortium, *Continuous-time analysis of pre- and post-flight physiological signals for determination of the mechanism of orthostatic intolerance*, Principal Investigator, 9/17/97-6/30/98, $20,000 ($20,000).

GE Faculty of the Future Program, West Virginia University, *Signal Processing in Modern Biomedical Devices*, Principal Investigator, 7/28/97-10/1/98, $20,000 ($20,000).

Association of Women in Science – WV chapter – Career Enhancement Award, *Collaboration with University of Memphis Researchers for Development of Animal Model of Sudden Death*, Principal Investigator, 5/1/98-8/30/98, $1,700 ($1,700).

WV-ESPCOR Mini-Grants, *Development of a Proposal to NSF-CAREER*, 4/1/98-8/30/98, Principal Investigator, $3,000 ($3,000, plus $1,000 for two mentors).

3. *Equipment grants or donations*

Coulter Foundation (from gift to Clarkson University), *Development of the Biomedical Signal and Image Processing Group*, 1/1/03-12/31/04, with S. Kumar, E. Sazonov, A. Ziarani, $110,000 ($27,500).

NSF-EPSCoR, *West Virginia Blueprint for Science and Technology: Strengthening Statewide Multidisciplinary Academic Research Infrastructure*, Participant with Paul Hill (PI), Lawrence Hornak (co-PI), Laura Jenski (co-PI), Frances Van Scoy (co-PI), 1/1/2002-12/31/2005, 8,937,895. ~$550,000 for Statistical Biosignal and Image Processing Group (~$100K shared equipment).

NSF EPSCOR Infrastructure, *Identification Technology*, 8/1/01-12/31/01, Participant, Included $122,000 ($60,000) equipment specifically for biomedical signal processing group.

NSF EPSCOR Infrastructure, *Identification Technology*, 7/1/98-6/30/01, Participant, Included $100,000 equipment specifically for biomedical signal processing ($50,000)

Hewlett Packard, *Collaborative Medical Informatics Laboratory*, Technical participant, Co-Director of Technical Management Group, Donation of ~$500,000 (shared) worth of equipment, 7/1/97-6/31/2000.

IV. SERVICE ACTIVITIES

A. Profession

International Offices Held

2020-pres **Board of Directors,** *Biometrics Institute*

2018-pres **Head***, Academic Innovation Group, Biometrics Institute*

2009-pres **Co-Chair, Liveness Detection Competitions, LivDet 2009, 2011, 2013, 2015, 2017**

2015-pres **Chair**, Biometrics Sub-group, FIDO Alliance (standards for authentication to replace the password) (July 2015- present)

2018-2019 **Conference Chair,** *IEEE BTAS 2019*

2018-2019 **Program Chair,** *IEEE ISBA 2019*

2016-2018 **Program Committee,** *FedID*

2012-2017 **Vice President for Finances***, IEEE Biometrics Council*

2017 **Program Chair***, NSF IUCRC Biennial Meeting 2017*

2015 **Competition Chair**, *IEEE BTAS 2015 Conference*

2015 **Finance Chair**, *IEEE ISBA 2015 Conference*

2011-14 **Chair,** *IEEE Biometrics, Identity, and Systems (BIDS)* **2011, 2012, 2013, 2014**

2010 **Co-Chair,** *NSF Workshop on Fundamental Challenges in Trustworthy Biometrics*, ~40 attendees from university, government, and industry, Nov. 8-9, 2010

2006-2010 **Webmaster**, *International Society of Computerized Electrocardiology*

2000 **Chair, Professional Activities and Continuing Education (PACE) Committee**, *IEEE Engineering Medicine and Biology Administrative Committee*

1999-00 **Region 2 Representative**, *IEEE Engineering Medicine and Biology Administrative Committee*

1999 **PACE Committee**, *IEEE Engineering Medicine and Biology Administrative Committee*

Regional Offices Held

2000-01 **Chair**, *IEEE Upper Monongahela Subsection*

1998-9 **Vice-Chair**, *IEEE Upper Monongahela Subsection*

1997-8 **Secretary/Treasurer**, *IEEE Upper Monongahela Subsection*

Offices Held at University

1994 **Graduate Committee Director**, *Society of Women Engineers*
Founded and directed a graduate group for women in engineering. (5th year Anniversary was held in November, 1999. Still active as of 2019)

1995 **Symposium Co-Organizer**, *Society of Women Engineers*
Organized the first-ever UM Women in Engineering Symposium, a one-day event which hosted over 45 speakers and 125 attendees.

