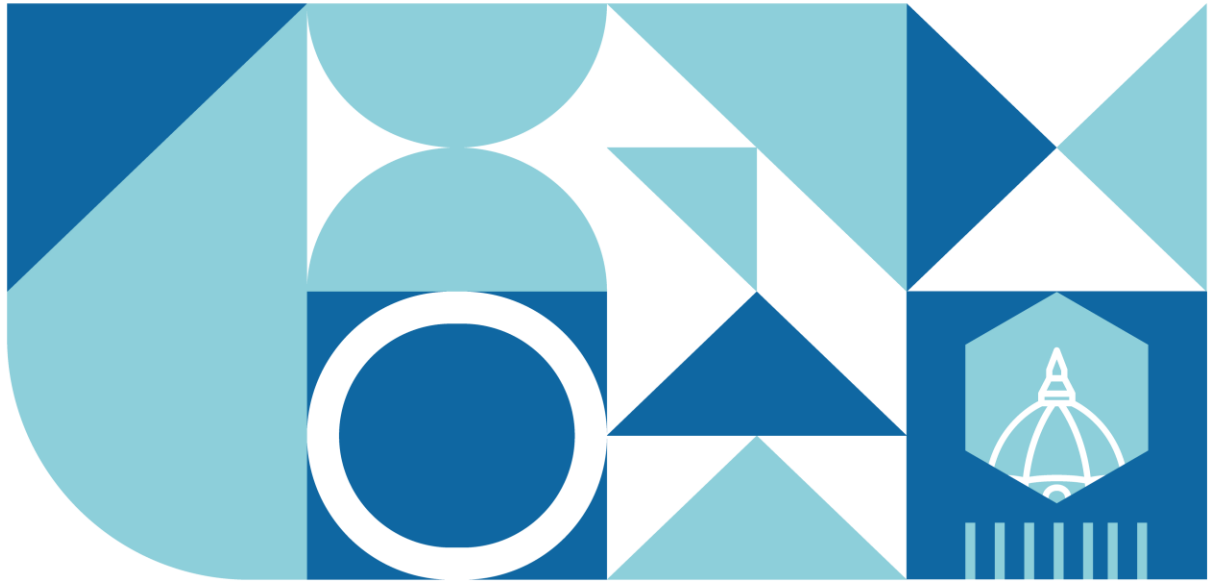
PATENTS WEEK by ULPGC



Más allá de la visión humana para la detección del cáncer

Gustavo Marrero Callicó

Catedrático de Universidad en la Universidad de Las Palmas de Gran Canaria

PATENTS WEEK by ULPGC

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01 **Human Vision**
How humans detect objects through sight and brain

