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20 YEARS OF EXCELLENCE

Department of Biomedical Engineering

COLUMBIA | ENGINEERING

2000–2020

2021 BME Senior Design Final Pitch Event

A VIRTUAL EXTRAVAGANZA!

COLUMBIA UNIVERSITY

APRIL 22, 2021 | 10AM - 2PM

HOSTED BY

Aaron Kyle, Ph.D.
Columbia University

JUDGES

Krista Durney, Ph.D.
TARA Biosystems

Bryan Grulke, M.B.A.
Volcano Capital

Grigorios Marios Karageorgos
Columbia University

Joan José Martínez, Ph.D.
Columbia Tech Ventures

Alessandra Schaszberger
Georgetown University Law Center

Katherine Strong
Johnson & Johnson

Sabriya Stukes, Ph.D.
Stellate Therapeutics /
The City College of New York

Moshe Willner
Columbia University

Keith Yeager, M.E.
Columbia University

AGENDA

10:00 a.m. **Project Pitches**

Design Teams (in presentation order)

- AutoTone
- Perfecto Injector
- Pilotaro
- AutoCap
- Melanin Vision
- EyePhone
- TOEtal Care
- BP Pro

11:30 a.m. **Break / Wonder.me Tutorial**

11:45 a.m. **Project Team Networking**

12:45 p.m. **Judge Deliberations**

WELCOME

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2021 BME Senior Design Pitch Event

Aaron M. Kyle, Ph.D.
Columbia University

Welcome to the 2021 BME Senior Design Day, held as a virtual event for the second time since its inception as part of the Columbia Engineering Senior Design Expo in 2014. This cornerstone event is an exhibition of the Senior students' design efforts. Given the current health crisis, we had to shift the end expectations of our projects, but we still have compelling needs, prospective solutions, and business plans that the BME Designers will present to our distinguished panel of judges in a pitch-style event.

We are excited to celebrate the hard work that our undergraduates have done as they complete their Biomedical Engineering studies at Columbia!

DESIGN TEAMS

Team #1: AutoTone

Audrey Bischoff, Sabrina Gjerswold-Selleck, Jacy Fang, Nikita Podobedov, Paul Spezza

Postpartum hemorrhage (PPH) is the leading cause of maternal mortality with over 70% of cases being caused by uterine atony, the failure of the uterus to contract after birth. External uterine massages are ideally performed by nurses every 15 minutes after delivery to detect early stages of atony and stimulate contractions, preventing the onset of severe PPH. However, due to the unpredictable nature of labor and delivery, this is not always feasible. Our solution, AutoTone, is an automated mechanical uterine massager that performs massages in timed intervals and incorporates real-time monitoring of uterine tone. Engineered to attach to a patient's hospital bed, AutoTone mimics the massage performed by labor and delivery professionals by pressing into the abdomen using two pads to stimulate contraction. With continuous monitoring and automation, our solution will save time, standardize the administration of uterine massage, and promote uterine contractions to prevent PPH.

Advisor:

Clark T. Hung, Ph.D.
Professor of Biomedical Engineering & Orthopedic Sciences (in Orthopedic Surgery)

Team #2: Perfecto Injector

Divya Gandla, Cyrus Jonathan Ghaderi, Julia Hutsko, Alexander Kaminsky, Guntaash Sahani

More than 25 million patients are currently being treated for posterior eye segment disorders like macular degeneration or diabetic retinopathy. Ideal treatment includes drug delivery into the suprachoroidal space (SCS). SCS medication delivery is minimally invasive, has better target-site specificity, and allows for more sustained delivery compared to other methods of administration. However, current suprachoroidal injectors require the ophthalmologist to sense subtle tactile cues as the needle moves into the target. Consequently, there is a need to develop an easy-to-use, minimally invasive suprachoroidal drug delivery method to make the process less demanding and more broadly available. To address this problem, our Perfecto Injector detects differential pressure changes that occur as a needle is injected through the sclera and into the SCS, alerting the ophthalmologist when SCS access is achieved. Initial testing demonstrates precise ability to reach the SCS without over-insertion, indicating that this may be a promising technique to broadly provide SCS drug therapy.

