INNOVATION HUMAN BRAIN PROJECT Newsletter

N#3 · April · 2021

EXTERNAL NEWSLETTER

RESULTS FROM THE CALL "ENGAGEMENT OF INDUSTRY, SMES AND START-UPS"

INNORATE: SOLUTION FOR STARTUPS AND SMES

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THE HBP MULTILEVEL HUMAN BRAIN ATLAS IN EBRAINS

NEW MARKET ANALYSIS: RECENT ADVANCEMENTS ON DEEP SPIKING NEURAL NETWORKS ALGORITHMS

Visit our Innovation web

SOLUTION WORKSHOPS FOR BRAIN TECHNOLOGY START-UPS

FOLLOW THE EIC PATHFINDER CHALLENGE!

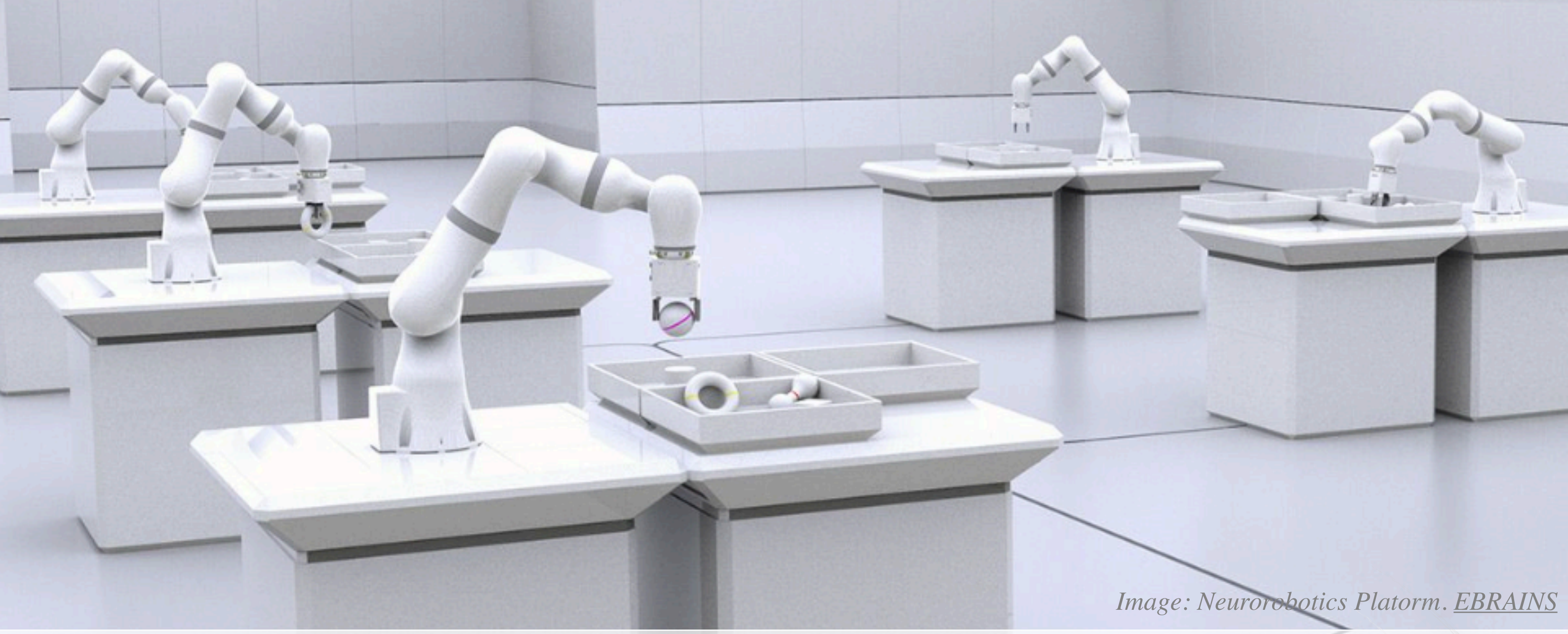

Image: Neurorobotics Platorm. EBRAINS

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UPM Innovation Team

LETTER FROM THE CIIO OF EBRAINS

Since I joined EBRAINS and HBP last fall, I have witnessed the depth and width of the scientific achievements in the project. We have had several breakthrough papers publish even as recent as last year and I sure this pace will pick up in the next years.