02 **Hyperspectral Imaging**
How machines detect objects through cameras and AI

03 **Applications in cancer detection**
Use of HSI in cancer detection

04 **Results and conclusions**
What has been obtained and with what quality

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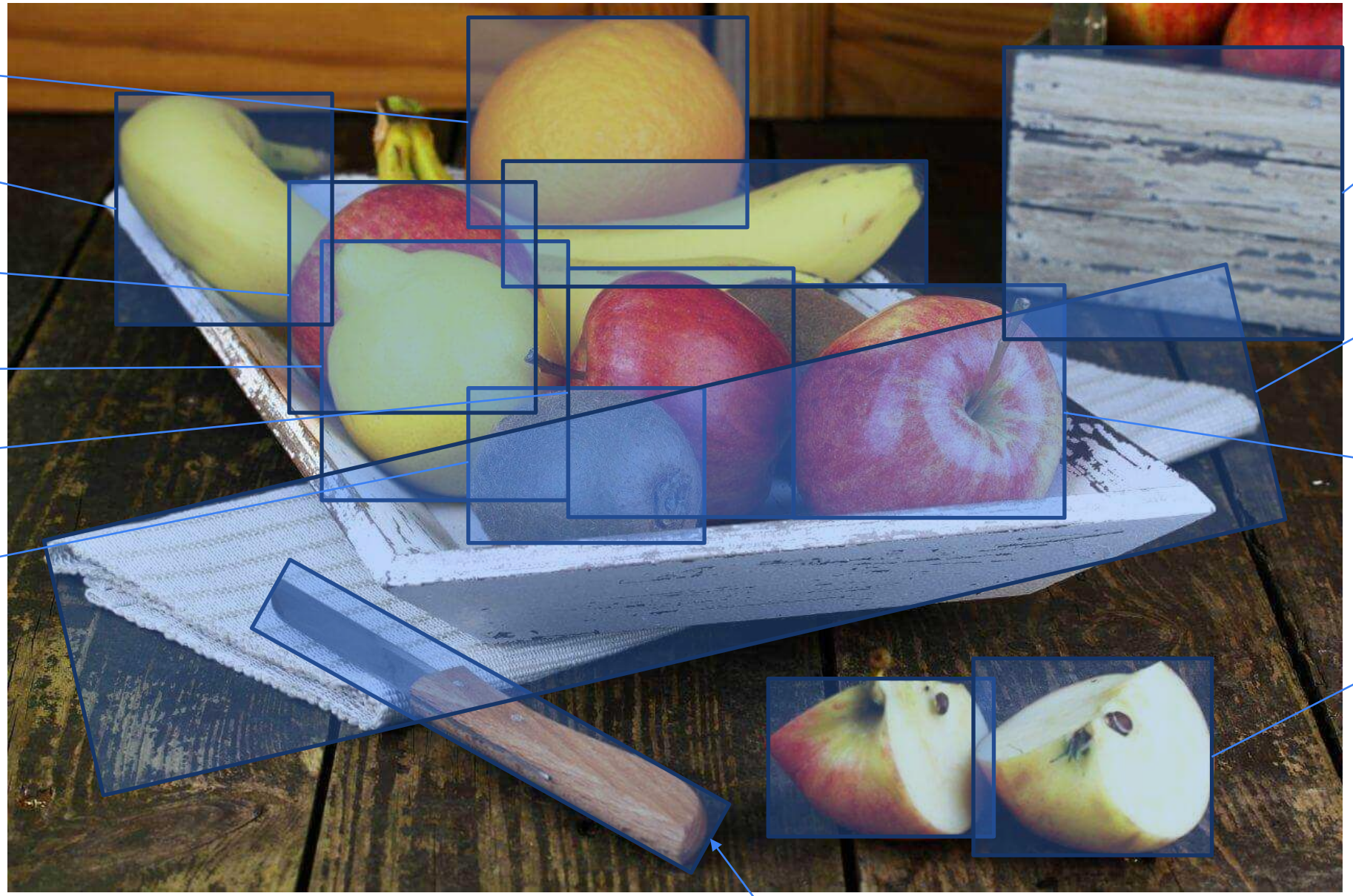
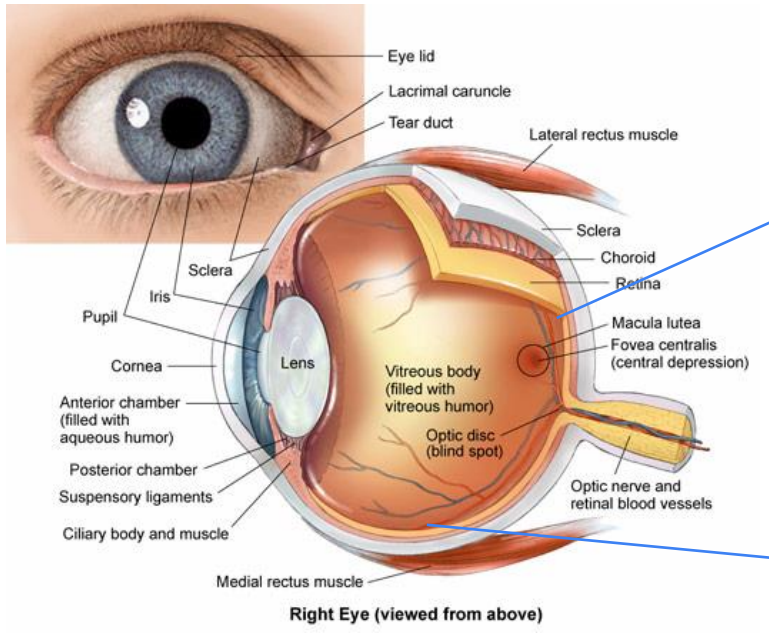
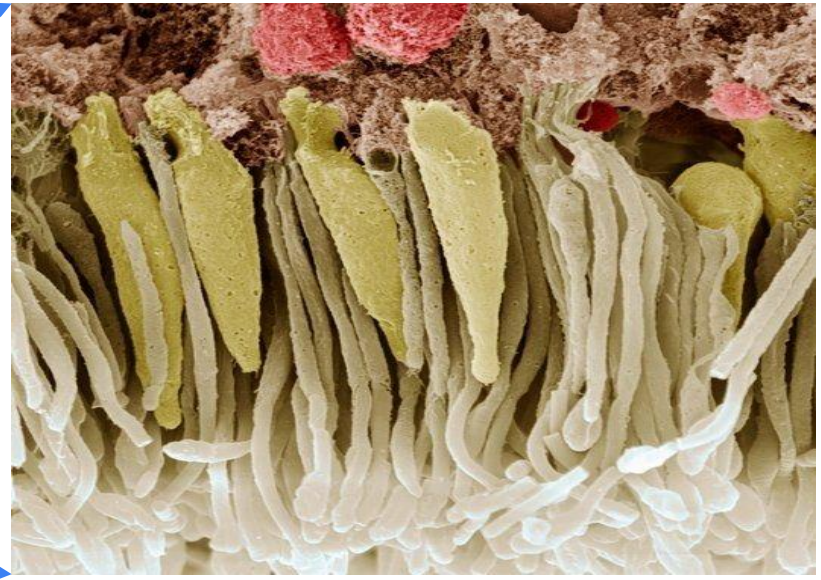
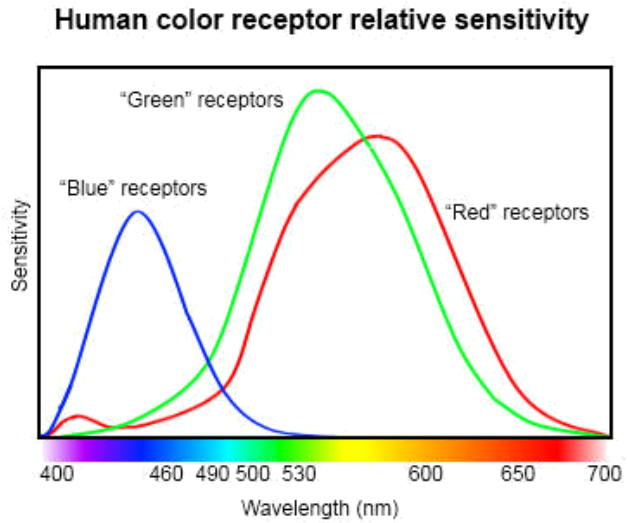
Human Being Classification



