HyperProbe

Project title: Transforming brain surgery by advancing functional-guided neuronavigational imaging

Project acronym: HyperProbe

Grant Agreement: 101071040

Call identifier: HORIZON-EIC-2021-PATHFINDERCHALLENGES-01

D7.1 Project website and visual identity

Lead partner:	EIBIR
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Work Package:	WP7
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Type:	R
Dissemination level:	PU

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European Innovation Council

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Disclaimer

1 HyperProbe Website

The HyperProbe website has been developed as the main public-facing online presence.

It contains the most important information about the project and efforts were made to keep the information understandable for the general public.

The website is a constantly changing and evolving platform. The initial release provides basic functionality and information, but will change substantially over the course of the project.

All separate pages are attached at the end of this document.

1.1 Landing page

The landing page features an attention grabbing hero element at the top of the page. This is followed by more details about the objectives of the project. Both sections link to more in-depth information about HyperProbe.

This is followed by a section displaying the latest news items, which also links to a news archive.

As a next sections, briefly introduce the work packages, the expected results and the and overview of the consortium is included. All consortium partners are included with their logo. All of these sections include their parent link, where more information about the work packages, results and consortium partners can be found.

The menu at the top of the page remains at the top for easy navigation.

A footer at the bottom of the page includes information about the EC funding and the disclaimer regarding the public views of HyperProbe. It also includes direct contact details and quick links to each main section.

1.2 About Us page

The About Us page provides more details about HyperProbe, including the mission as well as some hard facts about the project such as runtime, number of partners, coordination teams etc.

1.3 Work Packages

The specific objectives and work packages are described on this page.

1.4 Consortium and partner-specific pages

This page provides a geographical overview of the consortium, showing its global nature, as a list of partners. Every partner can be clicked on for navigation to more details about each partner. This includes a general description of the organisation, their role in the project and the staff involved.

This page also includes information about the multidisciplinary nature of the consortium, and its complementary expertise.

1.5 Results

The results page involves three categories of public results: scientific publications, public deliverables and press material. The dropdowns will be constantly uploaded with the newest publications, public deliverables or press releases.

1.6 Contact page

The contact page does not include any contact forms, but only provides details for direct contact means; a dedicated email address.

The decision not to include a contact form was made for GDPR compliance reasons. See section 2 for more details.

2 Security and compliance

All connections to and from the website are SSL-encrypted and secure.

All data is stored in a data center in Belgium.

A GDPR-compliant cookie banner for consent and management is implemented.

The backend of the website is running on WordPress with Elementor. Elementor does **not** set HTTP cookies. Instead, Elementor works with LocalStorage and Session Storage. However, these are legally treated as (HTTP) cookies. Rather than HTTP cookies, data stored is an entry in the local storage and in the session storage of the browser. The collected data will most only be stored on the visitor's local browser for a limited period and will not be sent to Elementor, the website operator's server or any third party.

The LocalStorage and Session Storage data is classified as essential according to the current state of knowledge. In this case, local storage and session storage are responsible for ensuring that pop-ups, sitebars, etc. are not displayed again so that the visitor can use the website undisturbed. Whether these "cookies" are actually considered necessary is disputed.

Nevertheless, according to ePrivacy Directive 2002/58/EC, access to browser memory is only permitted if the visitor has consented (GDPR Article 6 (1) lit. a) or if the access is absolutely necessary in order to provide or operate the service.

In both cases, this means that European users of Elementor should provide their website visitors with detailed information on what data is stored locally in accordance with the GDPR.

Since we consider local and session storage to be essential in this case, opt-in consent from website visitors is technically not needed. However, to err in the safe side, we comply with the obligation to inform according to Article 13 of the GDPR. In addition to cookies, we refer to the data storage in our cookie notice.

In addition to the Elementor local storage, we also use Matomo Cloud for tracking visitor statistics. This data is also stored in Belgium. Matomo is a fully GDPR-compliant alternative to Google's Analytics for website.

Cookies are only stored on the visitors computer if they consent in the cookie notice. Following this, an option to manage consent is permanently available at the bottom right of each page.