I feel there is also an eagerness to use some the results, find applications for them, even go to market with them. Sometimes that is difficult as it requires building bridges between fundamental science and those who are focused on results. This difficulty should not lead to frustration, it is also an opportunity. Building bridges typically means working on both banks. It is in this context that we have decided to rollout an innovation practice.

We will turn the tables in this approach and identify market pull for our innovations by engaging in a focused approach with several key industries. We are focusing on health and pharma in a first phase, other industries will follow. This focus is key to allow enough time and resources to engage and produce tangible results. Those identified opportunities or needs will then be used to specifically target HPB/EBRAINS results or ongoing research, eventually this will allow some of our researcher to build a new dedicated pitch for their innovations.

Another important aspect is mapping out where innovation around brain research is happening today. We are mapping the startup community in this space, both geographical and topical and planning a dedicated engagement with a selection of these companies to learn their needs and provide solutions from our platform.

I am privileged to have witnessed several initiatives where new solutions are being brought to market based on HBP research. We are gaining tracking in health space and our data solutions allow us to venture into the new initiatives around federated health data. Even more exciting is that in all these conversations a desire to keep working with EBRAINS in the long term is expressed. This opens yet another avenue to valorize our results.

Lastly we see new initiatives appearing as we bring EBRAINS RI to the forefront. It acts as a catalyst to entice new ideas on how such a platform could be used and extended. One such opportunity is extending the EBRAINS platforms support to neuroengineering, allowing that growing field of applications to benefit from the simulations and modeling that is available on EBRAINS.

It is exciting to be part of the future,

Steven Vermeulen

HBP Innovation Director
CIIO of EBRAINS AISBL

Image: Shutterstock

SOLUTION WORKSHOPS FOR BRAIN TECHNOLOGY START-UPS

SGA3 of the HBP is accelerating the utilisation of its tools and services by scientific institutions, hospitals and industrial companies working in Neuroscience, Neurocomputing and Neurorobotics. Some initiatives, like the “CEoI Engagement of Industry, SMEs and start-ups” or the Voucher programme are already showing the ambition of HBP to attract new users to EBRAINS, exploit research results, and materialise research-industry co-development possibilities. Another complementary activity, whose objective is to map the interests, problems and necessities of brain-related start-ups and spin-offs in Europe, has been recently launched by the HBP Innovation team. This activity will help to explore where, in practice, brain innovation and entrepreneurship is happening. Around 400 emerging companies have been identified and analysed to understand their interests and explore how EBRAINS could contribute to address their challenges and technological needs. The mobilisation of technology-based start-ups around HBP should indeed help to progressively build a critical mass of users around EBRAINS that guarantees the growth and sustainability of the research infrastructure beyond the end of HBP.

To accelerate this engagement, and to reinforce even more the visibility of EBRAINS within the industrial context, a series of events will be organised by the HBP Innovation team to show, in a hands-on way, the full potential of the infrastructure to these start-ups, which are essential part of the HBP innovation ecosystem.

Around 400 emerging companies have been identified and analysed to understand their interests and explore how EBRAINS could contribute to address their challenges and technological needs

A series of thematic and interactive meetings, called “SOLUTION WORKSHOPS”, will be held to catalyse connections between HBP researchers/developers and private companies. The selection of these companies will be made according to the possibilities of matching their interests with the tools and services HBP offers in specific areas. Previous dialogues with these companies will serve to confirm their problems, assess their innovation potential, and collaborate in further HBP innovation activities. The first pilot of this series will be organised between May and June 2021.

