Songning Zhu

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SUMMARY

Research scientist specializing in cancer biology, optical imaging, and machine learning-driven analysis of subcellular structures. Over five years of experience leading lab-based projects in tumor microenvironment, chemoresistance pathways, and organelle-specific treatments. Expertise in cellular engineering, single-cell workflows, and advanced imaging techniques.

EDUCATION

University of California, Irvine, The Henry Samueli School of Engineering Expected: May 2025
Doctor of Philosophy in Biomedical Engineering, Biophtonic concentration GPA:3.96/4.00
The Pennsylvania State University, University Park - College of Engineering State College, PA
Bachelor of Science in Biomedical Engineering Month and Year Received: May 2020
Cum Laude GPA:3.83/4.00

TECHINICAL SKILLS:

Scientific Computing: Python, MATLAB, R, ImageJ, SOLIDWORKS, Microsoft Office
Microscopy & Imaging: Confocal & Two-Photon Microscopy, Fluorescence Lifetime Imaging, 3-D Tissue Imaging, Hyperspectral & Bioluminescence Imaging
Data Processing & Machine Learning: Pandas, NumPy, scikit-learn (sklearn)
Laboratory Techniques:DNA Purification/Amplification, ECG Amplifier Design, Spin-Coating, Graphene Monolayer Exfoliation, FESEM, Block Copolymer Synthesis
Cell Culture: Human Cell Line, Animal Cell Line

EQUIPMENT MAINTENANCE

Microscopy Systems: Regular maintenance and calibration of advanced microscopy equipment: ZEISS LSM 880, LSM 710, ISS Alba, and home-built bioluminescence imaging system
Lab Equipement: Oversaw the operation and upkeep of 4 incubators and 5 biosafety cabinets, ensuring compliance with laboratory safety protocols.

RESEARCH EXPERIENCE:

Digman Lab Irvine, CA
Graduate Research Assistant July 2020 till present

- Phasor Unmixing to Reveal Organelle Organization and Cellular Response in Chemoresistant MDA-MB-231 Cells (66th Biophysical Society presenter)
    - Two photon, confocal microscopy hyper-spectral imaging and unmixing for cellular dynamics
    - Designing and implementing a robust pipeline for algorithm analysis on high-dimensional datasets using Python
    - Using phasor model to understand drug perturbation in complex chemoresistance MDA-MB-231 model
- Investigation of metastasis potential using PHLDA2 breast cancer overexpression model via machine learning
- Development of Mechano-Sensitive Biomaterials for Cardiomyocyte Monitoring Using Hyperspectral Imaging and Advanced Signal Processing

Bio-Photonics and Ultrasound Imaging Laboratory State College, PA
Undergr*aduate Research Assistant* January 2019 to December 2019

- Understanding and operation of the functionality of photo-acoustic imaging: ACOUSTIC X, Verasonics
- Investigation of photo-acoustic and ultrasounds imaging in the application of neonatal brain
- Modeling the biological response to photo-acoustic stimulus using MATLAB and SOLIDWORKS

PUBLICATIONS

Scipioni, L., Tedeschi, G., Navarro, M., Jia, Y., **Zhu, S.**, Halbers, L. P., Di Bona, M., Atwood, S., Prescher, J. A., Gratton, E., & Digman, M. *ESPRESSO: Spatiotemporal omics based on organelle phenotyping*. *Nature Methods* (In Press).

Hedde, P. N., **Zhu, S.**, Barylko, B., Chiu, C. L., Nelson, L. T., Digman, M. A., Albanesi, J. P., James, N. G., & Jameson, D. M. (2024). Effect of pathogenic mutations on the formation of high-order Dynamin 2 assemblies in living cells. *Biochemistry, 63*(21), 2750-2758. [DOI: 10.1021/acs.biochem.4c00262]. PMID: 39390788.

Fazel, M., Jazani, S., Scipioni, L., Vallmitjana, A., **Zhu, S.**, Gratton, E., Digman, M. A., & Pressé, S. (2023). Building fluorescence lifetime maps photon-by-photon by leveraging spatial correlations. *ACS Photonics*.

Zhu, S., Digman, M., Thompson, J., & Campos-Chillon, F. (2023). IVF bovine oocyte classification and selection. *Biophysical Journal, 122*(415a). [DOI: 10.1016/j.bpj.2022.11.2253].

