CURRICULUM VITAE (CV)

Samuel "Sam" Freitas

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GitHub ----------github.com/Sam-Freitas
Google Scholar https://scholar.google.com/citations?user=_vYUUR4AAAAJ&hl=en
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Overview

Multidisciplinary Engineer with a passion for innovative research, knowledge, and exploring the unknown

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Sections

Chronology of Education

2015-2019 **Batchelor of Science in Biomedical Engineering (May 2019)**
University of Arizona, Tucson, AZ
Minor: Mechanical Engineering
Dean's list with distinction
Capstone: Dynamic Bioreactor for Engineering Cartilage tissue cells
Capstone Advisor: Dr. David Margolis
Research: Robotic Automation of Biological Processes
Research Advisor: Dr. George Sutphin

2019-2021 **Master of Science in Biomedical Engineering (August 2021)**
University of Arizona, Tucson, AZ
Thesis: Worm Paparazzi – A High Throughput Lifespan and Healthspan Analysis Platform for Individual *Caenorhabditis Elegans*
Advisor: Dr. George Sutphin
Committee: Dr. George Sutphin, Dr. Ali Bilgin, Dr. Ted Trouard, Dr. Andrew Paek

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Chronology of Employment

2015-2019 **Individual Engineering/Math Tutor**
Tucson, AZ

2018-2019 **Undergraduate Research Assistant**
Sutphin Lab – The University of Arizona, Tucson, AZ
Advisor: George Sutphin

2019-2021 **Graduate Research Assistant**
Sutphin Lab – The University of Arizona, Tucson, AZ
Advisor: George Sutphin

2021-2025 **R&D Mechanical Engineer I**
The University of Arizona, Tucson, AZ

2024-current **Chief Technology Engineer (CTO)**
Senfina Biosystems LLC – Tucson, AZ
Co-Founder & Managing Member

2025-current **R&D Mechanical Engineer II**
The University of Arizona, Tucson, AZ

Finished Hardware/Biological Projects

1. **Large-scale Environmental Control Unit for Biological Analysis (2019):**
   Developed a large-scale environmental control unit to house robotic platforms for automated analysis of *C. elegans* lifespan, healthspan, and fluorescent output. The system precisely monitored and controlled temperature, stabilized humidity, and eliminated light pollution to ensure optimal sample conditions for long-term experiments.
2. **Dynamic Bioreactor for Engineering Cartilage tissue cells (2019):**
   Developed a custom bioreactor for engineering cartilage-like tissue for targeted regenerative medicine in knee tissue. Implemented a two-axis loading system that applied controlled environmental stresses to adult stem cell-derived tissues, promoting their transformation into cartilage for implantation and regeneration.
3. **WormWatcher Robotic System (2021):**
   Contributed to the development of the first full-scale WormWatcher robotic platform in collaboration with the Feng-yen Lab at the University of Pennsylvania. Enabled high-throughput, individualized analysis of C. elegans, facilitating targeted investigations into the effects of interventions on lifespan and healthspan at unprecedented precision and scale.
4. **WorMotel and Terasaki optimizations (2022):**
   Optimized and customized containment wells for individualized, longitudinal analysis of *C. elegans* on solid media. These modifications enhanced compatibility with both current and custom experimental setups,

streamlining workflows and improving data reliability (see Finished Publications (2) and (3)). The molds were custom printed using the SLS process for a desired surface finish.

5. **Worm Paparazzi imager (WP_Imager) (2024):**
   Developed a fully automated, large-scale robotics platform for individualized longitudinal analysis of *C. elegans* lifespan, healthspan, and millimeter-scale fluorescent outputs. Integrated machine learning and custom algorithms to maintain calibration, focus, and precise operation across multi-month experiments, enabling diverse biological tests and consistent data collection.
6. **MiniMax (2024):**
   Developed a small fluorescent solid media plate scanning robotic system for benchtop use in research laboratories. The system can either be manually controlled or automated for batch processing of any type of fluorescent analysis. The system can export data to any computer system or be used as a proof-of-concept/qualitative fluorescent imager/microscope.