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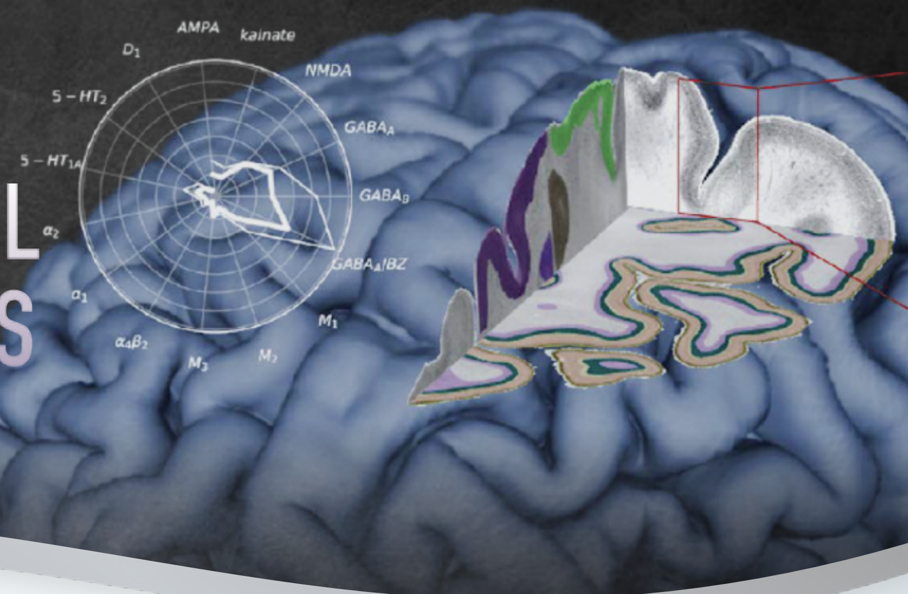
Image: Human Brain Atlas, EBRAINS

THE HBP MULTILEVEL HUMAN BRAIN ATLAS IN EBRAINS



The 4th meeting of the Spanish National Innovation Community took place on March 11, with Dr. Timo Dickscheid as invited guest, who introduced the Multilevel Human Brain Atlas being developed within HBP.

Dr. Dickscheid, Head of the Big Data Analytics group at the Institute of Neuroscience and Medicine (INM-1) in Forschungszentrum Jülich (Germany), is also the leader of the **EBRAINS Atlas service category** (SC2). This category includes the development of brain reference atlases and the corresponding software interfaces for exploration, data integration and data analysis.

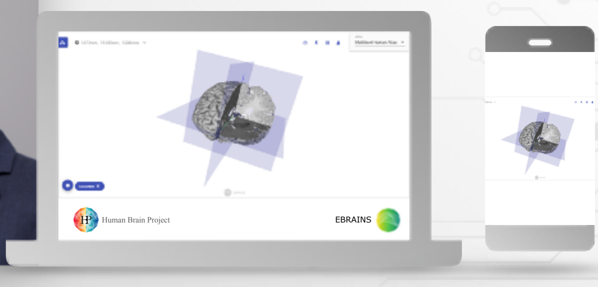
In his presentation to the Spanish National Innovation Community, he introduced the **Multilevel Human Brain Atlas** to over 50 representatives, an attendance indicative of the remarkable interest generated by this technology. The EBRAINS Multilevel Human Brain Atlas integrates different facets of brain organization, represented by complementary maps of structure, function and connectivity that are defined across multiple reference spaces, going down to the micrometre resolution of the BigBrain model.

The atlas retrieves all data from the **EBRAINS Knowledge Graph**, information that can be then explored using a 3D Interactive Atlas Viewer as well as through different programming interfaces (or APIs; soon to be available on EBRAINS). Furthermore, these APIs will enable users to connect their own workflows to the atlas. To end his presentation, Dr. Dickscheid entered online into some of the atlas' tools and exemplified how to use them.

The EBRAINS Multilevel Human Brain Atlas integrates different facets of brain organization, represented by complementary maps of structure, function and connectivity

Some communities that have been identified as potential users of this technology include neuro-surgeons and physicians; medical scientists; experimental and computational neuroscientists; neuroanatomists and students and, finally, brain-inspired AI researchers. Other communities, such as pharma, still need to be explored. You can access the recording of this Spanish Innovation Community meeting through this link.