Zhu, S., Scipioni, L., & Digman, M. (2022). Phasor unmixing to reveal organelle organization and cellular response. *Biophysical Journal, 121*(278a). [DOI: 10.1016/j.bpj.2021.11.1352].

Manuscripts in Preparation: **Zhu, S.**, Scipioni, L., & Digman, M. PRISMOS: Single-Excitation Phasor-Resolved Hyperspectral Imaging for Multiplexed Organelle Phenotyping in Chemoresistant Triple-Negative Breast Cancer (main PhD. thesis)

PROFESSIONAL EXPERIENCE:

Optical Engineer Intern, KLA Milpitas

- Investigate different design options and finding the best option through evaluating tolerances, manufacturability, light budgets and other trade-offs.
- Perform a tolerancing analysis for optical components or optical system
- Building analysis pipeline with computer science department for precision control

Capstone Design Project, BME Department at Pennsylvania State University State College, PA

Project Leader Fall 2019

- Facilitated meetings, delegated tasks, and ensure completion of the team's mission to design a micro-fluidic device that allows plasma protein isolation with a budget of $3000 over the course of a semester
- Manufactured the graphene oxide monolayer member via block co-polymer synthesis and reactive ion etching. And the characterization via FESEM
- Compiled a 41 page proposal and a showcase poster to the sponsor company.
- Effectively communicated with the other team for a smooth transition of the remaining project

CAMPUS & COMMUNITY INVOLVEMENT

Undergraduate Student native for Biomedical Research (USIBR) July 23 - July 28, 2023 & July 29 - August 2024

Workshop leader

- Lecturing & Teaching: Deliver engaging lectures on topics related to optical imaging and quantitative biology alongside Prof. Digman, Prof. Enrico Gratton, and other expert postdoctoral fellows.
- Mentorship & Leadership: Lead a team of 5-10 undergraduate students through an intensive, hands-on research experience, fostering critical thinking and hypothesis-driven exploration.
- Project Guidance: Design and guide "mini" research projects, allowing students to test real-world biological questions and contribute to ongoing research in the lab.
- Skill Development: Help students develop laboratory techniques, data analysis skills, and scientific communication abilities in a collaborative and supportive environment.

Vice President o Social Affairs, AGS August 2021 till August 2022

- Event planning & Execution: Lead the social committee in organizing monthly pub bights, trivia/karaoke events and large-scale social gatherings
- Campus-wide coordination: represented graduate student interests in major campus events, including graduate student orientation
- Marketing & Outreach: Collaborated across different organizations such as SWE, Partnered with organizations such as the Graduate Resource Center (GRC), International Center, DECADE, GPS-STEM, and departmental graduate associations to co-host events and expand outreach.
- Leadership: Worked with AGS executives and council members to align social programming with student need

Social Program Coordinator, AGS August 2021 till August 2022

- Design, organize and conduct UCI graduate student community-based social programs and service

International Chair, **AGS** August 2020 to August 2021

- Identify and assess the needs and desires of international graduate students

- Design and provide quarterly events of a social, professional development, or networking nature and coordinate with the clubs and resources on campus.
- Communicate with service providers present on campus about international students.
- Advocate for international student needs and concerns both on and off-campus.
- Create a gateway for international student participation in the Student Government.

Teaching Assistant for Biomechanics, University of California, Irvine December 2020 to March 2021
- Held study sessions to go over important concepts in class
- Meeting with the instructor for student feedbacks
- Grade the weekly homework and exams

Organic Chemistry Tutor, The Pennsylvania State University January 2018 to December 2018
- Held study sessions and discussion session for study assist and exam preparation
- Collaborated and assisted the teaching team to arrange academic plans and provide student feedbacks.

Undergraduate Research Symposium (UROP) Oral Presentation Judge May 2024
- UROP presentation video competition Judge

Undergraduate Research Symposium (UROP) Research Symposium Judge May 2024
Undergraduate Research Symposium (UROP) Poster Presentation Judge May 2024
Undergraduate Research Symposium (UROP) Research Symposium Judge December 2024

AWARDS

Undergraduate Research Symposium (UROP) Awardee 2023
"Evaluation of anti-breast cancer treatments at the organelle level" (TOTAL: $400)
Second Place, AGS Annual Graduate Research Symposium 2023
Recipient, Center for Complex Biological System 2024
"Learning from live cell hyper spectral fluorescence imaging data via stochastic physics informed equivariant autoencoders" (TOTAL: $11,000)

MEETING & CONFERENCES

Biophysical Society 66th Annual Meeting **San Francisco**
Student presenter February 2022
Presentation topic: Phasor Unmixing to Reveal Organelle Organization and Cellular Response. Zhu, Songning et al. Biophysical Journal, Volume 121, Issue 3, 278a.