Advisor:

Barclay Morrison III, Ph.D.
Professor of
Biomedical Engineering

Team #3: Pilotaro

Nikita Kupko, Madeline Meier, Kshithija KJ Mulam, Archana Murali, Kayla Stewart

An increasing proportion of the aging global population faces issues related to blindness, one of the top ten disabilities worldwide. Living with permanent visual impairment can cause difficulties with independently navigating environments, which can affect general productivity and lead to increased risk of injury. While many assistive navigational tools exist, they fail to provide adequate upper body protection, a pressing issue for older members of the blind community at risk for head level injuries. Pilotaro aims to provide an assistive technology for tracking obstacles affecting the upper body to aid the general navigation and safety of those who develop permanent visual impairment later in life. Our product employs a wearable harness mounted with an array of ultrasonic sensors for comprehensive, full-body obstacle detection with bidirectional, modulated haptic feedback for local navigation. Initial testing and prototyping indicates that our detection-and-feedback system provides the sensitivity and accuracy for users to avoid nearby obstacles.

Advisor:

Paul Sajda, Ph.D.
Vice Chair and Professor of
Biomedical Engineering, Electrical
Engineering, and Radiology

Team #4: AutoCap

Nicolas Acosta, Vincent Guo, Rachel Park, Ashley Rosenberg, Brian Ross

Current methods for measuring capillary refill time (CRT) are highly subjective, depending on manual application of force to a capillary bed, e.g., a finger or toe, and timing the return of color to the skin. CRT is a highly useful diagnostic parameter, particularly in detection of severe sepsis, which manifests in abnormal CRT. Thus, accurate, objective, and regular CRT measurement can improve care of patients who may be susceptible to septic shock. The AutoCap improves CRT monitoring by standardizing the measurement, making the solution ideal for ICU bedside monitoring. Our device induces blanching via a linear actuator that administers a consistent, controlled force to the tip of the finger. Then, we optically detect the return of blood flow to the capillary bed after blanching, and our algorithm can successfully produce precise CRT measurement values. AutoCap has the potential to significantly improve CRT measurement and expand its use as a reliable vital sign.

Advisor:

Nandan Nerurkar, Ph.D.
Assistant Professor of
Biomedical Engineering

DESIGN TEAMS

Team #5: Melanin Vision

Rika Ichinose, Ioana Lia, Lexi Orlinsky, Ziad Saade, Ethan Thayumanavan

There exists a significant gap in understanding and diagnosis of skin cancer in People of Color (PoC). At diagnosis with melanoma, 56% of PoC receive an initial diagnosis of advanced-stage cancer, compared to only 16% of white people, which leads to significantly lower survival rates in PoC. Presentation of skin cancer differs between PoC and white people, and both medical professionals and patients lack the information necessary to perform visual skin examinations, which are often the first step in detecting skin cancer. Our mobile application provides an interactive database of skin cancer images across PoC with varying skin tones. We additionally provide image processing technologies for analysis of single lesions, informing providers and patients on the type of skin lesion that they may have detected, enabling earlier detection of skin cancer in PoC.

Advisor:

Sam Sia, Ph.D.
Professor of Biomedical
Engineering and Faculty Director,
SEAS Entrepreneurship

Team #6: EyePhone

Allegra Campanini-Bonomi, Katherine Liu, Lauren Sekiguchi, Anisha Tyagi, Helen Ugulava

There are over three million people who suffer from glaucoma in the U.S. The vision loss from glaucoma is irreversible, and most of the current treatments are focused on preventing further progression of the disease. Preventing disease progression is heavily dependent on consistent monitoring; however, monitoring is often inadequate due to a number of factors including improper intervals between examinations or poor patient adherence. EyePhone is a mobile phone app that works in coordination with a Google Cardboard to create a virtual reality field for at-home visual field testing. Our prototype produces stimuli of varying intensities across the user's visual field and uses voice recognition to document detection of the stimuli. The device utilizes existing visual field testing algorithms to assess a person's vision outside of a doctor's office, promoting more regular and accessible monitoring of glaucoma progression.

