Working Toward Diversity and Inclusion in Neural Engineering

Junio Alves de Lima, Ashley Dalrymple, Maria Jantz, and Chantel Charlebois

Introduction by Cynthia Weber

■ **HOW DO WE** begin to consider ways to broaden the reach of our field, both to engage younger students and also those from different ethnicities, classes, and socio-economic backgrounds? Where are the opportunities to make our research, our laboratory, our surrounding community more open, inclusive, and diverse? By what means can we increase outreach in our communities, providing avenues for diverse students to explore STEM topics and engage in research?

These and other questions are addressed by the NER 2021 Diversity and Inclusion Essay Award winners, all young leaders in the neural engineering field, chosen at the 10th International IEEE EMBS Conference on Neural Engineering (NER), held May 4–6, 2021. Their essays offer inspiring examples of ways to bring awareness of diversity, equity, and inclusion (DEI) issues to the forefront, to engage meaningfully with the local community, to build sustainable efforts that work to change who has access to the sciences, as well as increase recognition of the value that different backgrounds and perspectives brings to the field, and provide the support needed for all to thrive and be successful.

"We were interested in projects and initiatives that had identified clear issues and that proposed concrete solutions," says Solaiman Shokur, Ph.D., Bertarelli Foundation Chair in Translational Neuroengineering at EPFL, one of the conference organizers. Candidates (in this case, young investigators who were presenting a conference paper) were asked to send a one-page essay describing the actions that they have taken to reduce inequalities and increase the diversification of the neural engineering community.

"As scientists, we are often busy in a frenetic routine of teaching, writing papers, applying for grants, but we have noticed that some people around us—students, other colleagues—were finding the time to help their communities. We believe this is an important mission for scientists and should be recognized as such," Shokur adds. With the support of the diversity office at the University of Pittsburgh, as well as the equality office at EPFL, the conference organizers chose three of the 15 entries to receive awards. "Our goal was to put a spotlight on initiatives (individual or as part of an organization) that aim at improving inclusion and diversity."

Shokur would like to see increased participation in the future, as well as to receive more entries from other regions. Marco Capogrosso, Ph.D., assistant professor at University of Pittsburgh and a conference organizer adds, "It would be important that this award is kept in future conferences. Indeed, many trainees invest a significant amount of time into the activities of DEI, which could be considered 'service' that is never accounted for. They do it in the weekends, they do it at night while enduring the same research and education requirements as their peers. This award is a way to acknowledge the work of these young professionals so that we can promote a culture of active initiatives for increasing inclusion and diversity in the neural engineering community."

The three essays awarded describe different approaches to increasing DEI, but what they have in common are viable efforts that offer solutions. Junio Alves de Lima and colleagues at the Instituto Santos Dumont in Macaíba, Brazil, present a project in the northeast of Brazil that aims to reduce inequalities through exposure to neuroengineering at multiple ages. In addition to educational workshops and activities, one of the examples of community work involved the development of acetate face shields to donate to COVID-19 health centers.

The efforts described by Maria Jantz and Ashley Dalrymple at Rehab Neural Engineering Labs at the University of Pittsburgh aim to promote DEI by combining community outreach, internal training, and policy, and continuously assessing how their work interacts with the city of Pittsburgh and with the larger neural engineering and STEM communities.

While these first two essays involved groups of students as part of larger organizations, there were also several submissions describing personal involvement and experiences. The jury was particularly impressed by Chantel Charlebois, a graduate student at the University of Utah, who is inspiring and supporting women in neural engineering. The winning essays are included here in their entirety.

"This award is a statement of the community to the young generations," concludes Capogrosso. "It says your ideas matter, your initiatives matter as much as your scientific achievements, please help us improve the community, for us and for the future generations."

Reducing Inequalities Through Neuroengineering

Junio Alves de Lima, Domingos Lira de Almeida Neto, Alessandra Vitoria Nascimento Lope, Ana Paula de Souza Galdino*, Thaiza Rohanna da Silva Vasconcelos*, Sthefany Marques Silva*, Gustavo Gabriel Alves de Araujo*, Maria Alice Guedes Moura*, and Edgard Morya

*High school students developing scientific education at ELS-IIN

Three out of five adults (60%) did not finish high school in the Northeast of Brazil. Neuroengineering can be a powerful stimulation approach to students from primary to higher education. To help reduce these inequalities and foster engagement and interest in neuroengineering, we developed projects for each schooling level.

Primary school: Students up to 11 years old are guided through neural engineering laboratories during 2 hours (from brain machine interface to neurorehabilitation). Neuroengineering master students and researchers prepare a scientific tour with hands-on activities (nervous system models, 3-D printing, robotics, microscopy, robotic gait, and weight support gait). These activities may include up to 20 primary school students accompanied by their respective teachers. Overall, feedback from the teachers has been positive, and the students start relating their school learning with the scientific tour, and raising more intriguing questions related to how technology could help identify illnesses and also find a cure for them.