Center for Advanced Design and Manufacturing of integrated Microfluidics Meeting **Irvine**
Presentation topic: Phasor Unmixing to Reveal Organelle Organization and Cellular Response. February 2022

Biophysical Society 67th Annual Meeting **San Francisco**
Student presenter February 2023
Presentation topic: IVF Bovine Oocytes Classification and Selection. Zhu, Songning et al. Biophysical Journal, Volume 122, Issue 3, 415a

Biophysical Society 68th Annual Meeting **San Diego**
Student presenter February 2024
Presentation topic: IVF Bovine Oocytes Classification and Selection. Zhu, Songning et al. Biophysical Journal, Volume 122, Issue 3, 415a

Biophysical Society 69th Annual Meeting **Los Angeles**
Student presenter February 2025

15th LFD Workshop in Advanced Fluorescence Imaging and Dynamics **Irvine**
Workshop Leader: Leading hands-on session for over 30 participants October 2021

16th LFD Workshop in Advanced Fluorescence Imaging and Dynamics **Irvine**
Workshop Leader: Leading hands-on session for over 30 participants October 2022

17th LFD Workshop in Advanced Fluorescence Imaging and Dynamics **Irvine**
Workshop Leader: Leading hands-on session for over 30 participants October 2023

18th LFD Workshop in Advanced Fluorescence Imaging and Dynamics **Irvine**
Workshop Leader: Leading hands-on session for over 50 participants October 2024
Workshop Lecturer: Lecture Hyperspectral Imaging

MEDICAL SHADOWING

UCI hospital
Radiology/Advanced Imaging, Pathology, Advanced Heart Failure, Nephrology, Gastroenterology, Vascular Surgery, Urology 5-7 hours/department ~40 hours

Xiangya Hospital Central South University Psychiatry department **July 2019**
- Laboratory of National Clinical Research Center for Mental Disorders 45 hours
- Under the supervision of Dr. Hao Wei.

China's National Center for Cardiovascular Diseases
- Pediatric department 30 hours
- Under the supervision of Dr. Li Hanmei

VOLUNTEERING

Kaiser Permenate **Irvine**
Health scholar March 2025 till present
- **Clinical Support:** Work alongside nurses, physicians, and allied health professionals to assist in providing basic patient care.
- **Administrative Exposure:** Learn about healthcare operations, hospital workflows, and the business of healthcare.

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Zhu, Songning (32441521)
BIOMEDICAL ENGR (GRADUATE DIVISION)

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Master's Degrees

ADVANCED TO CANDIDACY - 02/23/22
PLAN II - COMPREHENSIVE EXAMINATION OF BIOMEDICAL ENGINEERING PASSED 06/07/24
DEGREE CONFERRED - JUNE 14, 2024
MS BIOMEDICAL ENGINEERING

Doctoral Degrees

ADVANCED TO CANDIDACY - 09/22/23

2020 Fall Quarter

MOLECULAR CELL ENGR	BME	210	4.0	A	16.0	
SENSORY MOTOR SYS	BME	220	4.0	A-	14.8	
APPLIED ENGR MATH I	BME	230A	4.0	A	16.0	
RESEARCH METHOD DIS	BME	295	2.0	A+	8.0	
SEM IN BIOMED ENGR	BME	298	2.0	S	0.0	SU
INDIVIDUAL RESEARCH	BME	299	2.0	A+	8.0	

Term Totals ATTM: 16.0 PSSD: 16.0 GPTS: 62.8 GPA: 3.925

Cumulative Totals ATTM: 16.0 PSSD: 16.0 GPTS: 62.8 GPA: 3.925

2021 Winter Quarter

CANCER BIOLOGY I	MOL BIO	217A	4.0	A	16.0	
ORGAN TRANSPORT SYS	BME	221	4.0	A-	14.8	
APPLIED ENG MATH II	BME	230B	4.0	A-	14.8	
SEM IN BIOMED ENGR	BME	298	2.0	S	0.0	SU
INDIVIDUAL RESEARCH	BME	299	2.0	A+	8.0	

