A New Worldview: Innovative Bioengineering Techniques and Diversity Today

Irene Schiatti[1] interviews Lucia Schiatti

Lucia Schiatti (M.Sc. in Mechatronic Engineering and Ph.D. in Bioengineering and Robotics) is currently a postdoc researcher at the Computer Science and Artificial Intelligence Lab (CSAIL) of the Massachusetts Institute of Technology (MIT), in Boston. Her research focuses on exploiting advanced machine learning methods to develop novel assistive technologies for the visually impaired. After completing a PhD program at the Istituto Italiano di Tecnologia (IIT) in Genoa, Italy, she joined the IIT Unit for Visually Impaired People (U-VIP), led by Dr. Monica Gori, where she worked as a postdoc researcher on the topic of multisensory development and visual rehabilitation of visually impaired children, in collaboration with the clinical partners Istituto Casimiro Mondino, in Pavia, and Istituto Chiossone, in Genoa. In 2020 she was awarded a Marie Skłodowska-Curie Action (MSCA) Global Individual Fellowship under the Horizon 2020 Program with the project TIRESIA (896415) "Technology for visual Impairments Rehabilitation on Early-life through Social Information Augmentation", developed in the framework of a collaboration between the IIT Unit for Visually Impaired People and the Massachusetts Institute of Technology. In September 2021, she started working within the MIT Infolab group, taking care of the TIRESIA project under the supervision of Dr. Boris Katz and Dr. Andrei Barbu. TIRESIA's main goal is to implement a novel visual assistive technology that augments the residual sight of visually impaired individuals (especially children) to enhance their access to socially relevant visual information.

1. Irene Schiatti is the Coordinator for Custom Programs at ISI Florence

How did your collaboration with the MIT start?

To make a long story short, I am at MIT thanks to a Marie Curie fellowship, which is an individual grant awarded by the European Commission in the framework of a research program dedicated to postdoctoral researchers. I opted for a version of this program that allows me to write a three-year project involving stays in two institutions, one within the EU framework (in my case the IIT, Italy) and the other in an extra-EU country (in my case the MIT, US).

The long story, on the other hand, is built upon a combination of interconnected (sometimes wrong) choices, meeting inspiring people, and exploiting good opportunities. In 2013, after completing my Master's Degree in Mechatronic Engineering in Trento, I understood that the engineering job itself was not meaningful to me without a human factor. So, I re-oriented my interests towards the field of assistive technologies. In 2014 I applied for a PhD position at the Istituto Italiano di Tecnologia, in Genoa, with a proposal about assistive Brain-Computer Interfaces (more precisely, interfaces allowing to control a PC or an external device only through brain signals). On being granted a scholarship, I joined the Biomedical Robotics Lab, which was then led by Leonardo Mattos. In those years I worked on a nationally funded project (TEEP-SLA) whose aim was to develop alternative communication interfaces -- based on gaze and brain signals -- for motor impaired people, specifically Amyotrophic Lateral Sclerosis (ALS) patients. During the third year of my PhD, I applied for a summer school organized by the MIT Center for Brains, Minds and Machines (CBMM). I thus spent one month in the US, precisely in Woods Hole, Massachusetts. The CBMM is a multi-institutional NSF Science and Technology Center dedicated to the study of intelligence, both human and artificial, combining approaches from the disciplines of computation, neuroscience, and cognitive science. Here different research groups investigate how the brain produces intelligent behavior and how intelligence can be replicated in machines. In this context, I met my current supervisors at MIT, Andrei Barbu and Boris Katz. I was intrigued by their work

about modeling social interactions among artificial agents and -- in general -- by their research interests, spanning from artificial intelligence to neuroscience.

Before getting to my current position though, I had another important crossway. After completing my PhD, I met Monica Gori during a postdoc position interview (which led me to join her group, the Unit for Visually Impaired People, at IIT). Her work on the impact of visual impairments and sensory deprivation (especially when arising at an early age) on the brain and the overall child's development inspired me. The time spent working side by side with rehabilitators and children with visual issues, led me to develop and write a research proposal putting together my experiences in the fields of machine learning and assistive technologies. The project linked MIT and IIT, thanks to Boris and Monica, who accepted to support and supervise my project from the two sides (EU and extra-EU). Our proposal was finally awarded by the European Commission, and that's how my current experience at MIT started.

How important is the idea of inclusion in your projects and in your job?

Both my PhD project and my current work are related to exploiting advanced technological and machine learning tools to promote inclusion and better quality of life for impaired individuals. Foreseeing a potential useful application for people suffering from disabilities keeps me motivated and willing to continue, despite the failures or dead ends that one often experiences when doing research.

In particular, the TEEP-SLA project (to which I contributed during my PhD) aimed at providing alternative communication technologies for people with severe motor impairments. In some degenerative diseases, such as ALS, the communication between brain and muscles is interrupted. This makes it impossible for the patient to perform almost any voluntary movement, even if brain cognitive functions are working perfectly. This condition, where the mind is "trapped" inside a paralyzed body, is

known as "locked-in syndrome." For these patients, it is crucial to find an alternative way to communicate with those around them and to restore – at least to some extent – the ability to autonomously control the environment they are in. While working on this project, I met a woman affected by ALS, who communicated with me and other researchers through a speller. She was able to select letters by gazing at them on a special screen provided with an eye-tracking technology; the final phrase that she composed was then reproduced by a synthetic voice. I was impressed by discovering how important it was for her to be able to autonomously send WhatsApp messages to her teenage daughter. Indeed, she felt that this spontaneous kind of communication was crucial for her to maintain a good relationship with the girl. Unfortunately, while technology exists that could potentially help people in this condition, effective aids are either still scarcely available on the market of assistive technologies or they are very expensive and not easy to use for impaired individuals. I believe that research can be a key factor in making things evolve. Research projects in this field can push the development of usable and accessible assistive technologies forward, which can make a true difference in the daily lives of impaired people.

