



“wearable EEG system for Auditory Attention Recording”

Deliverable 8.1: “Career Development Plan”

M2

Author:

Dr. Fabrizio Antonio Viola – Università degli Studi di Cagliari (UniCA)

Revised by:

Prof. Annalisa Bonfiglio – Università degli Studi di Cagliari (UniCA)



Releases history

Release	Date		Description
Version 1	20/02/2023		First version of the CDP. It can be revised if needed. Signed by the researcher and the supervisor.

CONTENTS

1. CAREER DEVELOPMENT PLAN – YEAR 1	4
1.1 Brief overview of Research Project and Major Accomplishments expected (half page should be sufficient):	4
1.2 Long-Term Career Objectives (over 5 years):	4
1.3 Short-Term Objectives (1-2 years):	5

1. CAREER DEVELOPMENT PLAN – YEAR 1

Name of fellow: Fabrizio Antonio Viola

Department: Department of Electrical and Electronic Engineering

1.1 BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS EXPECTED (HALF PAGE SHOULD BE SUFFICIENT):

The wEAR prototype, a wearable EEG system for Auditory Attention Recording, is an innovative lab-based hearable (i.e., wearable on-ears) technology that can estimate and decode the wearer's auditory attention, by processing her/his electroencephalography (EEG) signals with enhanced sensing capabilities. In its final shape, it comprises ultra-thin, conductive polymer based electrodes capable to couple with human ears reliably, comfortably, robustly, with minimum obtrusiveness and with aesthetic acceptability for the user, avoiding signal artefacts induced by head movements. wEAR will take advantage of novel dry electrodes, based on conductive polymers, with improved sensitivity and capable of recording for longer periods of time without the need conductive gels. The functional electrodes will be connected with a self-contained module (based on standard electronic components – amplifier, filters, battery etc.) for the EEG data processing – pre-processing (artifacts/noise removal), features extraction and classification (machine learning) – in order decode which source the listener wants to attend to.

With wEAR a new perspective can be given to hearable EEG devices, making them comfortable enough so to be properly embedded in the user's daily life. Furthermore, it will provide a better support to the functionality and rehabilitation challenges that arise for hearing impairment subjects.

The main objective of the project is, therefore, to demonstrate a new multi-functional technology that will be, in the future, potentially interfaceable with commercially available hearing aid devices as a complementary sound source localization tool, thus finally allowing individuals suffering HI to naturally behave in noisy environments, by tackling one of the most challenging problems faced by subjects with hearing disorders.

1.2 LONG-TERM CAREER OBJECTIVES (OVER 5 YEARS):

Goals: (i) refinement and acquisition of technical and theoretical skills, (ii) evolution as group leader, (iii) improvement on how to attract research funding, (iv) experience as lecturer.

What further research activity or other training is needed to attain these goals?

This project will allow me to complement and improve my career within the specific fields of organic electronics especially for biomedical/healthcare applications. Given my extensive academic background in electronic engineering and device fabrication, this *Young Researchers - SoE* fellowship will propel my research skills and capabilities to the desired level of professional maturity. Hopefully, it also allow me to be recognised at an international level. The acquisition of new and powerful methodological approaches will allow me to develop my competence in two distinct but complementary ways. Firstly, in terms of academic production, this fellowship will give me the opportunity to disseminate my research through (1) the publication of research papers and (2) the participation to international conferences. These outputs will enable me to enrich my track record and thus

acquire more credibility and opportunities in my academic field. Secondly, I will improve my skills on the fabrication techniques typically employed in ultra-thin/organic electronics, and acquire new skills, especially in the field of bioelectronics. With this fellowship I will increase my knowledge about this field – which is one of the most important field of application of wearable electronics – especially considering my integration within the host groups (DEALAB and MeDSP), the backgrounds of the supervisors (Prof. Annalisa Bonfiglio and Prof. Danilo Pani) and the training activities. Bioelectronics knowledge is of paramount interest and relevance within my future career plans, and this experience will be extremely useful not only within the academia but also for industry, especially for those that are active in the field of healthcare and biomedical R&D. Hopefully, I will be in a uniquely strong position considering the expertise that I will have at the end of the project, thus reinforcing my international reputation and networks. Moreover, through the *Young Researchers - SoE* fellowship I will improve my skills as a group coordinator, growing the experience needed to manage a research group. This fellowship will improve my mastery of time-, data-, and risk-managing skills, which are essential virtues of a senior researcher. It will help me to re-enforce a position of professional maturity and independence, managing a project with high societal, commercial, technological and scientific impacts, and co-supervising undergraduate and postgraduate students (indeed, I will supervise PhD students and master students). This fellowship is the first step in my career to consolidate a professional independence, as well as building long term deep collaborations with centers of excellence around the world. I will be more familiar with the process of grants writing (especially those that involve medical aspects, with patient/hospital input, ethics concerns etc.) and attracting research funding. Last but not least, I will be lecturer for courses within the Bachelor Degree in Biomedical Engineering at University of Cagliari, starting from the second year of the fellowship.