Term Totals ATTM: 14.0 PSSD: 14.0 GPTS: 53.6 GPA: 3.829

Cumulative Totals ATTM: 30.0 PSSD: 30.0 GPTS: 116.4 GPA: 3.880

2021 Spring Quarter

UNIVERSITY TEACHING	ENGR	399	4.0	S	0.0	SU
SPECTROSCOPY & IMAG	BME	238	4.0	A+	16.0	
PHD DISSERTATN RSCH	BME	297	6.0	A+	24.0	
SEM IN BIOMED ENGR	BME	298	2.0	S	0.0	SU

Term Totals ATTM: 10.0 PSSD: 10.0 GPTS: 40.0 GPA: 4.000

Cumulative Totals	**ATTM: 40.0**	**PSSD: 40.0**	**GPTS: 156.4**	**GPA: 3.910**			

2021 Fall Quarter

UNIVERSITY TEACHING	DEV BIO	399	4.0	S	0.0	SU
PHD DISSERTATN RSCH	BME	297	6.0	A+	24.0	
SEM IN BIOMED ENGR	BME	298	2.0	S	0.0	SU
Term Totals	**ATTM: 6.0**	**PSSD: 6.0**	**GPTS: 24.0**	**GPA: 4.000**		
Cumulative Totals	**ATTM: 46.0**	**PSSD: 46.0**	**GPTS: 180.4**	**GPA: 3.922**		

2022 Winter Quarter

PHD DISSERTATN RSCH	BME	297	10.0	A+	40.0	
SEM IN BIOMED ENGR	BME	298	2.0	S	0.0	SU
Term Totals	**ATTM: 10.0**	**PSSD: 10.0**	**GPTS: 40.0**	**GPA: 4.000**		
Cumulative Totals	**ATTM: 56.0**	**PSSD: 56.0**	**GPTS: 220.4**	**GPA: 3.936**		

2022 Spring Quarter

INTRO CLINICAL MED	BME	240	4.0	A	16.0	
BIO-SPECTROSCOPY	BME	295	4.0	A	16.0	
PHD DISSERTATN RSCH	BME	297	2.0	A+	8.0	
SEM IN BIOMED ENGR	BME	298	2.0	S	0.0	SU
Term Totals	**ATTM: 10.0**	**PSSD: 10.0**	**GPTS: 40.0**	**GPA: 4.000**		
Cumulative Totals	**ATTM: 66.0**	**PSSD: 66.0**	**GPTS: 260.4**	**GPA: 3.945**		

2022 Special / 10-Week Summer Session

INTERNSHIP	ENGR	291	1.0	S	0.0	SU
Term Totals	**ATTM: 0.0**	**PSSD: 0.0**	**GPTS: 0.0**	**GPA: 0.000**		
Cumulative Totals	**ATTM: 66.0**	**PSSD: 66.0**	**GPTS: 260.4**	**GPA: 3.945**		

2022 Second Summer Session

INTERNSHIP	ENGR	291	1.0	S	0.0	SU
Term Totals	**ATTM: 0.0**	**PSSD: 0.0**	**GPTS: 0.0**	**GPA: 0.000**		
Cumulative Totals	**ATTM: 66.0**	**PSSD: 66.0**	**GPTS: 260.4**	**GPA: 3.945**		

2022 Fall Quarter

INTERNSHIP	ENGR	291	1.0	S	0.0	SU
RESEARCH METHOD DIS	BME	295	2.0	A+	8.0	
INDIVIDUAL RESEARCH	BME	299	13.0	A+	52.0	
Term Totals	**ATTM: 15.0**	**PSSD: 15.0**	**GPTS: 60.0**	**GPA: 4.000**		
Cumulative Totals	**ATTM: 81.0**	**PSSD: 81.0**	**GPTS: 320.4**	**GPA: 3.956**		

2023 Winter Quarter

PHD DISSERTATN RSCH	BME	297	16.0	A	64.0	
Term Totals	**ATTM: 16.0**	**PSSD: 16.0**	**GPTS: 64.0**	**GPA: 4.000**		
Cumulative Totals	**ATTM: 97.0**	**PSSD: 97.0**	**GPTS: 384.4**	**GPA: 3.963**		

