NEW BRAIN CANCER DECISION SYSTEM

The main goal of the HELICoiD project is to apply hyperspectral imaging techniques to the precise localization of malignant tumours during surgical procedures. The HELICoiD project will develop an experimental intraoperative setup based on non-invasive hyperspectral cameras. This will be connected to a platform running a set of algorithms which are capable of discriminating between healthy and pathological tissues. **The prototype will be developed with the aim of recognising cancer tissues during the surgical procedure in real time.** This information will be provided to the surgeon via different display devices, and in particular by overlaying the conventional images with a simulated colour map to indicate the probability of any currently exposed tissue being cancerous. To meet these real time and in vivo cancer detection requirements, a hardware/software partition of the final platform will be derived, which will depend on the computational load requirements of the algorithms which are developed.

The integration of hyperspectral imaging and intraoperative image-guided surgery systems should have a direct impact on patient outcomes. Potential benefits include: allowing confirmation of complete resection during the surgical procedure, avoiding complications due to "body mass shift", and providing confidence that the goals of the surgery have been achieved.

A multidisciplinary consortium composed of surgeons, pathologists, ICT engineers, mathematicians and physicists has been created. Two European hospitals will be involved, as end-users, in setting the requirements for, and conducting validation of, the tools and systems developed within this project. If hyperspectral imaging techniques are demonstrated to be practical for surgical applications then it is expected that European industry related to hyperspectral imaging will be well placed to exploit this opportunity for growth.

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To offer the best prospects for success, this project will adopt the algorithms-architectures-implementations co-exploration paradigm. It is our belief that translation of hyperspectral image technology to real-time medical applications cannot be achieved by developing algorithms, architectures and implementations separately. Rather, this goal is better served by adopting a fully integrated approach from the outset.

Project co-ordinator:

Dr. Gustavo M. Callicó
Associate Professor
University of Las Palmas de Gran Canaria
Research Institute for Applied Micoelectronics (IUMA)
Campus Universitario de Tafira. Building A-212
E-35017, Las Palmas de Gran Canaria, Canary Islands. Spain
Phone: +34 928 451 271
gustavo@iuma.ulpgc.es
Visit: www.helicoid.eu

Pictures:

1: Brain cancer operation at University Hospital Dr. Negrín.

2: HELICoiD hyperspectral cameras.

3: Surgeons and operation theatre at University Hospital Dr. Negrín.

4: Simulation of the surgeons display with the results of the algorithm. Real image and tumour map.

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HELICoiD

HypErspectral Imaging Cancer Detection

FP7-618080 (FP7-ICT-2013-C)

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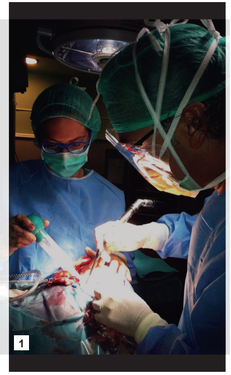
CHALLENGES OF BRAIN CANCER DETECTION

Brain cancer is one of the most important forms of the disease, and is a significant economic and social burden across Europe. The most common form is high-grade malignant glioma, which accounts for approximately 30-50% of primary brain cancers, with multiform glioblastoma making up 85% of these cases. These types of gliomas are characterized by fast-growing invasiveness, which is locally very aggressive, are in most cases unicentric and are rarely metastasizing.

Despite the introduction of new aggressive treatments combining surgery, radiotherapy and chemotherapy, there continues to be treatment failure in the form of persistent or locally recurrent tumours (i.e. recurrence at the primary tumour location or within 2-3 cm of adjacent tissue). Median survival periods and 5-year survival rates for anaplastic astrocytomas are only 36 months and 18% respectively, whereas for glioblastoma multiforme these are 10 months and less than 5%, respectively.

The relevance and importance of complete resection for low grade tumours is well known, especially in paediatric cases. However, traditional diagnoses of internal tumours are based on excisional biopsy followed by histology or cytology. The main weakness of this standard methodology is twofold: firstly, it is an aggressive and invasive diagnosis with potential side effects and complications due to the surgical resection of both malign and healthy tissues; and secondly, diagnostic information is not available in real time and requires that the tissues are processed in a laboratory.

There are several alternatives to conventional optical visualisation through a surgical microscope, including magnetic resonance imaging (MRI), computed tomography (CT), ultrasonography, Doppler scanning and nuclear medicine. Unlike these approaches, hyperspectral imaging offers the prospect of precise detection of the edges of the malignant tissues in real time during the surgical procedure.