Navaja = madera + metal







Colour	Wavelength
Violet	380–450 nm
Blue	450–495 nm
Green	495–570 nm
Yellow	570–590 nm
Orange	590–620 nm
Red	620–750 nm

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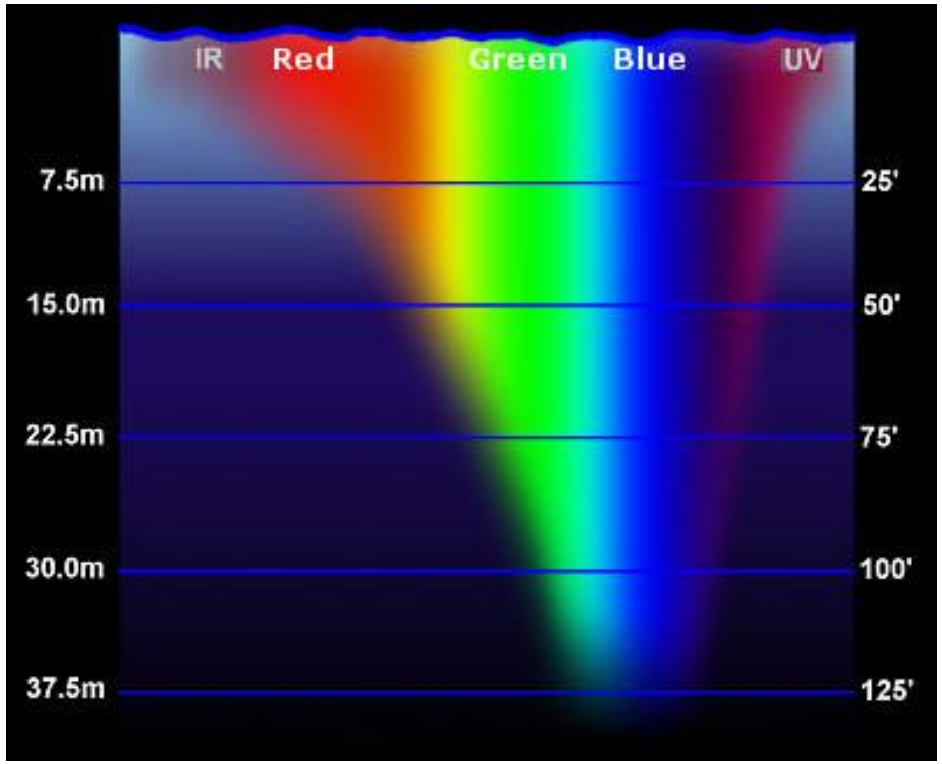
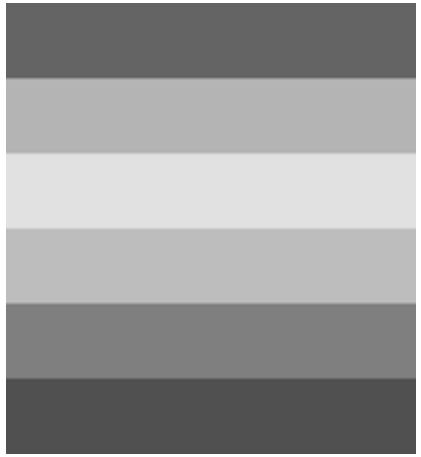
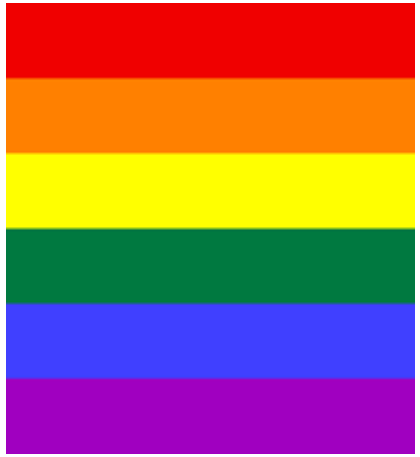
- **Marine mammals** such as dolphins, whales, seals, etc. are **monochromatic**, as below certain depth, frequencies corresponding to colours are attenuated.



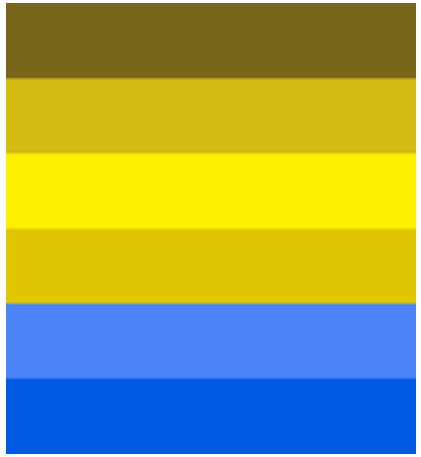
- Bulls, dogs and **almost all mammals** have **two different types of cones**. Practically all mammals can detect the color, but not exactly like a human being, as we have three types of cones and they only two: they are **dichromatic**.