Dr. Timo Dickscheid



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INNOVATION RADAR RESULTS

Eleven HBP results - produced in the period from 2018 to 2020 (HBP SGA2 phase) - have been recently published in the EU Innovation Radar platform. They add to the twenty results that were already included in the IR Platform from the previous phase of the project (HBP SGA1).

The Innovation Radar is a European Commission initiative to identify high potential innovations in EU-funded research. It aims to allow every citizen, public official, professionals, investors and business persons to discover the outputs of EU innovation funding and give them a chance to contact innovators for an eventual collaboration (commercial or non-commercial).

The Innovation Radar classifies the results according to the following scale of maturity:

Exploring

Innovations actively exploring value creation opportunities

Tech Ready

Progressing on technology development process (e.g. pilots, prototypes, demonstration)

Business Ready

Putting concrete market-oriented ideas together (e.g. market studies, business plans, end-user engagement)

Market Ready

Outperforming in innovation management and innovation readiness. Considered “Ready for market”

From the eleven newly published HBP results, 3 of them are market ready, 1 is business ready, 4 are tech ready and 3 of them are still in the exploring phase. Thirteen HBP partners from seven different countries have been involved in the development of these innovations.

They cover different technology areas reflecting the spectrum of activities of HBP. Five of them are in the field of neuromorphic computing and AI, including a deep learning method for spiking neural networks. There are also a tool to improve epilepsy surgery (BVEP) as well as an innovative technology platform for the direct in vivo generation of “nanobodies” against native proteins. Another interesting development is based on an inverted confocal light sheet fluorescence microscope that can resolve sub-cellular morphology over centimetre-sized cleared tissues at state-of the art acquisition speed.

The MIP -a privacy preserving, federated data analytics software- has also been included in the Radar. The NEST Desktop is in the list of selected technologies too, as it is a powerful simulator to explore and understand biological neuronal networks. Finally, the industrial potential of a HBP solution that enables a fast, flexible tracking of almost any behaviour in real-time has also been recognised.

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Follow the links to the above mentioned technologies at the Innovation Radar website


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BRAINSCALES-1 NEUROMORPHIC COMPUTING SYSTEM: ACCELERATED, WAFER SCALE, SPIKING NEURONAL NETWORK EMULATOR

BRAINSCALES-2 NEUROMORPHIC COMPUTING SYSTEM, ADDING STRUCTURED NEURONS, LOCAL PROGRAMMABLE PLASTICITY PROCESSOR AND RATE BASED OPERATION TO BRAINSCALES

MANY CORE SYSTEM-ON-CHIP FOR ENERGY EFFICIENT NEUROMORPHIC COMPUTING

PROCESSING ELEMENT ARCHITECTURE FOR DIGITAL HYBRID NEUROMORPHIC COMPUTING

POWERFUL DEEP LEARNING METHODS FOR SPIKING NEURAL NETWORKS

BAYESIAN VIRTUAL EPILEPTIC PATIENT (BVEP): PERSONALIZED BRAIN MODELS FOR BETTER SURGERY OUTCOME IN EPILEPSY

NANOBODY PLATFORM FOR BRAIN IMAGING AND SUBCELLULAR PHARMACOLOGY

IMPROVED LIGHT-SHEET MICROSCOPE FOR 3D RECONSTRUCTION OF MACROSCOPIC BIOLOGICAL TISSUE SAMPLES AT SUB-CELLULAR RESOLUTION

MIP- THE MEDICAL INFORMATICS PLATFORM FOR PRIVACY PRESERVING, FEDERATED DATA PROCESSING AND ANALYTICS

NEST AS A SIMULATION ENGINE FOR SPIKING NEURAL NETWORK MODELS OF ANY SIZE WITH NEST DESKTOP IS AN INSTALLATION-FREE INTERACTIVE TEACHING TOOL