3 Visual Identity

3.1 The HyperProbe logo

A professional, custom-made logo was prepared for the HyperProbe project. The logo was designed so that it resembles and refers to hyperspectral imaging via the rainbow colour choice, and the icon, which resembles beams of light or laser-like elements. Along the professional design, a font was also chosen (Lexend) which will be used on any visual display (ppt, poster, leaflet etc.) during the project.

Figure 1: HyperProbe logo

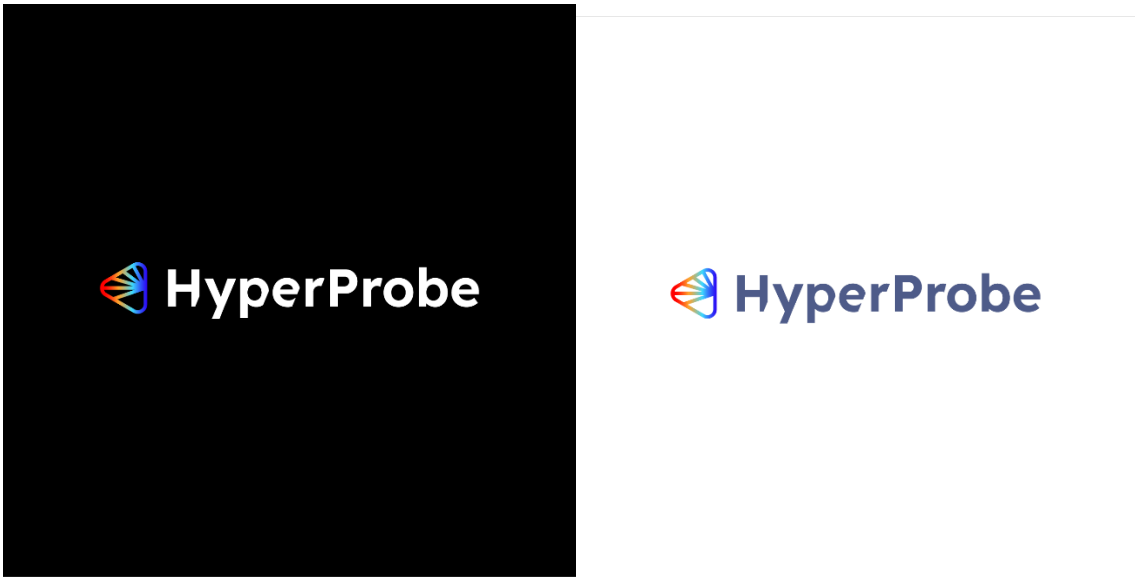
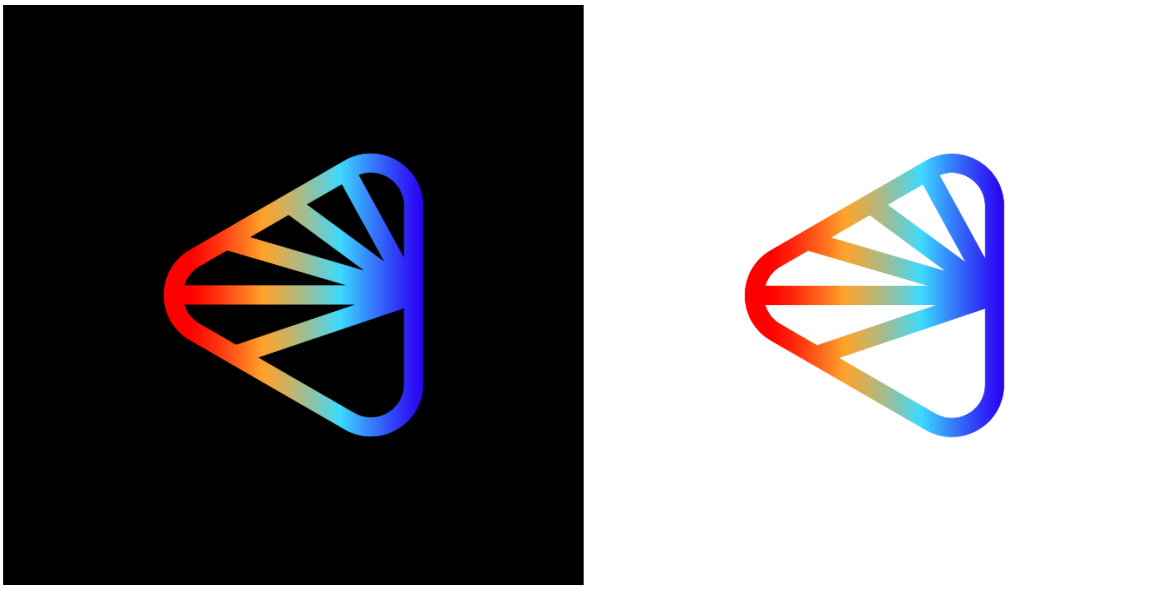