High school: Students up to 18 years old are also guided through neural engineering laboratories (neurosurgery, microelectrodes, electrophysiology recording, wet lab, electronic and robotic, microscopy, and neurorehabilitation). Activities with up to 40 students include project development to solve problems that they consider relevant, such as activities for teaching neuroanatomy through electronic materials. Each group of five students also gives a pitch explaining how they figure out the problem. A contributing positive result is that high school students become aware of the diversity (ethnicity, race, gender, sexual, and education background) we have in our neuroengineering group (students and researchers).

Master students: Students from health, biology, and engineering backgrounds make up the group of neuroengineering guides. Besides their active participation with primary and high school visiting scientific tours, they also develop additional activities. Recent activities include: developing acetate face shields to donate to COVID-19 health centers, woman in science proposal approval, woman in innovation (startup project approval), face mask donation to a Quilombola community, and woman in science scientific divulgation.

Link with Academia: The two master students (the first two listed authors of this essay) participated as student representatives in the postgraduate commission, where they were often at the forefront of the aforementioned activities. In 2020, both joined IEEE as student members, with the aim of forming a student branch in neuroengineering. It is important to

emphasize that the multi-disciplinary environment favors a better understanding of the impacts that neuroengineering must bring to society, especially for young students. The knowledge of an engineer with the physiological vision of a health professional has made the dialogue much more directed towards satisfactory results for these activities, and shows that neuroengineering can in fact contribute to reduce inequalities, and make education a tool for life.

Understanding Cultural Contexts and Closing the Leaks in STEM
Ashley Dalrymple and Maria Jantz on behalf of RNEL

In the summer of 2020, following the murder of George Floyd and the international protests against racial injustice, many found themselves reflecting on ways to actively confront inequities and injustice. At the Rehab Neural Engineering Labs (RNEL) at the University of Pittsburgh, several students and postdocs joined together to write an open letter arguing that we cannot operate under the illusion that scientific progress is performed in a vacuum. Scientific communities, like the wider world, perpetuate racist ideologies as well as discrimination and harassment that must be addressed head-on. Following this call to action, trainees led an effort to identify specific steps to meet our goal of creating a more diverse, inclusive, and equitable culture within our lab. These steps include a range of efforts, from the recruitment of students, staff, and faculty from underrepresented backgrounds, to creating a sense of community to support our diverse lab environment and the broader field of neural engineering. Additionally, community engagement is necessary in order to have an impact not only within our lab group but also in the city of Pittsburgh. Many members of our lab group have joined efforts to register voters in primarily Black neighborhoods and engage youth in the community to explore their interests in STEM. We formed a group with six subcommittees to target the particular needs we identified. These subcommittees are Youth Outreach, Undergraduate Outreach, Training and Discussion, Messaging and Policy, Funding, and Political Action. Our subcommittees include all levels of experience, spanning trainees, staff, and faculty.

The Youth and Undergraduate Outreach subcommittees recognize that there is a leaky pipeline in STEM fields. Therefore, we aim to make STEM approachable at all levels as well as provide training to facilitate retention of underrepresented minority students. This leaky pipeline starts well before reaching the university level, making it important to give younger students the confidence and skills for future success. Recently, we developed and delivered a Python programming workshop series to youth formerly in foster care through MyPlace Action Housing and a virtual workshop series on STEM topics and careers to ninth grade students at Obama Academy, a public, predominantly Black High School in Pittsburgh. Additionally, we are engaged in outreach with local organizations, such as by judging for the Pittsburgh Regional Science and Engineering Fair. At the undergraduate level, we want to make sure students from minority backgrounds have opportunities to participate in STEM research, as well as receive training in neural engineering-related skills. We updated our recruitment process and training of undergraduate students, starting with holding a recruiting seminar during an engineering course at the Community College of Allegheny County. We are developing grant applications to support a summer research internship that aims to recruit and support underrepresented students as they explore neural engineering research. In addition, to ensure undergraduate students obtain concrete skills and consistent, high-quality mentorship while at RNEL, we created a formal undergraduate training program. Specifically, we set clear goals and timelines for undergraduate students and are planning onboarding training workshops to develop relevant skills for neural engineering research, including 3-D printing, motion capture, and electrophysiology.