REAL-TIME TRACKING OF LIMBS AND BODY IN HUMAN BEINGS, ROBOTS AND ANIMALS

For more information feel free to contact us here

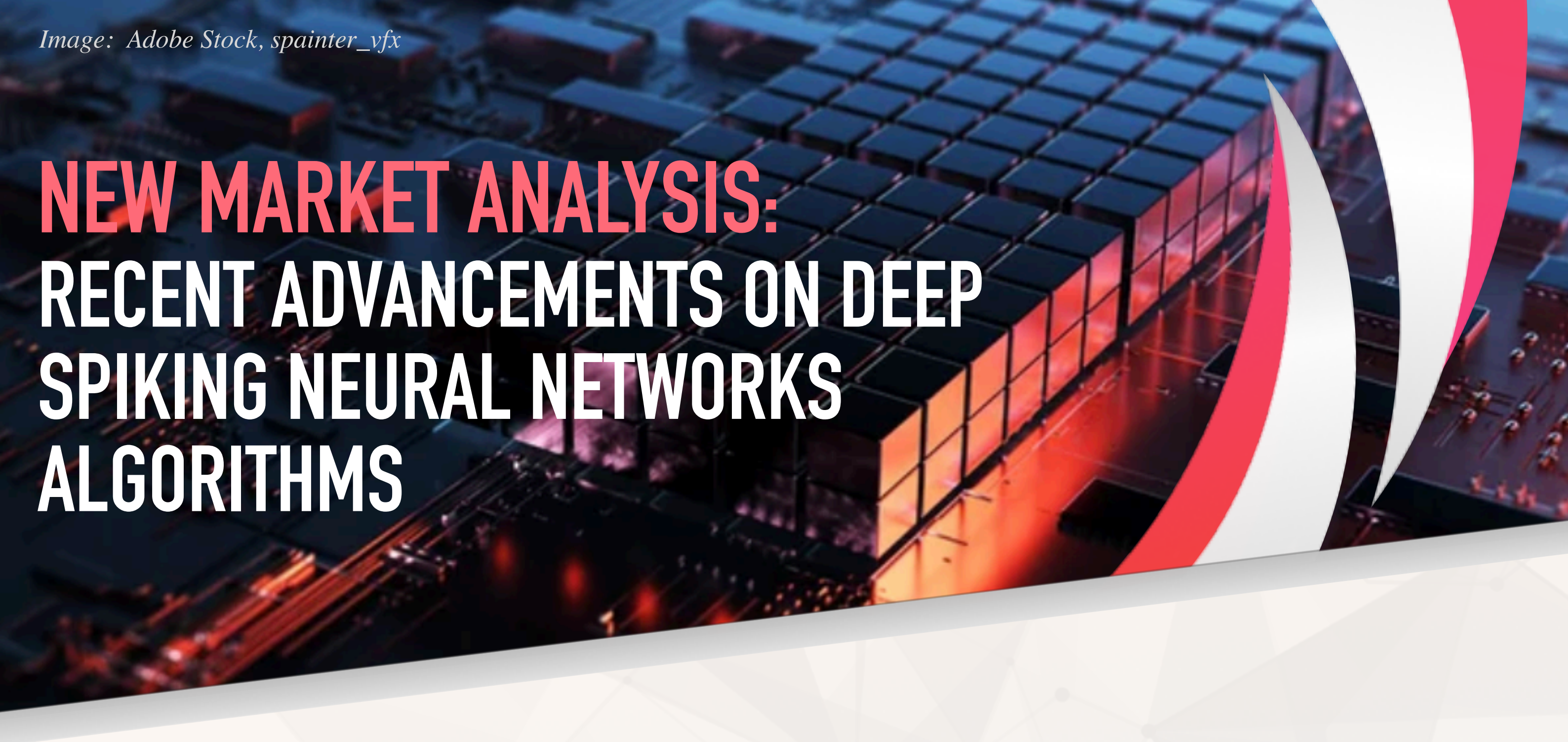


Image: Adobe Stock, spainter_vfx

NEW MARKET ANALYSIS: RECENT ADVANCEMENTS ON DEEP SPIKING NEURAL NETWORKS ALGORITHMS

Artificial intelligence is already a part of our daily lives. However, and regardless how successful AI applications have become, it is still difficult to find solutions with effective self-learning capacities in the AI landscape. Moreover, the ever-increasing volume of data, data-processing needs, and the large amount of energy requested explain the need for new hardware. Bio-inspired spiking neural networks (SNNs) models, implemented on neuromorphic chips, could be an impactful solution for effective self-learning capabilities and energy-efficiency.