Figure 2: HyperProbe icon

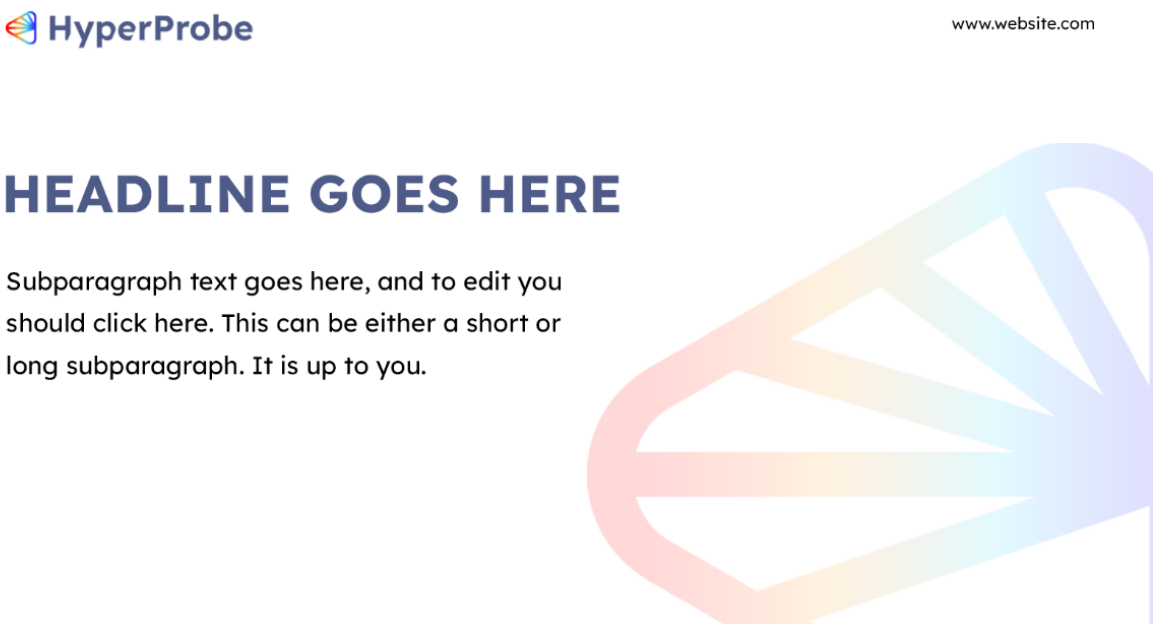


3.2 Visual materials for social media

Other visual materials were arranged specifically for social media use, such as cover pictures and templates for social media cards.

Figure 3: Social media cover picture

Figure 4: social media cards/post templates



3.3 Templates

A HyperProbe custom-made presentation template was prepared and made available for the whole consortium.