Finished Software Projects

1. **Worm Paparazzi (2021):**
   High Throughput Lifespan and Healthspan Analysis Platform for Individual *Caenorhabditis Elegans.* Providing scalable and reproducible results for aging and fundamental biological research.
   https://repository.arizona.edu/handle/10150/661628
2. **Entropy DIC (2022):**
   Developed an entropy filter-based segmentation of cultured cell images in confocal Differential Image Contrast (DIC) Scratch assay analysis. Enhanced cell segmentation and precision for automated cell tracking workflows, improving on the previously manually scored data. https://github.com/Sam-Freitas/entropy_DIC
3. **Python_to_GRBL (2021):**
   Developed an open-source Python-to-GRBL sender for controlling 3-axis GRBL/CNC/gcode machines via serial/USB connections. The tool ensures sequential command execution, improving control accuracy for complex machining or automation tasks. https://github.com/Sam-Freitas/python_to_GRBL
4. **Systematic Imaging of *Caenorhabditis* Killing Organisms (SICKO) (2023):**
   Created a quantitative analysis pipeline for fluorescently tagged bacteria in infection and immune response analysis in *C. elegans* models. This analysis suite streamlined a novel bacterial tracking and allowed immune response quantification. https://github.com/Sam-Freitas/SICKO
5. **LightSaver (2023):**
   Developed a tool for the quantitative analysis and automatic segmentation of fluorescently labeled C. elegans. Optimized for batch processing to support high-throughput biological studies.
   https://github.com/Sam-Freitas/LightSaver
6. **WP_Imager (2024):**
   Designed software and firmware for operating the WP_Imager robotics system. Enabled seamless control, analysis, and longitudinal tracking of lifespan, healthspan, and fluorescent outputs in *C. elegans* experiments.

Finished Publications

1. **Freitas, S.** (2021). *Worm Paparazzi – A High Throughput Lifespan and Healthspan Analysis Platform for Individual Caenorhabditis elegans*. https://repository.arizona.edu/handle/10150/661628
2. Gardea, E. A., DeNicola, D., **Freitas, S.,** Peterson, W., Dang, H., Shuck, K., Fang-Yen, C., & Sutphin, G. L. (2022). Long-Term Culture and Monitoring of Isolated Caenorhabditis elegans on Solid Media in Multi-Well Devices. *Journal of Visualized Experiments (JoVE)*, *190*, e64681. https://pmc.ncbi.nlm.nih.gov/articles/PMC10368520/
3. Espejo, L., Hull, B., Chang, L. M., DeNicola, D., **Freitas, S.,** Silbar, V., Haskins, A., Turner, E. A., & Sutphin, G. L. (2022). Long-Term Culture of Individual Caenorhabditis elegans on Solid Media for Longitudinal Fluorescence Monitoring and Aversive Interventions. *Journal of Visualized Experiments (JoVE)*, *190*, e64682. https://pmc.ncbi.nlm.nih.gov/articles/PMC10368144/
4. Castro-Portuguez, R., Raymond, K. M., Thullen, E., Hendrickson, A. M., **Freitas, S**., Hull, B., Meyers, J. B., Thorns, N., Gardea, E. A., Dang, H., Espejo, L. S., & Sutphin, G. L. (2023). *Inhibition of haao-1 enhances oxidative stress response by activating hormetic redox signaling in C. elegans* (p. 2023.02.16.528568). bioRxiv. https://doi.org/10.1101/2023.02.16.528568
5. Dang, H., Castro-Portuguez, R., Espejo, L., Backer, G., **Freitas, S.,** Spence, E., Meyers, J., Shuck, K., Gardea, E. A., Chang, L. M., Balsa, J., Thorns, N., Corban, C., Liu, T., Bean, S., Sheehan, S., Korstanje, R., & Sutphin, G. L. (2023). On the benefits of the tryptophan metabolite 3-hydroxyanthranilic acid in Caenorhabditis elegans and mouse aging. *Nature Communications*, *14*(1), 8338. https://doi.org/10.1038/s41467-023-43527-1
6. Espejo, L. S., **Freitas, S.**, Silbar, V., Chang, L., Balsa, J., Antenor, A., Dang, H., DeNicola, D., & Sutphin, G. L. (2023). *SICKO: Systematic Imaging of Caenorhabditis Killing Organisms* (p. 2023.02.17.529009). bioRxiv. https://doi.org/10.1101/2023.02.17.529009