Although neuromorphic chips have demonstrated their adaptation to deep Neural Networks (DNN), they lack efficient inference and suitable training algorithms compliant with the spatiotemporal structure of the brain, since the application of gradient backpropagation algorithms are challenging to implement on neural structures. This shortcoming restricts the application of neuromorphic hardware, preventing it from being scaled, and eliminates the competitive advantages they have over the currently utilised AI accelerators.

The algorithms enable gradient calculations with SNN which improve efficiency of deep learning applications on neuromorphic chips and provide efficient solution for on-device training

Prof. Wolfgang Maass' studies on SNN algorithms shed light on these problems and enabled practical connections between Biology and deep learning. The algorithms enable gradient calculations with SNN which improve efficiency of deep learning applications on neuromorphic chips and provide efficient solution for on-device training.

"Recent Advancements on Deep Spiking Neural Networks Algorithms and their implementation on Neuromorphic chips" is inspired by novel solutions on deep SNNs and explore their potential impact on the artificial intelligence area. The report aims to serve as a bridge between scientists and non-expert readers, demonstrate the potential of this research stream, and define the position of SNNs within the AI market.

MAIN TOPICS INCLUDED IN THE REPORT

Common methodologies of training SNNs, and advantages of new algorithms.

Market Analysis of Edge, online-training application areas and current actors in the field.

Advancements within and outside the Human Brain Project.

Required components for efficient, effective, and scalable SNN training, and trend analysis (actors, patents, research centres).

Additional information that you can find in the report:

- Well-established queries that can be easily re-used to follow updated patent information on specific search lines.
- Top researchers and research centres working on spiking neural network algorithms, including location analysis.

Together with the previous report "Neuromorphic computing: concepts, actors, applications, market and future trends" (Bulut, Velasco & Leon, 2020) the Innovation team has completed a first series of exploitation-oriented guidelines for a non-specialised audience and investors that have an interest in the neuromorphic computing domain.

Background: Adobe Stock, Rawpixel

RESULTS FROM THE CALL

"Engagement of Industry, SMEs and Start-ups"

The Call for Engagement of Industry, SMEs and start-ups was created to involve private companies in the development of tools and services for the EBRAINS research infrastructure. The candidates were required to present technology development plans to improve EBRAINS tools and facilitate their exploitation in scientific and industrial users' markets.

The Call was launched on 5 August 2020 and closed on 26 October 2020. The budget was 1M€ direct costs to grant four proposals, with a maximum funding per proposal of 250k€. A total of 24 pre-proposals and 15 admissible and eligible full proposals were received. An external evaluation panel selected the 4 winners according to excellence, impact, implementation, equal opportunities, and ethical compliance criteria.

Two of these projects are allocated, as specific tasks, in the HBP WP1 "The human multiscale brain connectome and its variability - from synapses to large-scale networks and function":

Project 1: NEURO-CONNECT

(Knowledge management solution for multimodal brain atlas and connectome integration). Coordinator: Biomax Informatics AG, Germany.

A novel and cutting-edge knowledge management solution especially designed for the semantic integration of connectome data from different structural (DWI: Diffusion Weigted Imaging, PLI: Polarized Light Imaging) and functional imaging modalities (fMRI, EEG, MEG). Connectome data will be made available together with related processing information as well as with related meta-information such as brain atlases, demographic information as well as longitudinal assessments.

Project 2: LB2020 – (LIVING BRAIN)

Coordinator: GEM Imaging SA - ONCOVISION, Spain.

The specific objective of this project is building a prototype dedicated brain PET incorporating revolutionary innovations upgrading neurophysiology knowledge, advanced neurological research, and expanding clinical applications. Adding the molecular/functional perspective to existing brain atlas will complete their contribution to comprehensive brain knowledge. This will multiply its practical impact for both research and clinical care of healthy, altered, and pathological brains, fulfilling HBP ambition and objectives.