Advisor:

Stephen Tsang, M.D., Ph.D.
Laszlo T. Bito Professor of Ophthalmology, and Pathology and Cell Biology

DESIGN TEAMS

Team #7: TOEtal Care

Shemar Anderson, Katherine Hegermiller, Kyla Holbrook, Josh Jaton, Ketsia Zinga

According to the CDC, onychomycosis, a fungal infection of the toenail, affected 46.4 million Americans in 2020. Left untreated, the nail plate thickens and separates from the nailbed, leaving the skin around the nail inflamed and painful. Diabetics and people over the age of 65 are at higher risk due to diminished blood circulation. As a result, the infectious burden is more severe for these patients: Diabetics are three times more likely to get secondary infections that can lead to much more serious outcomes including toe or foot amputation. Current treatments such as oral antifungal drugs and medicated nail polishes are not specific, have a lengthy treatment timeline, and may result in recurrent infections. Our TOEtal Care utilizes ultraviolet (UV) light in the C-bandwidth (254 nm) to eradicate toe fungus under the nail bed without the use of pharmacological intervention. TOEtal Care utilizes a minimal effective dose of UV-C to prevent any damage to surrounding dermal tissues, making it safe for in-home treatment of onychomycosis.

Advisors:

Clark T. Hung, Ph.D.
Professor of Biomedical Engineering & Orthopedic Sciences (in Orthopedic Surgery)

Rodney Rothstein, Ph.D.
Professor of Genetics and Development

Team #8: BP Pro

Andrew Geng, Zamaan Hashimi, Anthony Ortega, Jaden Zhao

White coat hypertension (WCH) is a phenomenon in which patients experience elevated blood pressures in healthcare settings due to stress. It is estimated that over a third of the population is susceptible to WCH, which can lead to multiple types of misdiagnosis: failure to provide treatment may cause a 36% increased risk of heart disease, while overtreatment can lead to complications such as rebound hypertension or addiction. Current standards for identifying WCH rely on sustained at-home blood pressure readings; however, it is difficult for clinicians to immediately determine if their patients have WCH (i.e. if their patients are experiencing clinical setting-induced stress) after measuring high blood pressure. There is a need to quantify the effect of stress on blood pressure monitoring. Our solution can measure a patient's blood pressure in coordination with monitoring their stress level, providing a more objective view of whether the patient is exhibiting WCH. BP Pro monitors galvanic skin response (GSR), a direct indicator of sweating due to stress, during blood pressure measurement to detect WCH. Initial testing demonstrates the ability to simultaneously measure blood pressure and GSR. These measurements will be evaluated using machine learning tools, facilitating the detection of WCH in patients.

Advisor:

Lance Kam, Ph.D.
Professor of Biomedical Engineering
and Medical Sciences (in Medicine)
Chair of Undergraduate Studies

Krista Durney, Ph.D.
TARA Biosystems

Krista Durney, Ph.D. is the Senior Project Manager at TARA. Dr. Durney was trained in the laboratories of Dr. Gerard Ateshian, Ph.D. and Dr. Clark Hung, Ph.D at Columbia University where her graduate research focused on musculoskeletal biomechanics and tissue engineering. Krista was trained in financial markets and business valuation at Goldman Sachs where she covered the pharmaceutical and biotechnology sectors as an equity research fellow.

During her graduate studies, Krista's entrepreneurial spirit has led to her involvement in bringing two technologies out of the university through funding from Columbia's Biomedical Technology Accelerator and Cisco's Global Problem Solver Challenge. She obtained both her Bachelor and Master of Engineering degrees from The Cooper Union in NYC (Inter-Disciplinary and Mechanical Engineering), and her Ph.D. from Columbia University (Biomedical Engineering).

Bryan Grulke, M.B.A.
Volcano Capital

Bryan Grulke is a Partner at Volcano Capital, an early stage health care venture capital firm based in New York City. Volcano Capital focuses on the medical device sector and has made 15+ investments to date. Prior to joining Volcano Capital, Mr. Grulke worked as a strategy consultant at Bain & Company and in the corporate strategy group at Philips International. Mr. Grulke graduated from Harvard Business School and Duke University, summa cum laude with a B.S. degree in Economics.