2023 Spring Quarter

PHD DISSERTATN RSCH	BME	297	16.0	A+	64.0

Term Totals	**ATTM:**	**16.0**	**PSSD:**	**16.0**	**GPTS:**	**64.0**	**GPA: 4.000**
Cumulative Totals	**ATTM:**	**113.0**	**PSSD:**	**113.0**	**GPTS:**	**448.4**	**GPA: 3.968**

2023 Fall Quarter

INDIVIDUAL RESEARCH	BME	299	16.0	A+	64.0

Term Totals	**ATTM:**	**16.0**	**PSSD:**	**16.0**	**GPTS:**	**64.0**	**GPA: 4.000**
Cumulative Totals	**ATTM:**	**129.0**	**PSSD:**	**129.0**	**GPTS:**	**512.4**	**GPA: 3.972**

2024 Winter Quarter

INDIVIDUAL RESEARCH	BME	299	16.0	A+	64.0

Term Totals	**ATTM:**	**16.0**	**PSSD:**	**16.0**	**GPTS:**	**64.0**	**GPA: 4.000**
Cumulative Totals	**ATTM:**	**145.0**	**PSSD:**	**145.0**	**GPTS:**	**576.4**	**GPA: 3.975**

2024 Spring Quarter

SYSTEMS DEV BIO	DEV BIO	203C	4.0	B+	13.2
INDIVIDUAL RESEARCH	BME	299	8.0	A+	32.0

Term Totals	**ATTM:**	**12.0**	**PSSD:**	**12.0**	**GPTS:**	**45.2**	**GPA: 3.767**
Cumulative Totals	**ATTM:**	**157.0**	**PSSD:**	**157.0**	**GPTS:**	**621.6**	**GPA: 3.959**

2024 Fall Quarter

PHD DISSERTATN RSCH	BME	297	16.0	A+	64.0

Term Totals	**ATTM:**	**16.0**	**PSSD:**	**16.0**	**GPTS:**	**64.0**	**GPA: 4.000**
Cumulative Totals	**ATTM:**	**173.0**	**PSSD:**	**173.0**	**GPTS:**	**685.6**	**GPA: 3.963**

2025 Winter Quarter

PHD DISSERTATN RSCH	BME	297	16.0	A+	64.0

Term Totals	**ATTM:**	**16.0**	**PSSD:**	**16.0**	**GPTS:**	**64.0**	**GPA: 4.000**
Cumulative Totals	**ATTM:**	**189.0**	**PSSD:**	**189.0**	**GPTS:**	**749.6**	**GPA: 3.966**

INCOMPLETE GRADES:	0	**UNITS:**	0.0
NR GRADES:	0	**UNITS:**	0.0
P/NP GRADES:	0	**UNITS:**	0.0
S/U GRADES:	11	**UNITS:**	23.0
W GRADES:	0	**UNITS:**	0.0

GRADE UNITS ATTEMPTED	189.0	**GRADE POINTS**	749.6	**UC GPA**	3.966
TOTAL UNITS PASSED	189.0	**UNITS COMPLETED**	212.0		

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Research Statement

My research centers on quantitative imaging of organelle dynamics to elucidate cellular identity and disease mechanisms. I developed PRISMOMS (Phasor Resolved imaging with Single Excitation and Multiplexed Organelle Signatures), an analytical pipeline that acquires hyperspectral signatures of seven organelle-specific probes using a single-wavelength multiphoton excitation. By integrating minimal laser power with phasor unmixing and a supervised random-forest classifier, PRISMOS achieves pixel-level classification of organelle features with high precision and accuracy.

Applying this tool to tamoxifen-resistant MDA-MB-231 breast cancer cells, one has the potential to identify distinct alteration in lipid droplet quantity, nuclear DNA compaction, Golgi apparatus fragmentation, endosomal and lysosomal pH, ATP production, and microtubules architecture during chemoresistance development. These finding demonstrated PRISMOS's capability to capture multi-organelle phenotypes that are overlooked by conventional multispectral imaging.

My work advanced hyperspectral imaging technology and provides novel insights into chemoresistance pathways, highlighting potential therapeutic targets. These accomplishment reflect my commitment to methodological innovations, rigorous validation, and translational impact. I am condiment that my expertise in hyperspectral analysis, machine-learning-driven classification, and organelle phenotyping aligns with the award's criteria for innovation, interdisciplinary excellence, and transformative contributions to cellular and cancer biology.