Monochromatic Rainbow



Trichromatic Rainbow



Dichromatic Rainbow

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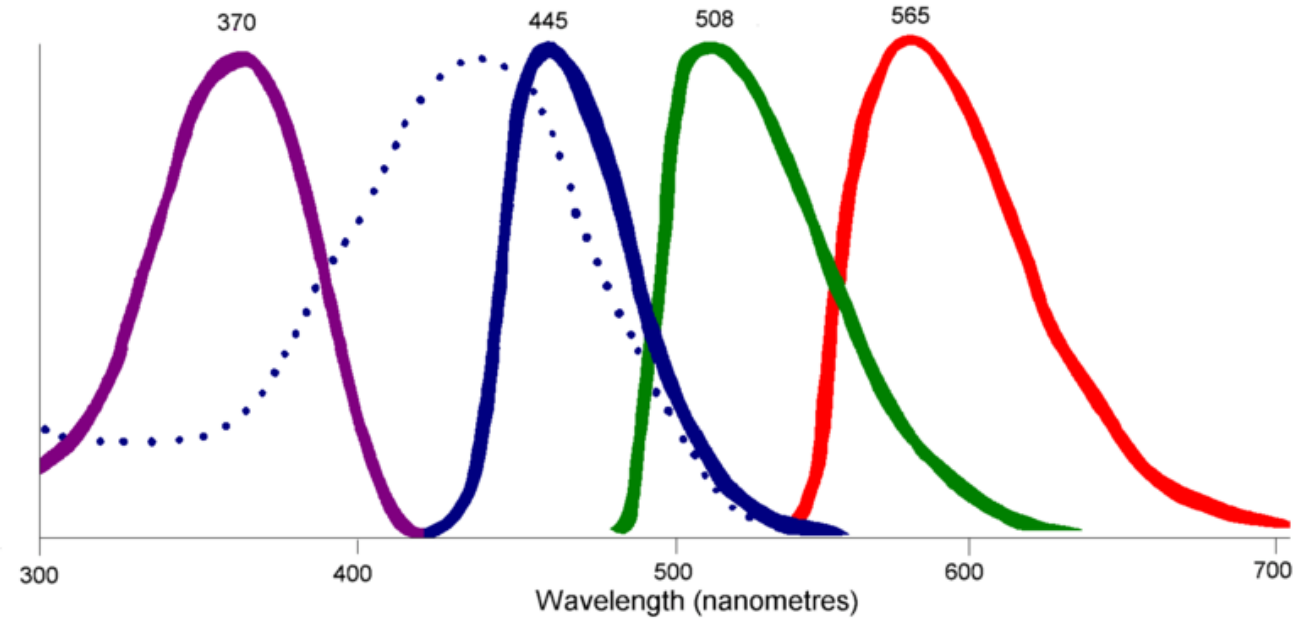
- **Tetrachromatic**, vision of birds with sensibilities to ultraviolet, red, green and blue.



http://stochasticscientist.blogspot.com.cy/2013/07/birds-see-what-we-dont.html

The pigeons are **pentachromatic** (dotted line).