Figure 5: HyperProbe PPT: title page

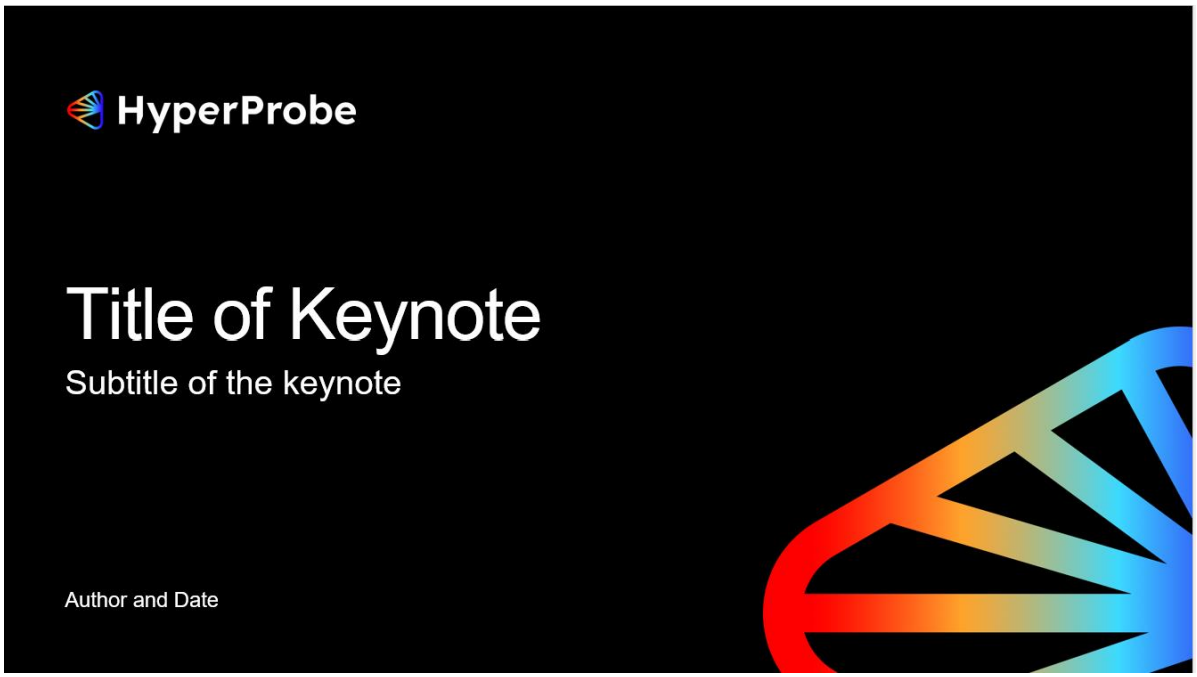


Figure 6: HyperProbe PPT: section title page

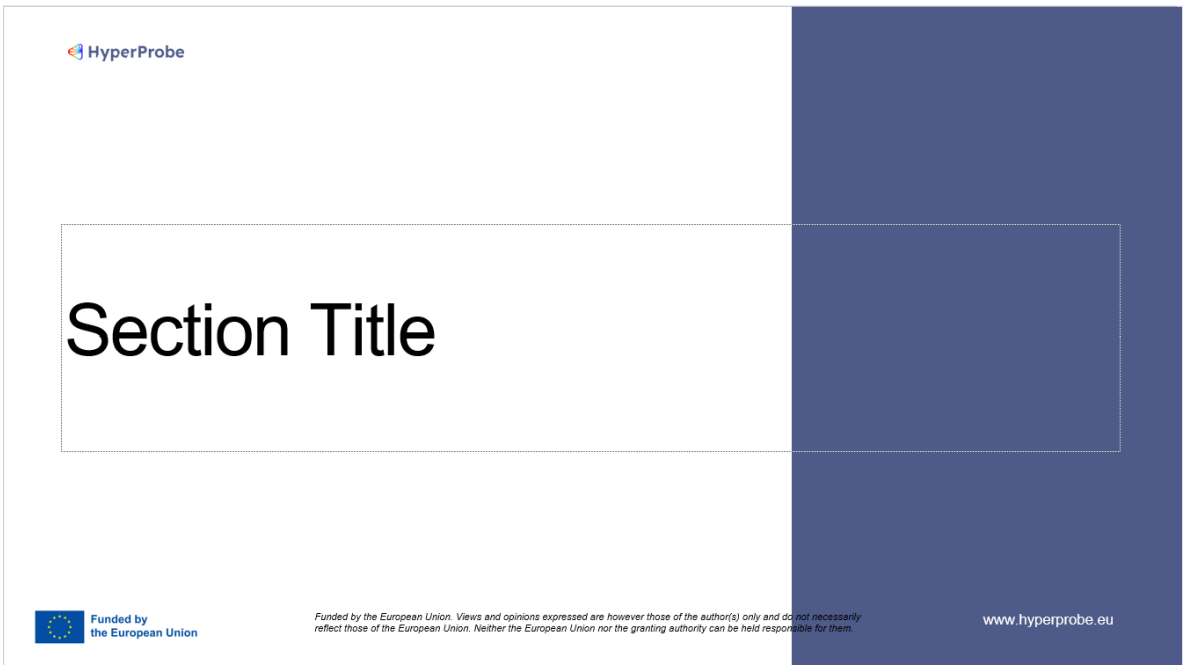
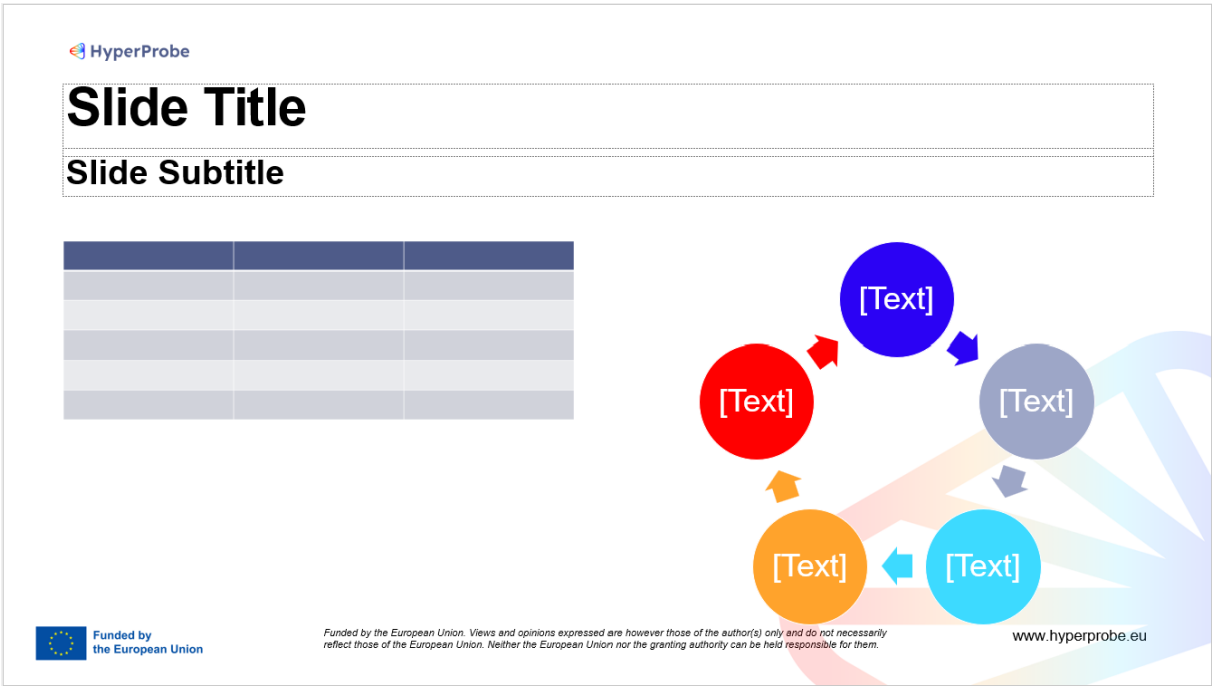


Figure 7: HyperProbe PPT: slide with custom table design and figure



Additionally, a uniform word template was made specifically for HyperProbe related reports and deliverables.

WELCOME TO THE HYPERPROBE PROJECT

Revolutionising brain surgery with multi-wavelength spectral imaging and artificial intelligence

Improved patient outcomes in neurosurgical procedures

Learn more

HyperProbe Objectives

Building A Novel Advanced Optical Imaging System

We will develop a cost-effective, transportable, and compact hyperspectral imaging system to guide neurosurgery

Developing Artificifal Intelligence Algorithms For Biomarker Identification

We will develop algorithms to identify biomarkers of brain activity for in vivo imaging during brain surgery and cortical activity stimulation

Validating HyperProbe In Clinical Settings

We will conduct feasibility studies on the performances of HyperProbe on patients during glioma surgery and multiple paradigms of stimulation of brain activity

About HyperProbe

News

We will periodically share news on research developments, publications, presentations and more.