In a similar vein, the TIRESIA project aims at pushing forward the field of visual assistive technologies by exploiting advanced expertise in computer vision, neuroscience, visual rehabilitation, as well as solid scientific and clinical collaboration networks. During my collaboration with Ospedale Mondino in Pavia and Istituto Chiossone in Genoa, I had the chance to meet many children with different kinds of visual impairment. I realized how important it is to prevent as much as possible any vision or sensory impairment from affecting the children's quality of life and their relationships, thus helping them to feel self-confident and have fun when they play and interact with other people despite their visual issues. Most people with such problems still retain some degree of vision; our goal is to use advanced machine learning methods to enrich (or, in other words, to augment) their residual vision. Vision is our main source to retrieve any kind of information from the surrounding environment, in-

cluding information useful to understand others and interact with them. For this reason, the lack of vision or an impairment of the visual system can seriously impact the development of important skills, such as the perception of space, orientation, and motor capabilities. This also applies to social behavior, which impacts the patient's quality of life significantly. Visual rehabilitation is therefore essential to help a person suffering from visual impairments to correctly develop all important functional skills, especially during childhood, when such skills are developing, and the brain's plasticity is maximal. Despite its fundamental role, still today the field of visual rehabilitation often relies on qualitative more than quantitative paradigms, and the standard training protocols do not fully exploit the potential offered by novel technological tools. With TIRESIA, we are trying to develop a special application of "augmented reality" that facilitates visually impaired people's access to socially relevant information in what they can still "see". The objective that this kind of technology aims to achieve is twofold. On the one hand, it intends to provide an assistive function by increasing the saliency of socially relevant visual information. On the other, it pursues a rehabilitative function by training children with visual deficits to pay more attention to visual information that is useful for their social interaction. In doing so, it improves these children's long-term social skills.

Can you tell us more about the Marie Curie program, which allowed you to work and study abroad?

The Marie Skłodowska-Curie Actions (MSCA) is one of the most important research funding programs within the European Union. It is part of the wider program Horizon Europe (previously included in Horizon 2020), and it supports doctoral education and postdoctoral training of researchers. MSCA aims to enhance Europe's capacity for research and innovation by investing in the long-term career of excellent researchers. To this purpose, MSCA funds the development of excellent doctoral and postdoctoral training programs and collaborative research projects

worldwide. The main principles underlying the selection for funding include the projects' potential for equipping researchers at all stages of their careers with new knowledge and skills, and to promote their mobility across countries, sectors, and disciplines.

For researchers already holding a PhD, there's the possibility of applying for Postdoctoral Fellowships by submitting an individual research project, supported by a Host Institution. These include two types of fellowships, either European or Global. European fellowships are open to researchers of any nationality moving within Europe or coming to Europe from another part of the world to pursue their research career; they last either one or two years. Global fellowships are open to nationals or long-term residents of the EU; they can last two or three years, and they allow researchers to travel and live outside Europe for one or two years, respectively.

Proposals are evaluated in terms of the excellence of the scientific ideas, the impact of the project on the researcher's individual career, the research field and on society. In my case, I applied for a three-year Global fellowship, with a mobility of two years to the US. What I really liked about the MSCA is that it gave me the opportunity to work on my own project. This allowed me to grow as a more independent and autonomous researcher. Furthermore, I truly believe this program can foster an effective transfer of competences, and that I will go back to IIT with a significantly richer and interdisciplinary wealth of knowledge, which I could successfully transfer to my work with clinical partners and visually impaired children.

What would you tell students who have not started a post-doc program yet and may feel discouraged?

In general, I think that it is important for students who want to pursue an academic career to try and clearly define their long-term goals. Research can be at the same time a very exciting and frustrating path. I would not suggest students to enroll in a post-doc program unless they

are sure about how it fits their personal and professional goals.

When choosing an academic career, it is important to develop the ability of handling failures. Likewise, one should learn to re-design or modulate her/his own professional direction and goals, being aware that also the time eventually yielding bad results is not wasted time. On the contrary, it is very useful to generate knowledge. Bearing in mind the deepest reason why you chose to work in that precise field helps a lot, and not to lose motivation when things don't seem to work as expected.

Another tip could be to give yourself a deadline. In my case, for example, I would have probably abandoned academia if I had not received this fellowship. I felt it was important for me, at that stage in my professional development, to start working on my own project. It is important not to get discouraged easily, but also to give yourself a timeline to honestly evaluate if you are progressing or not and see if it's better to consider alternative and more rewarding career options.

One last suggestion is to exchange views with people already working in the same or other research fields and learn from their experience. Among the most enriching aspects of working in research is the possibility of developing a wide network of professional and personal relationships with other researchers, allowing to exchange and discuss ideas, often establishing fruitful collaborations in the process. Besides the topic's relevance to your personal interests, having a good feeling and integration within your research group is even more important, and can truly change one's own experience. The many difficulties in keeping and establishing social connections that we all experienced during the Covid pandemic reinforced my awareness about how best achievements come from the synergy established among people who share the same purpose, more than relying on individual strengths. And this applies to both our personal and professional life.