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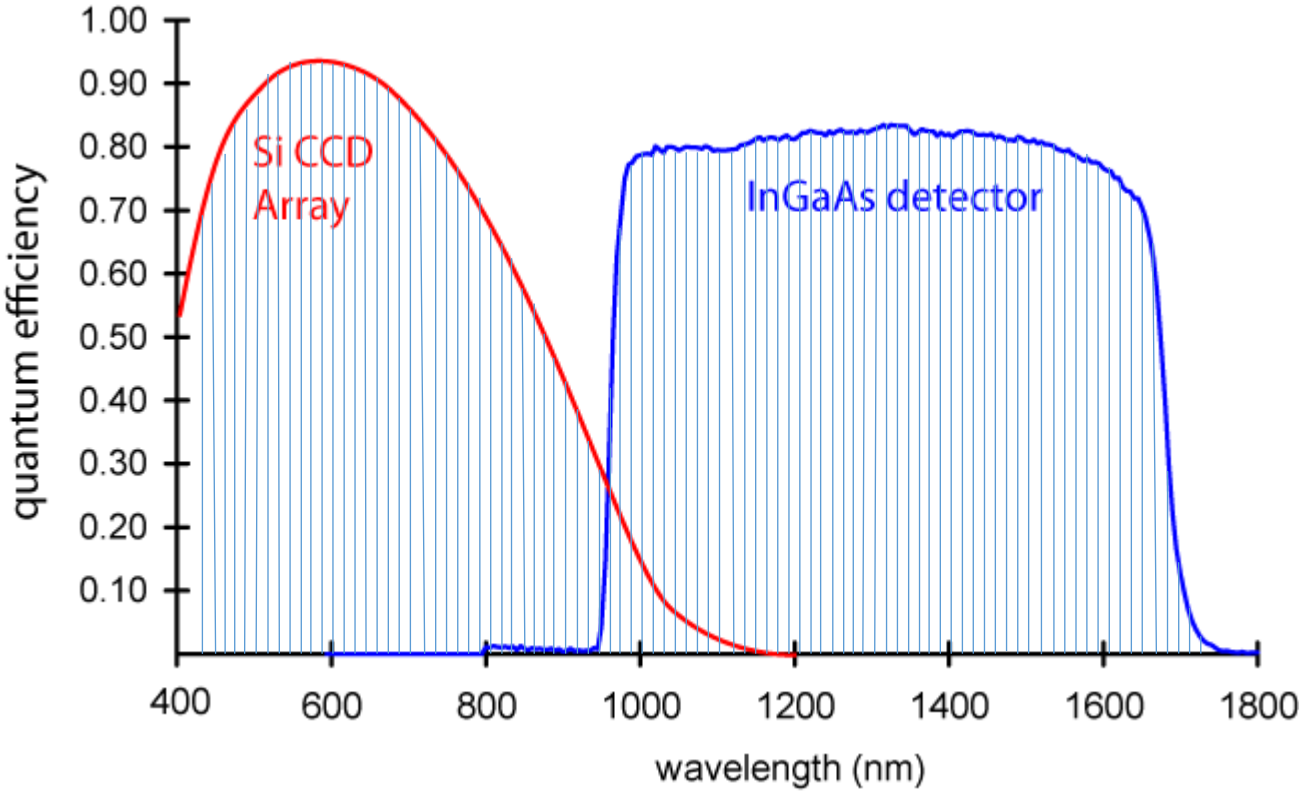
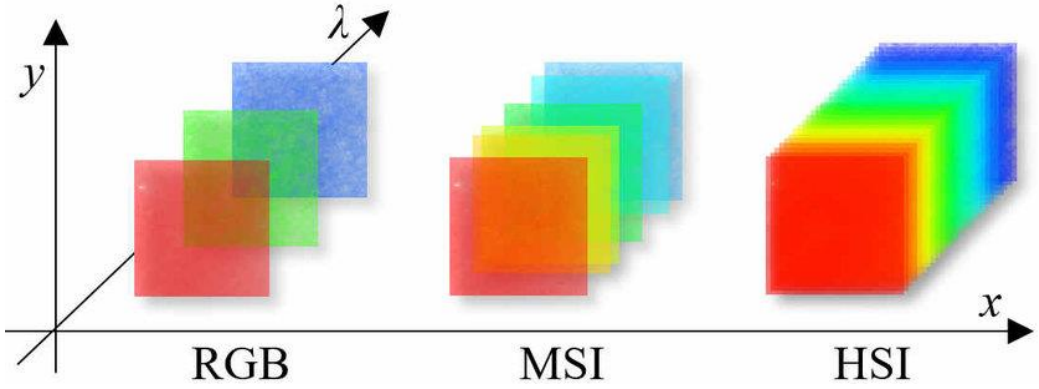
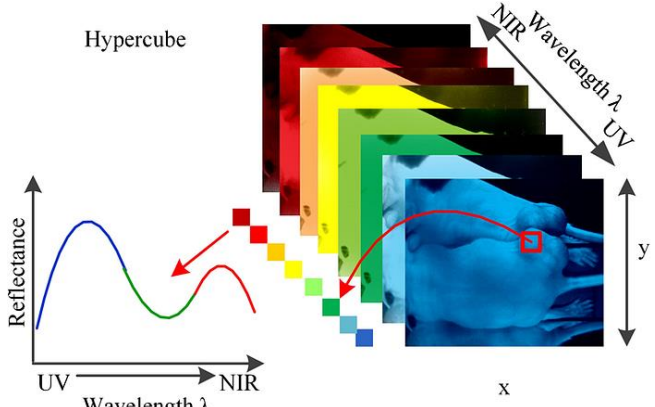
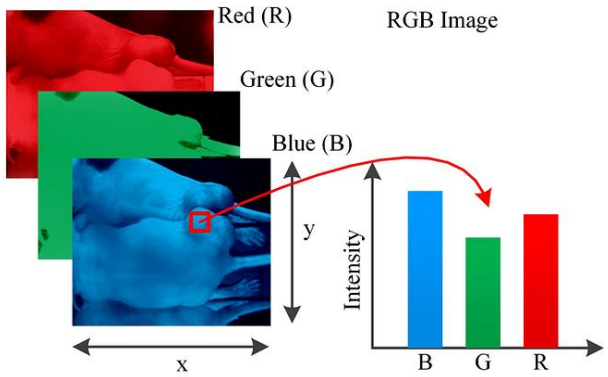
- One of the fern plants is **fake**, but the use of wavelengths in the visible range (400 nm – 850 nm) makes it difficult to identify.