News Archive

Follow us on Twitter and LinkedIn

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HyperProbe project launched

Read More

Work Packages

To address the key objectives of the project, HyperProbe is divided into 8 work packages.

- WP1: Lab system development
- WP2: Down-scale & prototyping
- WP3: Optical and metrological characterization
- WP4: End-to-end trainable pipeline image reconstruction and analysis
- WP5: Validation against gold standards
- WP6: Clinical observational studies
- WP7: Dissemination, communication and exploitation
- WP8: Project Management

Find out more

Our Results

We're making our research findings available for readers and are providing open access to our publications and public deliverables.

Learn More

Partners

The HyperProbe consortium is a multidisciplinary team includinoptical and imaging engineers, physicists, software engineers, clinicians and industry players.

The project brings together nine renowned organisations and industry partners from all over Europe.

University of Florence
Florence, IT

EMOLED
Florence, IT

Technical University Of Munich
Munich, DE

Université Lyon 1 Claude Bernard
Lyon, FR

Centre De Recherche En Acquisition Et Traitement De L'Image Pour La Santé
Lyon, FR

University Hospital Carreggi
Florence, IT

European Institute For Biomedical Imaging Research
Vienna, AT

Hospices Civil De Lyon
Lyon, FR

University College London
London, UK

Find out more

HyperProbe will transform brain surgery by advancing functional-guided neuronavigational imaging

The HyperProbe project receives funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101071040.

The UK participant in HyperProbe (University College London) is supported by UKRI grant numbers 10048587.

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Our Mission

HyperProbe is constructing a new optical imaging device that will improve brain surgery by providing enhanced information to neurosurgeons during surgery. The HyperProbe device will provide real-time, high spatial resolution brain tissue images. It will resolve brain tissue cellular and molecular biomarkers with high specificity and sensitivity Furthermore, it will implement AI and ML approaches for data analysis and image reconstruction for a variety of purposes. The HyperProbe device will be a compact instrument allowing surgeons to easily use it, read the data it provides and integrate it with existing instrumentation. This will contribute to enhance patients' treatments and life expectancy.

About the project

The HyperProbe device will: provide real-time brain tissue images; resolve with high specificity and sensitivity brain tissue cellular and molecular biomarkers; and implement AI and ML approaches for data analysis and image reconstruction for a variety of purposes. Furthermore, HyperProbe would be completely non-invasive, as it is based on the use of non-ionising light. In addition to this, the system will aim at being compact and cost-effective, completely transportable in order to easily fit in the surgical room and with the advantage of being capable of integration with current neuronavigation modalities, such as the surgical microscope.

Facts And Figures

Name: Transforming brain surgery by advancing functional-guided neuronavigational imaging

Acronym: HyperProbe

Start Date: October 1, 2022

End Date: September 30, 2027

Coordinator: Universita Degli Studi Di Firenze (UNIFI)

Consortium: 8 partners from 4 countries

Funding: € 3 360 825.00

Context

In recent years, through the advancement of imaging technologies (such as MRI, PET, CT, among others) clinical localisation of lesions of the central nervous system (CNS) pre-surgery has made possible for neurosurgeons to plan and navigate away from functional brain locations when removing tumours. However, neuronavigation in the surgical management of brain tumours remains a significant challenge, due to the inability to maintain accurate spatial information of lesioned and non-lesioned locations intraoperatively.

To answer this challenge, we have put together a team of engineers, physicists, data scientists and neurosurgeons to develop an innovative, all-optical intraoperative imaging system based on hyperspectral imaging (HSI) for rapid, multi wavelength spectral acquisition, and artificial intelligence (AI) for image reconstruction and molecular fingerprint recognition.

We will validate the developed capacity in phantoms, in vivo against gold standard modalities in neuronavigational imaging, and finally provide proof of principle during brain tumour surgery. HyperProbe aims at providing functional and structural information on biomarkers of interest that is currently missing during neuro-oncological interventions.