Standards Activities

2017-pres **Contributor** (through FIDO Liaison), ISO/IEC JTC 1/SC 37, 30107-4, Information Technology—Biometric presentation attack detection— 5 Part 4: Profile for testing of mobile devices

2017-pres **Contributor** (through FIDO Liaison), ISO/IEC JTC 1/SC 37, 19795-9, Information technology – Biometric performance testing and reporting -- Part 9: Testing on mobile devices

2010-11 **Contributor** (US Delegation), ISO/IEC JTC 1/SC 37, 30107-3, Information technology — Biometric presentation attack detection — Part 3: Testing and reporting

2010-11 **Contributor** (US Delegation), ISO/IEC JTC 1/SC 37, 30107-1, Information technology — Biometric presentation attack detection — Part 1: Framework

Memberships

Senior Member, *Institute of Electrical and Electronics Engineers, 2007*
Member, *Institute of Electrical and Electronics Engineers, 1996*
Member, *Society of Women Engineers*
Member, *International Society for Computerized Electrocardiology*
Member, *Sigma Xi, The Scientific Research Society*
Member, *American Society for Engineering Education*
Member, *Tau Beta Pi, 1990*
Member, *Eta Kappa Nu, 1990*
Member, *Association for Women in Science, 1998*

B. Recent Referee Activity

2018-pres **Associate Editor,** IEEE Transactions on Biometrics, Behavior, And Identity Science

2019 **NSF Review Panel,** IUCRC Program, May 2019.

2008 **Co-Editor,** Special Issue on Biometrics, *EURASIP Journal of Applied Signal Processing*

2002-pres **Member,** Conference Program Committees, *IEEE BTAS; ICB; IJCB; ICIP; CVPR Workshop*

Reviewer (episodically)

Pattern Recognition
IEEE Transactions on Information Security and Forensics
IEEE Pattern Analysis and Machine Intelligence
IEEE Transactions on Systems, Man, and Cybernetics
EURASIP Journal of Applied Signal Processing
John Wiley & Sons
NIH SBIR
IEEE Engineering Medicine & Biology Magazine
Physiological Measurement
American Heart Association
IEEE Transactions on Biomedical Engineering
National Science Foundation
Medical & Biological Engineering and Computing
IEEE Transactions on Education
IEEE Southeastern Symposium on System
North American Society of Pacing and Electrophysiology

C. Service to University

Clarkson University

2021-pres **Interviewer***, Clarkson Honors Program*
2021-pres **Reviewer***, Clarkson Goldwater Scholar Committee*
2020-pres **Mentor***, ClarksonConnect, mentored 8 freshman students*
2019-pres **Faculty Advisor***, FIRST Robotics SPEED Team*
2018-pres **Member**, *Dept Promotion and Tenure Committee*
2017-pres **Member**, *University Research Committee*
2015-pres **Faculty advisor**, Tau Beta Pi
2017-pres **Member**, *ADVANCE STEM-LEAF Leadership Committee*
2018-20 **Member**, *ECE Faculty Search Committee*
2019-20 **Chair**, *ECE Computer Engineering Search Committee*
2019 **Chair**, *ADVANCE STEM-LEAF Director Position Search Committee*
2018-2019 **Chair**, *Provost Search Committee*
2017-2018 **Chair**, *CEE Chair Search Committee*
2012-2017 **Member**, *ECE Faculty Search Committee*
2013-2018 **Editor***,* ECE Facebook page
2015–2018 **Member***,* Systems Adhoc committee (developing graduate tracks)
2015 **Member***,* CEPHOS committee (explored emergency management and homeland security graduate program - disbanded)
2012-2013 **Member**, *University Tenure Committee*
2012-2013 **Chair**, *Marketing Committee, ECE Department*
2010 **Presentation**, Clarkson Alumni Luncheon, The Tower, Tyson's Corner, VA, December 2010.
2010 **Presentation**, *Fingerprints, Iris Scans and Voice Recognition: The Real Threat of Spoofing*, Family Weekend, 2010.
2009-2010 **Member**, *ECE Chair Search*
2009 **Presenter**, Biometrics, Fingerprints, and Spoofing, *Science Café Presentation, Oct 2009.*
2008-2011 **Member**, *Undergraduate Research Committee*

2005-2011 **Chair**, *Biomedical and Rehabilitation Engineering and Science Curriculum Committee*

2007-2008 **Co-advisor**, *Society of Women Engineers* student group
-Organized panel discussion at Clarkson Alumni Reunion for 35th anniversary, July 08.

2007-2008 **Presentation**, *Fingerprints, Iris Scans and Voice Recognition: The Real Threat of Spoofing*, Clarkson University Alumni Reunion, 2007, 2008.