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We also recognize the need to improve communication around DEI topics and lab members' understanding of the cultural context from which these issues arise. The first step in that communication was to clearly state scientific and community values on our lab website. We are building on that momentum by leading regular training and discussion seminars on a range of topics including race, gender, and sexuality in STEM, socioeconomic class, mental health, and disability. In addition, we hold monthly neuroethics seminars explicitly aiming to connect our research to the larger world and our impact on it. Topics that were recently

covered in these discussions include the neuroscience of stereotypes, history of anti-Black racism in the United States, and technology access and disability. For several of these topics, we have invited experts in the field to present as a jumping-off point for deeper discussion. During these seminars, our lab members have shared their experiences, highlighting the ways in which they need support and how our lab environment can be made more comfortable.

Our efforts to actively promote inclusion, diversity, equity, and anti-racism in STEM, and especially in neural engineering, include both short-term and long-term goals. Several of our initiatives were enacted immediately, and we have quickly made changes to improve our online messaging, engage in political activism in the community, develop relationships with public schools and community colleges, design programming and STEM workshops for youth, and organize and deliver internal training and discussion seminars. However, improving inclusion, diversity, equity, and anti-racism in STEM requires ongoing attention to all of these areas. We have acquired funding from the Pitt Year of Engagement, with matching support from the Department of Physical Medicine and Rehabilitation, which we are using to support our upcoming initiatives to lead in-person workshops on activities including prosthetic design, 3-D printing, and circuit design. This funding will provide a sustainable foundation for our ongoing efforts. As new members join the lab, DEI initiatives will be included in orientation and training programs to encourage active involvement and to maintain and grow our efforts. This award from NER will help recognize the people at RNEL who have worked hard to implement these changes and the initiatives we plan on moving forward, as we are committed to the long-term process of making sustainable change and improving DEI in our lab, our city, and more broadly in STEM.

Increasing Diverse Representation and Supporting Women in STEM
Chantel Charlebois

My mom has always been one of my biggest inspirations and supporters growing up. She worked as a computer engineer at IBM for over 25 years and broke down many barriers as she was often the only woman in the room. She and my dad, also a computer engineer, have always supported and encouraged my sister and me to pursue engineering.

This support gave me the confidence to pursue my dreams of a career in biomedical/neural engineering. I have come to admire my mom's strength and courage even more since moving to Utah to pursue my doctorate and experiencing discrimination firsthand as a woman in STEM. According to the Institute for Women's Policy Research, Utah is ranked last in the nation for the percent of women employed in STEM. I am in a unique position to be a role model, like my mom, for the next generation of neural engineers in Utah and beyond.

To influence and encourage the next generation of women, I am involved with many different outreach groups. I am currently co-president of the Graduate Women in Biomedical Engineering (GWBE) Group, aiming to encourage diversity and equality through departmental community building, professional development, and outreach. My goal is to increase exposure to neural engineering at a young age and act as a role model for the next generation of women and other underrepresented groups in STEM. To accomplish this, I co-presented a novel educational tool to promote electrophysiology education into middle and high school curriculums at the American Society for Engineering Education Conference in 2018. I then organized a workshop at the local Expanding Your Horizons camp where GWBE members used this DIY Brain Demo to teach middle and high school girls about neurophysiology. I have additionally been involved in the international campaign to teach the public about the advances and significance of neuroscience research through Brain Awareness Week (BAW). For the last four years, I have been a workshop leader for BAW, and one year I helped create one of the workshops where students recorded electromyography signals from their arm and facial muscles.

While it is essential to encourage the next generation, it is also necessary to support underrepresented groups who are currently trainees in neural engineering to continue on their career paths. For two years I coordinated the Neural Engineering Research Group (NERG) at the University of Utah. I organized bi-weekly seminars for neural engineers in training to practice presenting and disseminating their work while receiving feedback in a constructive and low stakes environment. I also aim to support my neural engineering graduate student peers through GWBE. We host career path talks where women in industry or academic positions speak about their career paths and provide advice about navigating as a woman in

STEM. When everything moved to virtual space, we began doing biweekly Zoom check-ins with GWBE members in order to create a safe space for students to talk about what they are struggling with and find the resources they need. Additionally, GWBE hosts socials to create a sense of comradery and connectedness. Socials have looked like happy hours, hikes, book clubs, virtual baking lessons, holiday parties, and crafts.

As I am nearing the end of my Ph.D., I have become more invested in the potential career paths available after graduate school. I feel that we get a lot of exposure to academic career options but less exposure to the large variety of industry positions. I therefore started a project called "50 Coffee Chats" where I interview neural engineers in industry to better understand what type of job I might be interested in and the skills I need to acquire that job. I have created a website where I make this information publicly available. I hope this resource will help other students identify what neural engineers do or be inspired by a particular career path!

I AM DEDICATED to serving underrepresented groups in the neural engineering community and inspiring them to join and stick with the STEM and neural engineering fields. ∎

Acknowledgment

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