1.3 SHORT-TERM OBJECTIVES (1-2 YEARS):

Research Results:

- (i) Anticipated publications (**Pu**) and patent (**Pa**):
 - Pu1:** the validation of the thin ear-electrodes for the acquisition of brain signal will be published on a scientific journal with interest on material science for bioelectronics (e.g. *Advanced Healthcare Materials*);
 - Pu2:** the acquired dataset of ear-EEG signals, will be published in a scientific journal with interest on neuroscience (e.g. *IEEE Transactions on Biomedical Engineering*, *Frontiers in Human Neuroscience*);
 - Pu3:** the discrimination of ear-EEG signals – depending on the audio source – will be published in a scientific journal with interest on neuroscience (e.g. *IEEE Transactions on Biomedical Engineering*, *Frontiers in Human Neuroscience*);
 - Pu4:** when the results of the test on volunteers are available, the applicant intends to publish them on inter-disciplinary science journals with high impact factor;
 - Pa1:** the consortium (researcher and supervisors) will discuss Intellectual Property (IP) at the earliest phases of the project with Industrial Liaison Office (the University's technology transfer arm), which will support the consortium in evaluating findings suitable for potential patenting. If a patenting opportunity arises, the Office will support the researcher in preparing and filing the patent.

- (ii) Anticipated conference (**C**), workshop attendance (**W**), seminar presentations (**S**):
 - C1:** 1 conferences on Material Science (e.g. *MRS Spring 2023/24*, *MRS Fall 2023/24*, *e-MRS 2023/24*);

- C2:** 1 conference on Organic Electronics (e.g. ISFOE 2023);
- C3:** 1 conference on the Biomedical field (e.g. International Conference of the IEEE Engineering in Medicine and Biology Society);
- W1:** LOPEC workshop @Munich;
- W2:** InnoLAE (Innovations in Large Area Electronics) workshop @Cambridge;
- S1:** update on WEAR project at the Department of Electrical and Electronic Engineering (at the Host Institution);

Research Skills and techniques:

- (i) Training in specific new areas, or technical expertise etc. **(T)**:
 - T1:** fabrication of ultra-thin electrodes by means of spray coating or screen printing;
 - T2:** characterization of skin electrodes;
 - T3:** measurements for biopotential recordings;
 - T4:** data analysis and statistics on biopotential recordings;
 - T5:** competences in experimental design;

Research management:

- (i) Fellowship or other funding applications planned (F) (indicate name of award if known; include fellowships with entire funding periods, grants written/applied for/received, professional society presentation awards or travel awards, etc.):
 - F1:** MSCA European or Global Postdoctoral Fellowship 2023;
 - F2:** ERC Starting Grant 2024;
 - F3:** PRIMA Call;
 - + Project management skills (supervision, deadlines and delivery, resource management);
 - + IP management and protection;
 - + Skills appropriate to working with others and in teams and in teambuilding.

Communication skills: improvement on *written and oral communication* (both English and Italian); improvement on *presentation skills*; improvement on *non-verbal communication skills*; improvement on *public speaking skills*;

Other professional training (course work, teaching activity): I will be lecturer of courses (Bachelor or Master level) at the Host Institution; if possible, I will attend courses focused on the improvement of communication skills, project management, research funding (such as APRE courses) and on other disciplines that are relevant for this project (especially at the Host Institution, such as Elaborazione elettronica dei segnali, Strumentazione elettromedicale, Sistemi di acquisizione dati and Bioelettronica)

Anticipated networking opportunities: collaboration with national and international research groups:

- G1:** Polymat @Saint Sebastian (Spain) - <https://www.polymat.eu>
- G2:** Bioelectronics Group @University of Cambridge (UK) - <https://bioelectronics.eng.cam.ac.uk>
- G3:** Istituto Italiano di Tecnologia (Italy) - <https://www.iit.it/it/>
- G4:** IUSS Scuola Universitaria Superiore Pavia (Italy) - <https://www.iusspavia.it/it>

Other activities (community, etc) with professional relevance: n.a.



Date & Signature of fellow:

Firmato digitalmente da Fabrizio Antonio Viola

Cagliari, 20/02/2023

Date & Signature of supervisor

Firmato digitalmente da Annalisa Bonfiglio

Cagliari, 20/02/2023