View Our Work Packages

View Our Consortium

Coordination Team

Francesco Saverio Pavone

Francesco Saverio Pavone is a Full Professor at the Department of Physics of UNIFI and directs a research group at LENS and UNIFI working in the field of biophotonics on single molecule biophysics, microscopy imaging-spectroscopy techniques, biomedical imaging, laser manipulation of bio-samples.

Luca Giannoni

Luca Giannoni completed his PhD in Medical Imaging at UCL in 2020 and has been working in the field of biomedical optics and imaging for about seven years.

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HyperProbe

Work Packages

Aims and specific objectives

HyperProbe is constructing a new optical imaging device that will improve brain surgery by providing enhanced information to neurosurgeons during surgery. The HyperProbe device will be a compact instrument allowing surgeons to easily use it, read the data it provides and integrate it with existing instrumentation. This will contribute to enhance patients' treatments and life expectancy.

Work Package description

- **Objective 1**: Develop a hyperspectral imaging (HSI) system called HyperProbe to map, monitor and quantify biochemical compounds of interest in brain tissue during neurosurgery and cortical activity stimulation.
- **Objective 2**: Achieve industrial upgrade of HyperProbe to a cost-effective, transportable, and compact prototype, that is fully suit-able for the neurosurgical room.
- **Objective 3**: Characterise and metrologically validate HyperProbe on optically realistic brain tissue phantoms.
- **Objective 4**: Develop machine learning (ML) and artificial intelligence (AI) algorithms to identify biomarkers of brain activity for in vivo imaging with HyperProbe during brain surgery and cortical activity stimulation.
- **Objective 5**: Validate HyperProbe in clinical settings against other surgical imaging standards, such as fMRI and other optical modalities.
- **Objective 6**: Conduct feasibility studies on the performances of the HyperProbe on patients during glioma surgery and multiple paradigms of stimulation of brain activity, as part of observational, proof-of-concept analysis

WP1: Lab system development

- Design and develop a top-grade, benchtop HSI instrument for real-time mapping, monitoring and quantification of brain tissue biomarkers during surgical neuronavigation in tumour removal and cortical activity simulation.
- This main system will be used for preliminary testing, AI/ML-based software development, as well as for preliminary metrological and spectral characterisation. It will also be the basis for the down-scaling and industrialisation to a final prototype for clinical translation.

WP2: Down-scale & prototyping

- Down-scale the lab system into a cost-effective, compact, and easy-to-use prototype for validation against 'gold standards' and clinical studies. Two devices will be built to share with partners involved in the clinical studies and for upgrade to safety regulation requirements.

WP3: Optical and metrological characterization

- Provide new tools for the metrological characterization and the optimisation of its imaging and spectroscopic parameters. This will be done by developing a digital phantom platform and new optical phantoms.

WP4: End-to-end trainable pipeline image reconstruction and analysis

- Develop end-to-end trainable pipelines for image reconstruction and analysis. The initial prototypes will focus on separate deep-learning pipelines for image reconstruction and analysis. These will then be integrated into a synergistic framework for joint image reconstruction and analysis.

WP5: Validation against gold standards

- Understand the correlation/association of the intraoperative optical imaging contrasts from HyperProbe against current clinical used imaging standards for neuronavigation in tumour removal and cortical activity simulation.
- Assess Hy-perProbe targeted biomarkers as compared to corresponding current clinical modalities.

WP6: Clinical observational studies

- Execute observational, proof-of-concept studies on the applicability of HyperProbe during neurosurgery on patients. This will aim at understanding the effectiveness and its correlation/association with the routinely used intraoperative technologies to improve brain surgery, based on data concerning cerebral metabolism, vasculature and brain functionality.
- Report on the efficacy of HyperProbe in order to better distinguish the heterogeneous composition of brain tumour areas, in terms of metabolic activity, vasculature and relationship with white matter fibre tracts.

WP7: Dissemination, communication and exploitation

- Create awareness of the project.
- Disseminate and communicate the research outcomes.
- Develop a strategy for exploitation of results.