Patents

1. **U.S. Provisional Application No. 63/357,425**
   SYSTEMS AND METHODS FOR A NOVEL IMAGE-BASED MULTI-OMICS CLOCK FOR THE PREDCITION OF REMAINING LIFESPAN
   Filing Date: 30 June 2022
2. **U.S. Provisional Application No. 63/429,015**
   A HIGH-THROUGHPUT PLATFORM FOR MEASURING LIFESPAN AND MULTIPLE IN VIVO MOLECULAR BIOMARKERS OF AGING
   Filing Date: 30 November 2022
3. **U.S. Patent Application No. 63/448,539**
   HIGH-THROUGHPUT PLATFORM FOR MEASURING LIFESPAN AND MULTIPLE IN VIVO MOLECULAR BIOMARKERS OF AGING
   Filing Date: 27 February 2023

4. **U.S. Provisional Application No. 63/448,557**
   DATA ANALYSIS FOR HIGH-THROUGHPUT EXPERIMENTS FOR MEASURING LIFESPAN AND MULTIPLE IN VIVO MOLECULAR BIOMARKERS OF AGING
   Filing Date: 27 February 2023
5. **U.S. Provisional Application No. 63/494,334**
   SYSTEMS AND METHODS FOR IMAGING ANIMALS
   Filing Date: 5 April 2024
6. **International Patent Application No. PCT/US2023/069388**
   SYSTEMS AND METHODS FOR A NOVEL IMAGE-BASED MULTI-OMICS CLOCK FOR THE PREDCITION OF REMAINING LIFESPAN
   Filing Date: 29 June 2023
7. **International Patent Application No. PCT/US2023/081314**
   PLATFORM, SYSTEM, AND ASSOCIATED PROCESSES FOR MEASURING LIFESPAN AND MULTIPLE IN VIVO MOLECULAR BIOMARKERS OF AGING
   Filing Date: 28 November 2023

Research Mentorship

Undergraduate Students

1. Remi Stauss (BS, Biomedical Engineering, 2022 - 2022)
2. Michael Ulrich (BS, Biomedical Engineering, 2023 - 2024)
3. Elaina Wait (BS, Biomedical Engineering, 2023 - current)
4. Vanessa Hofschneider (BS, Biomedical Engineering, 2020 - 2022)
5. Jesus Lopez (BS, Biomedical Engineering, 2025 - current)

Graduate Students

1. Vanessa Hofschneider (MS, Biomedical Engineering, 2022 - 2024)

Service & Outreach

2014-2015 **Volunteer Swim Coach**
Catalina Terrace Marlins Swim Team
Tucson, AZ

2015-2018 **Volunteer Music instructor/helper**
The University of Arizona

The Arizona Academy of the Performing Arts (The Academy Drum Corps)
AZ (multiple sites)

2022-2024 **Head Coach**
The University of Arizona Men's Ultimate Frisbee team
Tucson, AZ

Honors and Awards

2019 Da Vinci Circle Finalist, *The University of Arizona*

2019 Dean's list with Distinction, *The University of Arizona*

Smaller/Miscellaneous/Personal Projects

1. **Phone mount for microscope (2019):**
   Designed and 3D printed a custom microscope eyepiece to phone camera mount for quick recording of qualitative data
2. **Zeiss microscope repairs (2019):**
   Fixed a batch of West-German manufactured Zeiss dissection scopes for use in *C. elegans* research.
3. **Custom shaker/mixer (2020):**
   Designed and customized an off-the-shelf laboratory shaker/mixer to be used in automated climate-controlled spaces.
4. **Large centrifuge adapters (2020):**
   Designed and 3D printed adapters for large scale centrifuges to rapidly switch between the many different types of centrifuge-tube types.
5. **Set up and fixing of microplate reader (2020):**
   Helped in the acquisition of a Synergy H1 microplate reader, then fixed the subsequent chamber temperature readings by disassembly and isolation of a stuck bearing.
6. **Dynamic Unet for segmentation (2021):**
   Custom Spatial Attentive (SA) UNET implementation that dynamically scales the network to the size of the given image/dataset. https://github.com/Sam-Freitas/SA-unet-dynamic
7. **Workstation and Server procurement (2021):**
   Built and deployed high-reliability workstations and servers for the Sutphin lab to use in their day-to-day tasks. https://github.com/Sam-Freitas/Sutphin_Lab_Utilities
8. **Custom water bath with integrated stir bar (2021):**
   Customized a hot-water bath to integrate a stir bar. Allowing agar and agarose to be kept at a specific water bath temperature and allows adding in of fully mixed chemicals with the stir bar.