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PARTNERS

UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA

IUMA

The University of Las Palmas de Gran Canaria (ULPGC) is a modern institution with a long academic track record, located in Gran Canaria, Canary Island. **The Institute for Applied Electronics (IUMA)**, coordinator of this project, is the first out of seven research institutes created at ULPGC. IUMA has extensive access through the European initiative EUROPRACTICE to a diverse set of tools and technologies focused on the design of complex microelectronic systems.

www.english.ulpgc.es - www.en.iuma.ulpgc.es Spain

FUNCIS Fundación Canaria de Investigación y Salud

Hospital Universitario de Gran Canaria Doctor Negrín

Fundación Canaria de Investigación y Salud (FUNCIS) is a foundation whose beneficiaries are those institutions, associations and individuals that participate in research activities in the field of health. **The University Hospital Doctor Negrín** is the main Research Unit (RU) of FUNCIS, accredited as an RU from 1993.

www.funcis.org Spain

Medtronic

Medtronic is a worldwide leading medical technology company, with a wide range of products in surgical navigation systems that enable surgeons to perform more precise procedures by integrating the most advanced instrument tracking technologies, intra-operative imaging and surgical planning software.

www.medtronic.com - www.medtronic.es Spain

The Hamlyn Centre for Robotic Surgery

Imperial College London

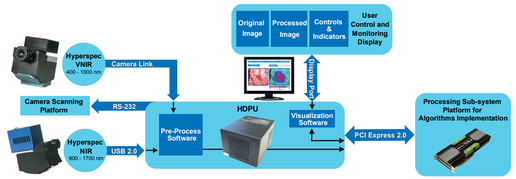
Imperial College London (ICL) is a university of world-class scholarship, education and research in science, engineering and medicine, with particular regard to their application in industry, commerce and healthcare. **The Hamlyn Centre** was established for developing safe, effective and accessible imaging, sensing and robotics technologies with a strong emphasis on clinical translation and direct patient benefit with a global impact.

www3.imperial.ac.uk United Kingdom

HELICoiD Project

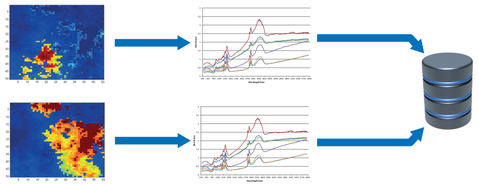
SPECIFICATIONS

Hyperspectral System Setup



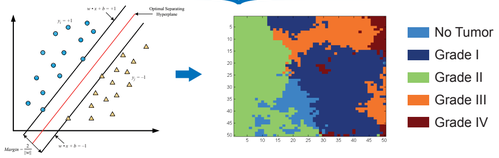
Hyperspectral Image Acquisition

Reference Database of Hyperspectral Images



Verification using the Image Database

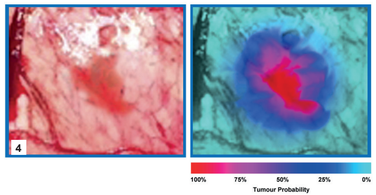
Cancer Detection Algorithms



Implementation and Acceleration of Cancer Detection Algorithms to Reach Real-Time Performance

Verification Using In-Vivo Surgical Data

Fine Tune of Real-Time Algorithms Using In-Vivo Surgical Images



The project will begin with the setting up of a hyperspectral image acquisition system in the operating theatre, using two hyperspectral cameras connected to a high performance data processing unit (HDPU). Critical processes will be executed in the processing sub-system platform for algorithm implementation. The results will be displayed to the neurosurgeons in in a convenient manner, and the display system will be also used for control and monitoring.

The system will be validated by means of an image database created during the project using a number of brain tissue samples. While the primary goal of the algorithm will be to provide a binary discrimination between tumour and normal tissue, we will also probe the limits of hyperspectral imaging by attempting to determine the grade of the tumour.

The algorithms will be refined using in vivo samples and verified against conventional pathology.

PARTNERS

ONCOVISION (GEM Imaging S.A.) is a Spanish technology company created in 2003 with the initiative of the Corpuscular Physics Institute (CSIC) and the University of Valencia, specialized in Molecular Vision applied to Health Sciences. It is focus on cancer diagnosis and treatment, and advanced research in neurology, oncology and cardiology.

www.gem-imaging.com Spain

ONCO VISION GEM-IMAGING SA

Virtual Angle B.V. (VA) provides solutions, services, and technologies for mission and business critical information systems. VA supports customers across several markets including telecom, medical, clinical, public sector, industry, aerospace, and defence. VA develops business activities at a global scale, delivering innovative solutions, and has brought efficiency and effectiveness to processes and business information management.

www.virtualangle.com The Netherlands

VA virtualangle

Universidad Politécnica de Madrid (UPM) is the oldest and largest Spanish technical University, with more than 4.000 faculty members. Electronic and Microelectronic Design Group-(GDEM) is currently focused on solving, from a holistic perspective, the power/energy consumption optimization problem of multimedia handheld devices.

www.upm.es Spain

ARMINES is a non-profit organization created in accordance with the 1901 law and covered by the law of 18 April 2006, enabling public higher educational and research establishments to entrust their contractual research activities to private organizations. ARMINES has a contract-based relationship with its partner schools, which include the network of engineering schools overseen by the Department of Industry.

www.armines.net France

ARMINES

University Hospital Southampton (UHS) is a large University Hospital with a track record in clinical research. It comprises the Wessex Neurological Centre where the research will be conducted. This unit provides specialist Neurosurgical services to a population of over 3 million and is one of the busiest neurosurgical units in the UK. It has a staff of twelve consultant neurosurgeons and its own state of the art neurointensive care unit and 3 Neurosurgical theatres.

www.uhs.nhs.uk United Kingdom

University Hospital Southampton NHS NHS Foundation Trust