Grigorios Marios Karageorgos
Columbia University

Grigorios Marios Karageorgos received the Diploma degree in Electrical & Computer Engineering from the National Technical University of Athens (NTUA), Greece, in 2016 and majored in electronic engineering. He conducted his Diploma thesis at the BIOmedical Simulations and IMaging laboratory (BIOSIM) of NTUA, where he worked on the development of a self-powered electromagnetic sensor for cardiovascular system monitoring. In 2017, he enrolled in the Ph.D. program in biomedical engineering at Columbia University, where he joined the Ultrasound Imaging Elasticity Laboratory (UEIL). His research interests include the development of ultrasound imaging techniques to estimate the mechanical properties of large arteries, and methods for vascular disease diagnosis and monitoring.

Joan José Martínez, Ph.D.
Columbia Technology Ventures

Joan José Martínez is a senior technology licensing officer at Columbia Technology Ventures, Columbia's tech transfer office that manages patenting and licensing of university inventions. In his 5 years at CTV, Joan has managed over 200 inventions and negotiated over 50 license agreements with industry partners. Before technology transfer, Joan completed his doctorate in bioengineering at University of Utah, where his work focused on neural coding and electrophysiology.

Alessandra Schaszberger
Georgetown University Law Center

Alessandra graduated from Columbia University in 2018. She majored in Biomedical Engineering. She is currently a third year law student at Georgetown University Law Center. She was the Editor-in-Chief of the Food and Drug Law Journal. She was also a student attorney at the Communications and Technology Law Clinic where she worked with her clients to ensure websites and online platforms complied with the Children's Online Privacy Protection Act. After graduation, Alessandra will be an intellectual property associate at a law firm.

Katherine Strong
Johnson & Johnson

Upon graduating from Columbia University, Katherine accepted a position at Johnson & Johnson's Design Studio in New York City. The J&J Design Studio creates end-user solutions across all the company's business groups: Consumer, Pharma, Medical Devices, and Corporate Communications. Katherine is a part of the Insights and Experience Strategy team. In her role as a strategist/analyst, Katherine uses synthesis, visualization, and storytelling to help design and communicate strategies that enable the organization to deliver people-centered solutions.

Sabriya Stukes, Ph.D.
Stellate Therapeutics /
The City College of New York

Sabriya Stukes is the founding Assistant Director of the Master's in Translational Medicine (MTM) program at The City College of New York, a brand new type of graduate degree that educates and trains scientists and engineers in the hands-on process of medical technology commercialization and healthcare innovation. A microbiologist, educator and science communicator, her expertise is in working with individuals to identify unmet community needs, design sustainable clinical solutions, think critically about the world around them and craft compelling scientific narratives. She also has worked for over a decade in fostering equitable and inclusive environments in the STEM disciplines and thinks deeply about how we can build sustainable healthcare solutions that work for all and not just some.