9. **Age Predictor using CNN (2022):**
   Developed a custom age predictor by transforming the GTEx dataset into images and applying a Convolutional Neural Network. https://github.com/Sam-Freitas/CNN_regression
10. **High-reliably filtered drying box (2022):**
    Built a custom drying box that blows filtered laminar air over agar plates to remove excess moisture without cracking or over-drying them.
11. **High precision long-reach robotic mount for cameras (2022):**
    Built a custom camera mount on top of stiffened linear rails to allow for precise linear control over depth of field in a robotic platform.
12. **Sutphin_lab_utilites (2024):**
    Built a suite of automation scripts to streamline data analysis/collection/transfer across the different robots/servers/HPC's that were utilized in the lab. https://github.com/Sam-Freitas/Sutphin_Lab_Utilities

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Works in Progress

1. Castro-Portuguez°, Miller KM°, Thullen E°, Hendrickson AM°, Freitas S°, Hull B°, Meyers JB°, Thorns N°, Gardea EA°, Dang H, Espejo LS°, Sutphin GL§. Inhibition of *haao-1* enhances oxidative stress response by activating hormetic redox signaling in *C. elegans*. *bioRxiv* 2023.02.16.528568. doi:10.1101/2023.02.16.528568. *Under review at Redox Biology*.
2. Espejo L°, DeNicola D°, Chang LM°, Hofschneider V°, Haskins A°, Balsa J°, Freitas SS°, Antenor A°, Hamming S°, Hull B°, Castro-Portuguez R°, Dang H°, Sutphin GL§. The Emerging Role of 3-Hydroxyanthranilic Acid on *C. elegans* Aging Immune Function. *bioRxiv* 2024.01.07.574394. doi:10.1101/2024.01.07.574394. *Preparing for submission to Nature Immunology*.
3. Espejo L°, Freitas S°, Hofschneider V°, Chang L°, Balsa J°, Antenor A°, Dang H, DeNicola D°, Sutphin GL§. SICKO: Systematic Imaging of *Caenorhabditis* Killing Organisms. *bioRxiv* 2023.02.17.529009. doi:10.1101/2023.02.17.529009. *Under review at Nature Communications*.
4. Freitas S°, DeNicola D°, Hofschneider V°, Gardea EA°, Peterson W°, Kelser D°, Hendrickson A°, Sutphin GL§. Worm Paparazzi—An automated platform for longevity and healthspan quantification in individual *Caenorhabditis elegans*. *In preparation for submission to Geroscience.*
5. Miller KM°, Rounseville S°, Castro-Portuguez R°, Dang H, Railey R°, Dundore K°, Espejo E°, Hofschneider V°, Freitas S° Sutphin GL§. Kynurenine Metabolism Mediates Tumor Progression in Murine Renal Cell Carcinoma. *In preparation.*
6. Freitas S°, Castro-Portuguez R°, Ulrich M°, Gardea EA°, Sutphin GL§. LightSaver—A tool for rapid fluorescence quantification in individual *C. elegans*. *In preparation.*
7. Gardea EA°, Peterson W°, Furtmann A°, Dang H°, DeNicola D°, Espejo L°, Castro-Portuguez R°, Freitas S°, Sutphin GL§. Cadmium sensitizes *C. elegans* to osmotic stress by disrupting glycerol production. *In preparation.*
8. Hull BT°, Irby IM°, Anderson A°, Gardea EA°, Haskins A°, Peterson W°, Furtmann A°, Shuck K°, Meyers J°, Espejo L°, Freitas S, Dang H, Sutphin GL§. Metals form a node in the *C. elegans* cellular stress network. *In preparation.*