And the following two granted projects are likely to be allocated, as specific tasks, in the HBP WP5 "EBRAINS Modelling Services":

Project 3: CESPAR

(Closed-loop exoskeleton simulation for personalized assistive rehabilitation within HBP NRP).
Coordinator: Alpine Intuition, Switzerland.
Partners: Autonomyo, Switzerland.

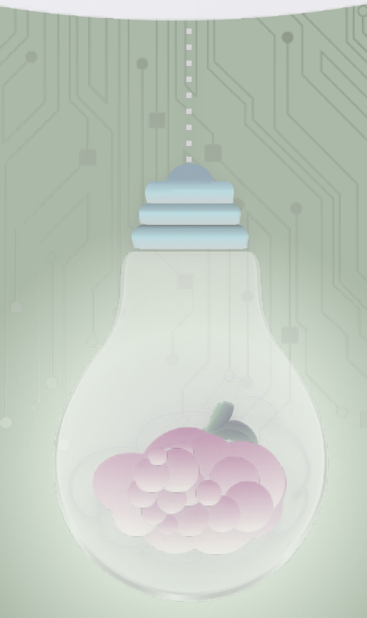
Integration of an additional tool to the HBP Neurorobotics Platform (NRP) which will allow users (e.g. exoskeleton companies) to integrate their devices to the musculoskeletal model of a patient. It also allow users to couple their devices with a spinal cord model based on neuromuscular control (a model developed in the context of the EU-Symbitron project) which embeds bio-mechanics, virtual muscles and deep neural network in the control of the exoskeleton.

Project 4: Neuro-robin

(Closed loop upper limb neurorobot simulator).
Coordinator: Bit&Brain Technologies SL, Spain.

Implementation of a new use case in the EBRAINS Neurobotics platform, able to support the simulation of EEG-based brain computer interfaces and movement of the robot exoskeleton for closed-loop upper limb motor rehabilitation, and to provide the tools to transfer the simulated models to a physical infrastructure and test them in reality for neurophysiology, psychophysics, neurotechnology and neurorehabilitation research.

The granted candidates will now join the HBP consortium, with the same rights and responsibilities as existing HBP partners. The Innovation team welcomes these interesting and impactful projects and wish new members the best of luck in developing so promising and relevant brain innovations.



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INNORATE: SOLUTIONS FOR START-UPS AND SMES

The 1st of January 2019 marked the start of **InnoRate**, a 3- year project funded from the European Union's Horizon 2020 research and innovation programme. The **InnoRate** consortium consists of 9 partners from 6 countries (Greece, Italy, Belgium, Bulgaria, France and South Korea), covering a wide range of competences and expertise.

The main objective of the project was setting and deploying a trusted, recognized, and objective service platform across the EU and Associated Countries to support and improve the decision-making processes of investors and lenders for vetting, prioritizing, and providing access to finance for innovative companies with high growth potential.

InnoRate can evaluate startups and SMEs technology, management marketability and business feasibility potential in a matter of a few clicks. Companies can use the platform services free of charge to assess their potential, get access to expert feedback, and connect with investors.

More info & registrations: http://innorate-project.eu/2021/03/19/innovation-and-ip-commercialisation-licensing-06-may-2021

The InnoRate Technology Rating Platform help to:

- Minimize the time and resources (human and financial) required by investors and lenders for assessing innovative SME cases
- Make the prospects of innovative SMEs clear to investors
- Reduce knowledge and information asymmetries and risk premiums paid by innovative project managers

P.S.:
May 06, InnoRate and European IP Helpdesk will be hosting a webinar on innovation and IP commercialization and licensing

EIC Pathfinder Challenge

European Commission Decision C(2021) 1510, March 2021

Tools to measure and stimulate activity in brain tissue:

Medical devices to measure and stimulate brain activity are emerging as tremendously powerful therapeutic tools that could revolutionise the treatment of brain diseases. Anomalous neuronal electrical signals are present in a wide range of disorders including memory impairment (Alzheimer's disease), epilepsy, chronic pain, mood disorders, movement disorders (Parkinson's), ischemic cognitive decline (post-heart attack), sensory disorders (hearing loss, tinnitus), cerebrovascular events, aging related neurodegeneration, traumatic brain injury amongst many others.