Moshe Willner
Columbia University

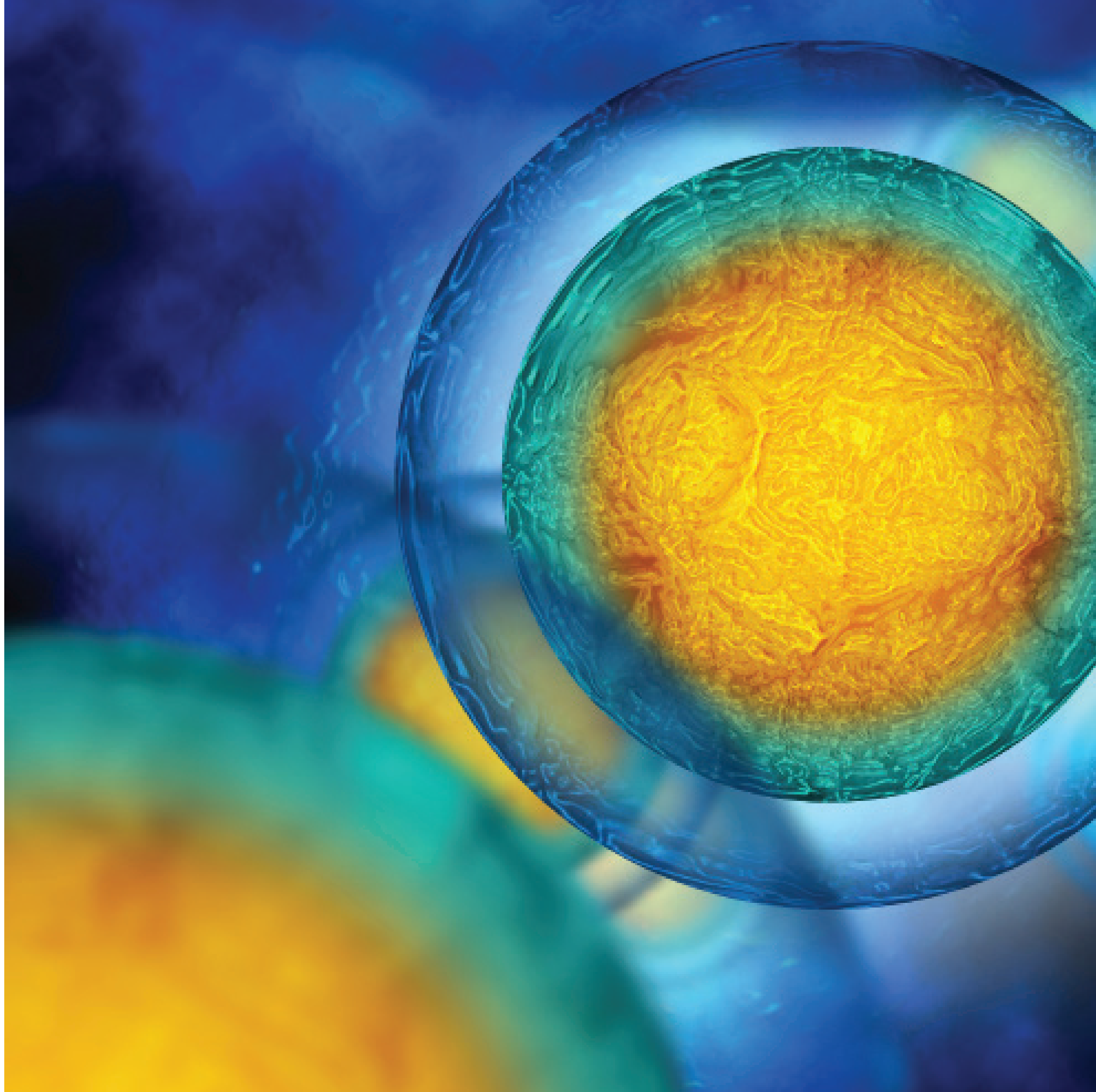
Moshe graduated magna cum laude from Columbia University's School of Engineering and Applied Sciences with a B.S. in Biomedical Engineering in May 2020. As an Egleston Scholar, Moshe conducted several years of neuroscience and engineering research, and he is currently working as a Research Associate at Columbia (Professor Kam Leong's lab) studying the use of brain organoid technology to better understand neuropsychiatric diseases. An aspiring physician-scientist, Moshe has also spent this past year applying to MD-PhD programs, and he is enormously excited (!) to be attending Columbia's MD-PhD program starting this fall.

Moshe is very grateful to Professor Kyle and the rest of the BME department for such a wonderful curriculum, including Senior Design, and for ongoing mentorship. Thank you Dr. Kyle!

JUDGES

Keith Yeager, ME
Columbia University

I'm a mechanical engineer with experience in early stage device development. I enjoy all aspects of design, prototyping, validation, and commercial translation. I work primarily in the field of tissue engineering and regenerative medicine, but also have experience with other areas of medical devices (typically low-risk solutions). I've been fortunate to contribute to many projects in research and commercial spaces, and love working with people to come up with clean solutions to various problems.

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