2004-5 **Member**, *College Open Faculty Search Committee*

2004-5 **Member**, *Director of Bio/Rehabilitation Engineering Search Committee*

2004 **Mentor**, Assistant Professor, Alireza Ziarani, ECE

West Virginia University

2001 **Member**, *Search Committee for College of Engineering and Mineral Resources Associate Dean for Research*

2000 **Featured in President's State of the University Address and Report**, *WVU Research: Supporting Economic Transformation of our State and Nation*

1999-00 **Member**, *Departmental Promotion and Tenure Committee*

1998-2002 **Member**, *Electrical Engineering Curriculum Committee*

1998-2002 **Faculty Advisor**, *West Virginia University Biomedical Engineering Society Student Chapter*

1997-2002 **Faculty Counselor**, *West Virginia University Society of Women Engineering Student Chapter*

1999-00 **Member**, *Dean of College of Engineering and Mineral Resources Five-Year Review Committee*

1998-2002 **Member**, *West Virginia University Bioengineering Executive Committee*

1998-2002 **Member**, *West Virginia University Biometric Curriculum Committee*

1998 **Workshop Coordinator,** *AWIS Science: It's a She Thing***,** High School Girls Science One-Day Workshop

C. Featured or quoted in the following:

Selected Media Coverage

2021 Biometric PAD standards in competition against spoof attacks, not each other: Stephanie Schuckers, Chris Burt, Jan 4, 2021. https://www.biometricupdate.com/202101/biometric-pad-standards-in-competition-against-spoof-attacks-not-each-other-stephanie-schuckers

2020 Competition results show iris biometric liveness detection a work in progress, Chris Burt, Sep 8, 2020. https://www.biometricupdate.com/202009/competition-results-show-iris-biometric-liveness-detection-a-work-in-progress

2019 CITeR Director talks research to inform dialogue on children's biometrics and privacy, Chris Burt, Dec 3, 2019. https://www.biometricupdate.com/201912/citer-director-talks-research-to-inform-dialogue-on-childrens-biometrics-and-privacy

2018 4 technologies a cyber moonshot should include, Fifth Domain, Justin Lynch, November 18, 2018.

2017 How To Make Spoof-Proof Biometric Security, National Public Radio Science Friday, 08/11/2017, https://www.sciencefriday.com/segments/how-to-make-spoof-proof-biometric-security/

2017 That Fingerprint Sensor on Your Phone Is Not as Safe as You Think, Vindu Goel, April 10, 2017. https://www.nytimes.com/2017/04/10/technology/fingerprint-security-smartphones-apple-google-samsung.html?_r=0

2016 The Macbook Pro's Most Important New Feature? Touch Id, Rian Barrett, Wired Magazine, 10/29/2016. https://www.wired.com/2016/10/macbook-pro-touch-id-secure-enclave/

2015 Biometrics researchers race to stay one step ahead of hackers, Joe Uchill, Christian Science Monitor, Jan 13, 2015. http://www.csmonitor.com/World/Passcode/2015/0113/Biometrics-researchers-race-to-stay-one-step-ahead-of-hackers

2015 Interview, Planet Biometrics, April 22, 2015. http://www.planetbiometrics.com/article-details/i/2956/

2015 BBC News, In your irises: The new rise of biometric banking, 3/20/2015. http://www.bbc.com/news/business-31968642

2015 Business Insider, The rise of biometric security could 'kill the password dead', 3/7/2015, http://www.businessinsider.com/afp-as-hacking-grows-biometric-security-gains-momentum-2015-3

2015 Clarkson Press Release, Clarkson University Professor Says Iris Recognition Gives Smartphone Users More Security Options, 06-23-2015
Picked up by:
-http://cacm.acm.org/news/188806-clarkson-university-professor-says-iris-recognition-gives-smartphone-users-more-security-options/fulltext
http://mobileidworld.com/clarkson-university-iris-recognition-6244/
-http://www.biometricupdate.com/201506/professor-says-iris-recognition-gives-smartphone-users-more-options-to-protect-devices
-Several others

2011 **Interview, "**CITeR: Researching the present and future of biometrics," *Third Factor,* January, 2011. http://www.thirdfactor.com/2011/01/10/citer-researching-the-present-and-future-of-biometrics

2010 **Radio Interview, "**WikiLeaks Raises Specter Of Biometric Data," *All Things Considered, National Public Radio*, November 30, 2010

2007 **Article**, "The Door Key That Can't Be Misplaced " *The New York Times*, June 10, 2007.

2007 **Article**, "Fingered" *Odyssey Magazine*, October, 2007.