Unfortunately, existing devices to restore normal patterns of brain activity by stimulation have serious limitations. Invasiveness, limited miniaturisation, poor resolution (with only coarse measurement and stimulation available), limited spatial coverage (not able to monitor or stimulate a sufficient number of neurons) hamper the therapeutic effect or render these solutions unattractive for clinicians and patients.

Further, progress can also be achieved by the discovery of new physical principles for activity monitoring (invasive or non-invasive) and activity modulation. These could explore ultrasound, light (optogenetics or otherwise), mechanical stimulation, local release of neuroactive compounds, etc. It is the right time to explore these opportunities and develop novel neurodevices that can be rapidly accepted by clinicians and patients.

Proposals submitted to this call should tackle at least one of the following two challenges:

- ❖ A full device with unique features, e.g. targeting a currently untreated disorder, offering unprecedented miniaturisation, low latency closed-loop monitoring-stimulation feedback

  or
- ❖ New or nascent physical principles or methodologies that could be the basis for future brain sensing and/or stimulation technologies.

Specific conditions for this challenge here

Engineered Living Materials:

Engineered living materials (ELMs) are composed, either entirely or partly, of living cells. ELMs entirely composed of living cells are called biological ELMs and they self-assemble via a bottom-up process, e.g. synthetic morphogenesis for organoids' production. ELMs only partly composed of living cells are called hybrid living materials (HLMs) and are built with a top-down process with integrated polymers or scaffolds. By being alive, ELMs represent a fundamental change in materials' production and performance, enabling new, better or similar functionalities, compared to traditional materials but with decreased costs and environmental impact. ELMs have the potential to transform virtually every modern endeavour from healthcare to infrastructures to transportation.

Image: Adobe Stock, Production Perig

The specific objectives of this call are to support the development of new technologies and platforms enabling the controlled production of made-on-demand living materials with multiple predictable dynamic functionalities, shapes and scales; and to build a community of researchers and innovators in ELMs.

Reaching these objectives requires a research team that strongly integrates, among others and not exclusively, expertise in synthetic biology, materials engineering, control engineering, artificial intelligence, synthetic or engineered morphogenesis as well as ethical, legal and social aspects (ELSA).

The specific expected outcomes depending on the choice of the ELM production process (top-down or bottom-up) are:

- ❖ a proof of principle of technologies far beyond the current state of the art enabling the production of a minimum of two novel biological ELMs bigger than 1 cm in all dimensions by programmable and controlled synthetic or engineered morphogenesis
  or
- ❖ a laboratory validated, automatized and computer-aided design-build-test-learn (DBTL) platform far beyond the current state of the art able to produce a minimum of two novel HLMs in multiple scales with enhanced or unprecedented properties.

Projects are strongly encouraged to consider multi-cellular ELMs. They are also encouraged to develop technologies that can be easily generalizable and adapted for the production of a broad range of ELMs from different cells.

Specific conditions for this challenge here

Medical Technology and Devices: from Lab to Patient

EU-funded early-stage Research on novel Medical Technologies and Devices is uncovering unique opportunities to benefit patients and support clinicians. Yet transitioning from a proof-of-concept result to a level of technological maturity appropriate for clinical evaluation poses significant technical, financial, business and operational challenges to innovators in the field.

The early-stage devices must often evolve substantially, being recast with electronics, software, materials, ICT system operating environments and processes compliant with the appropriate safety standards, e.g. IEC60601, ISO10993, etc. and suitable for future manufacturing with appropriate quality levels, etc. in line with ISO13485.

Medical Technology and Devices businesses are also facing long and capital intensive product development cycles, complex regulatory procedures, slow market uptake requiring the support of key opinion leaders and intensive follow-up with early adopters. As a result, in addition to a mature technology, a well thought-out and realistic exploitation path with emphasis on achieving market traction as proof of both clinical and market potential of the idea is needed.

Specific conditions for this challenge here

HUMAN BRAIN PROJECT

León, G., Velasco, G., Strange, B., Kireev, R., Gasset, B., Durmaz, B., Duran, T., Sánchez A., Fernández, A., Beltrán, B.