

Doctoral Researcher or Junior Postdoc (Physics and/or Optics)

General description:

Neurotechnology Laboratory is part of IICT-BAS (Institute of Information and Communication Technologies, Bulgarian Academy of Sciences). We are newly formed research group and the group's topic of research is focused on brain and computer/machine interfaces, as well as developing invasive and non-invasive technologies to interact with and monitor the brain for diagnostics, medical or control of external devices purposes.

For our current ongoing project, The Horizon Europe ERA Chair VIBraTE (<https://vibrate-project.eu/>), we are seeking a highly motivated and skilled Doctoral Student (or Junior Postdoc) in the field of experimental physics and/or optics to join our research team. The successful candidate will conduct cutting-edge research in the project and will work together with one of the Senior Postdocs in the group to build and use an Optical Microscopy setup for the core of the project as well as will participate in various developments within the group.

The ERA Chair VIBraTE is headed by Assoc. Prof. Dr. Dimiter Prodanov at the Institute of Information and Communication Technologies of the Bulgarian Academy of Sciences (IICT). ERA Chairs are funded by the European Union to support the development of research excellence in specific scientific areas. The objective of the ERA Chair project is to attract and maintain high-quality researchers at the host institution, improve research quality and impact, and enhance the institution's research environment. The project provides funding for research projects, mobility opportunities, and training activities for researchers.

The EU-funded VIBraTE project aims to support the establishment of a Neurotechnology Lab with a focus on BCI (Brain-Computer Interfaces) at the IICT. Among the objectives of the Neurotechnology Lab will be to model and investigate the properties, geometry, and mechanical effects of the interaction of the brain with implanted electrodes.

Location: IICT-BAS, Sofia, Bulgaria

Group (Web): <https://vibrate-project.eu>

IICT (Web): <https://www.iict.bas.bg>

About the Project:

A brain-computer interface is a technology that collects brain signals and transmits them to an external device that outputs commands. Exploring the interaction between brain-computer interface implants and the brain tissue will help maximize the potential of the technology.

The research objectives of the VIBraTE Chair project are situated along the following research axes:

- Axis 1: Viscoelastic coupling
- Axis 2: Optimization of the interface geometry for invasive and non-invasive BCI
- Axis 3: Diffusion phenomena in the brain tissue

- Axis 4: Effects of viscoelastic deformations on modeled brain activity

The main expected outcome in Axis 1 would be to quantify the mechanical interactions of different implants and link them to physiological states and the observed tissue response. Viscoelastic phenomena are typically investigated using the tools of fractional calculus. Fractional calculus is a domain of applied mathematics, which develops very fast and is especially suited to model processes with memory (time-fractional) or spatial inhomogeneities (space-fractional).

It is expected that Axis 2 would identify some design rules for brain electrodes and less invasive BCI as a main application.

The results in Axis 3 would extend our understanding of local drug or gene delivery in tissues. An example of such an approach is optogenetics, which could possibly be extended to human applications by local transfection around an implanted electrode.

Axis 4 could refine our understanding of the limitations of invasive neural electrode signal decoding (i.e. spike-sorting).

This position will focus on Axis 1 and 2, i.e. to experimentally investigate the influence of the implant's geometry and properties on the bio-mechanical interaction with the brain tissue, represented by phantom models (a medium that mimics the brain tissue mechanical properties). The goal is to find out the best implant electrodes with respect to material, geometries and properties that lead increased mechanical stability while implanted in the brain.

Responsibilities:

Conduct high-quality research in accordance with the research project's objectives and under the guidance and training of a Senior Postdoc. The main duties can be summarized as following:

- Experimental tasks: participate in building, maintaining and using an Optical Microscopy Setup needed for the experimental part of the project
- Software tasks: participate in developing and maintaining the setup software created or used in the group – Microscopy Imaging Software
- Laboratory tasks: help in maintaining devices and equipment, handling 3D printing jobs, keeping track of inventory, ordering equipment etc
- Engineering tasks: designing custom components if needed (using CAD software) for CNC and/or 3D printing, helps the group in the development of new instruments and tools
- Participate in project activities – workshops, schools, trainings
- Publish research findings through journals, conferences, and communication with the public
- For PhD candidates – write a high-quality doctoral thesis and defend it

Requirements:

- For PhD candidates – a master's degree in physics and/or optics, or at most to be within a year of obtaining the degree

- For Junior Postdocs – a PhD in physics (or relevant field) and some experience in building optical setups
- Excellent written and oral communication skills in English
- An advantage – having residency in the European Union

What we offer:

- A competitive salary according to the Marie Curie European standards
- An international research environment
- Access to state-of-the-art facilities and equipment
- Opportunities for professional development and career advancement
- Specific training depending on projects and needs
- Being part of the leading scientific organization in Bulgaria

For PhD candidates – this is a full-time position for three years (36 months) with the possibility of an extension until the end of the project (Jan 2028) based on the performance of the candidate. The successful candidate is expected to enroll in IICT's graduate program and pass an entry exam.

For Junior Postdocs – this is a full-time position for one year (12 months) with the possibility of an extension until the end of the project (Jan 2028) based on the performance of the candidate.

The position is available from Jan 2024, and applications will be reviewed on a rolling basis until the position is filled.

Application and Selection:

We look forward to receiving your application and will screen it as soon as possible. To apply, please submit the following documents:

- CV in English
- Full publication list (for Junior Postdocs)
- Cover letter in English, in which you describe your motivation and qualifications for the position
- Two letters of recommendation
- Copy of the relevant university or PhD diploma
- 3-minute video pitch in English describing yourself and your motivation, and qualifications for the position

The applications will be evaluated by an international hiring panel. Shortlisted candidates will be invited to an interview and may be asked to give a seminar at IICT. Applications should be sent to Tsvetelina Yorgova: tsvetelina.yorgova@iict.bas.bg (and cc: vibratelab@gmail.com)