2005 **Article**, "Is That a Finger or a Jell-O Mold? " *The New York Times*, Dec. 20, 2005

2005 **Article**, "Biometric expert shows an easy way to spoof fingerprint scanning devices", *Physorg.com,* Dec. 11, 2005

2005 **Video**, "Fooling the finger scanner", *Daily Planet* archives, Discovery Channel Canada, Dec. 13, 2005

2005 **Article and RealAudio**, "Fake Fingers and Computer Security" from Public Radio's *Future Tense*, Dec. 14, 2005

2003 **Article,** "Progress: Summaries of Research and Inventions from Science and Technology Journal," *IEEE Spectrum*, (for Pattern Recognition 2003 article), March, 2003

V. PATENTS & PATENT APPLICATIONS

US Patents Awarded

2019 Moshier, T.F., Doctor, K.A., **Schuckers, S.A.,** Banerjee, S.K. and Li, B., SRC Inc, 2018. *Methods and Systems for Biometric Identification of Dairy Animals Using Vein Pattern Recognition*. 10,474,791, November 12, 2019 (Application 15/712,370)

2019 F, Suni I, Cetinkaya C, **Schuckers S**, Sazonov E, *Integrated intra-dermal delivery, diagnostic and communication system*, 10,384,005, August 20, 2019.

2017 **Schuckers S**, Johnson, P, *Fingerprint pore analysis for liveness detection, 9,818,020*, November 14, 2017. (Application: US#1014/0294262 A1, PCT#61/807512, April 2014)

2017 Esra Vural, Mark Van Order, Peter Nyholm, **Stephanie Schuckers**, *Determining a user based on features*, 9,609,511, March 28, 2017. (Application 61/873,633, 9/4/2013)

2016 Aditya Abhyankar, **Stephanie Schuckers**, Lawrence Hornak *"Multi-Resolutional Texture Analysis Fingerprint Liveness Systems and Methods"* 9,367,729, June 14, 2016. (Divisional application 13/938,477, Filed May 30, 2014).

2015 Ian Suni, Yin Huang, **Stephanie Schuckers,** *Bioelectronic tongue for food allergy detection*, 9,201,068, December 1, 2015

2015 Sexton; Frederick A., Suni, Ian Ivar Cetinkaya, Cetin; **Schuckers, Stephanie**, Sazonov; Eduard, *Integrated intra-dermal delivery, diagnostic and communication system* United States Patent #9,022,973, May 5, 2015. (Application: 20100222224, submitted September 2, 2010)

2013 Aditya Abhyankar, Lawrence Hornak, **Stephanie Schuckers**, *"Fingerprint Liveness Analysis",* US Patent # 8,498,458, Issued July 30, 2013

2012 **Stephanie Schuckers**, Lawrence Hornak, Bozhao Tan, *"Regional fingerprint liveness detection systems and methods",* US Patent # 8,098,906, Issued January 17, 2012

2012 Aditya Abhyankar, **Stephanie Schuckers**, Lawrence Hornak *"Multi-Resolutional Texture Analysis Fingerprint Liveness Systems and Methods",* US Patent # 8,090,163, Issued January 3, 2012. (Application: 60/919,043 dated March 20, 2007, full patent submission dated October 8, 2008; 60/850,664, submitted 10/9/06, full patent submission dated October 8, 2007)

1999 **Stephanie Caswell**, Janice Jenkins, Lorenzo DiCarlo, *Method and Apparatus for Separation of Ventricular Tachycardia From Ventricular Fibrillation For Implantable Cardioverter Defibrillators* #5,857,977, Submitted August 1996, Awarded January 12, 1999

US Patent Applications (in progress)

2022 **U.S. Patent Application**, D Hou, S Schuckers, M Banavar, B Ayotte, System and method to authenticate users on a computing system using a free text behavioral biometric method, US Patent App. 17/591,385

2014 **U.S. Patent Application,** D. Rissacher, W. Jemison, S. Schuckers, *Cardiovascular and Pulmonary Radar System*. 12/8/2014, Application # 14563738, Provisional: 61/912,920, 12/6/2013.

2017 **US Patent Application**, *User Specific Classifiers For Biometric Liveness Detection*, 63/330,996, Priority Date: May 3, 2016, Full patent application submitted 5/2017.

Applications (not pursued)

2004 **U.S. Provisional Patent Application Submitted**, *A wavelet-based approach to detecting liveness in fingerprint scanners,* Submitted April, 2004, not pursued to completion

1999 **U.S. Provisional Patent Application Submitted**, *Method and Apparatus for Determining A Living Finger On A Fingerprint Sensor*, Submitted September, 1999, not pursued to completion

V. OTHER

2017-pres Editor, FIDO Biometric Certification Requirements, June 06, 2019 https://fidoalliance.org/specs/biometric/requirements/

2013 **Congressional Testimony,** *The Current and Future Applications of Biometric Technologies,* Subcommittee on Research and Subcommittee on Technology Joint Hearing, US House of Representatives, May 21, 2013. http://science.house.gov/hearing/subcommittee-research-and-subcommittee-technology-joint-hearing-current-and-future