WP8: Project Management

- Ensure the legal, financial, and day-to-day activities necessary for the project.

Our Consortium

The HyperProbe project consortium consist of a broad partnership, combining universities, SMEs, clinics and research organisations to provide all the necessary data, expertise and inputs for the success of this project from five different European countries.

A large and variegated interdisciplinary team of optical and imaging engineers, physicists, software engineers, and clinicians are selected to address the challenge from different perspectives, thanks to the established expertise each partner can provide for the success of the project.

List of Partners

Italy

University of Florence (project coordinator)

EMOLED

University Hospital Careggi

Germany

Technical University of Munich

France

Hospices Civil de Lyon

Universite Lyon 1 Claude Bernard

United Kingdom

University College London

Austria

European Institute for Biomedical Imaging Research

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UCL is one of the UK's premier universities and is consistently ranked in the world's top 10. UCL brings together world-renowned experts, from across the academic spectrum. It is a world-class research and teaching institution whose staff and former students include 28 Nobel Prize winners and three Field's medallists.

UCL in HyperProbe

Prof. Tachtsidis' group, the MultiModal Spectrosopy within the UCL Biomedical Optics Research Laboratory (BORL), is the largest group working in Near-Infrared Spectroscopy (NIRS) technology development and application in the UK. The group uses an iterative approach to instrumentation and algorithm development, laboratory-based validation, mathematical modelling and appropriately timed human studies.

The UCL team leads WP3 with the main objectives (1) developing a digital phantom based on Monte Carlo simulations of light diffusion in the brain; (2) developing a liquid optical phantom that simulates brain tissue properties and (3) supporting the characterisation of the HyperProbe instruments before the clinical feasibility study.

Prof. Ilias Tachtsidis

Professor Ilias Tachtsidis' research is highly multi-disciplinary, crossing the boundaries between engineering, physics, neuroscience, and clinical medicine. The technical focus of his work is the development and use of non-invasive optical instruments and techniques for monitoring brain oxygenation, haemodynamics and metabolism. A major part of Prof. Tachtsidis research is to develop the next generation of optical devices to monitor and image brain health. He is considered a leader in the development of instrumentation and algorithms for monitoring with NIRS non-invasively brain tissue cytochrome-c-oxidase (CCO), a marker of mitochondrial function and metabolism.

In 2016 Prof. Tachtsidis created MetaboLight, the public engagement alias of his research team; and created really imaginative and impactful ways of sharing how his interdisciplinary research is using light to understand brain function and improve patient care in newborn infants. MetaboLight has participated in a large number of outreach activities including school visits and science festivals.

Dr. Frédéric Lange

Dr. Frédéric Lange is an engineer/physicist working on the development of novel optical technologies to be used for biomedical applications. He received the M.Sc. degree in neuroscience and health imaging from the University of Caen Basse-Normandie, Caen, France, in 2012, and the Ph.D. degree in biomedical optics from the University of Lyon and INSA de LYON, Lyon, France, in 2016. Since 2016, he has been a Research Associate with the Biomedical Optics Research Laboratory, Department of Medical Physics and Biomedical Engineering, University College London, London, U.K. His current main research interests are in the development of novel optical technologies to monitor tissue's oxygenation and metabolism, with a specific interest for non-invasive brain monitoring in healthy (i.e., brain development/neuroscience) and pathological conditions.

Results

We're making our research findings available free of charge for readers and are providing open access to published papers and reports.

Scientific Publications

There are no scientific publications to show yet.

Public Deliverables

There are no Public Deliverables to show yet.

Press Material

1. EU project HyperProbe to radically improve brain surgery with new advanced image-guidance system – ESR, 13 December 2022

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Contact Us

If you have questions about the project or would like to receive more in-depth information, don't hesitate to get in touch with us!

You can contact us through our Twitter and LinkedIn pages,
or send us an email at hyperprobe@eibir.org.

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News Archive

News Archive

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We are now on Twitter and LinkedIn! Stay up to date with the latest news about the HyperProbe project by following @HyperProbe_eu on Twitter and

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HyperProbe project launched

October 1, 2022 marked the official start date of our HyperProbe project. The project was selected for funding by the European Commission and will run

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