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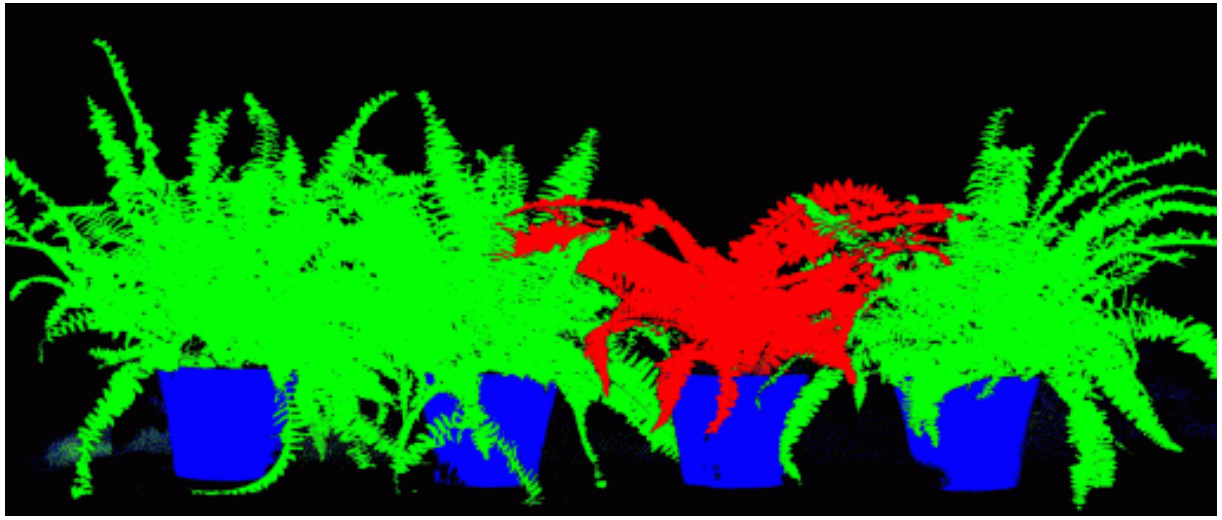
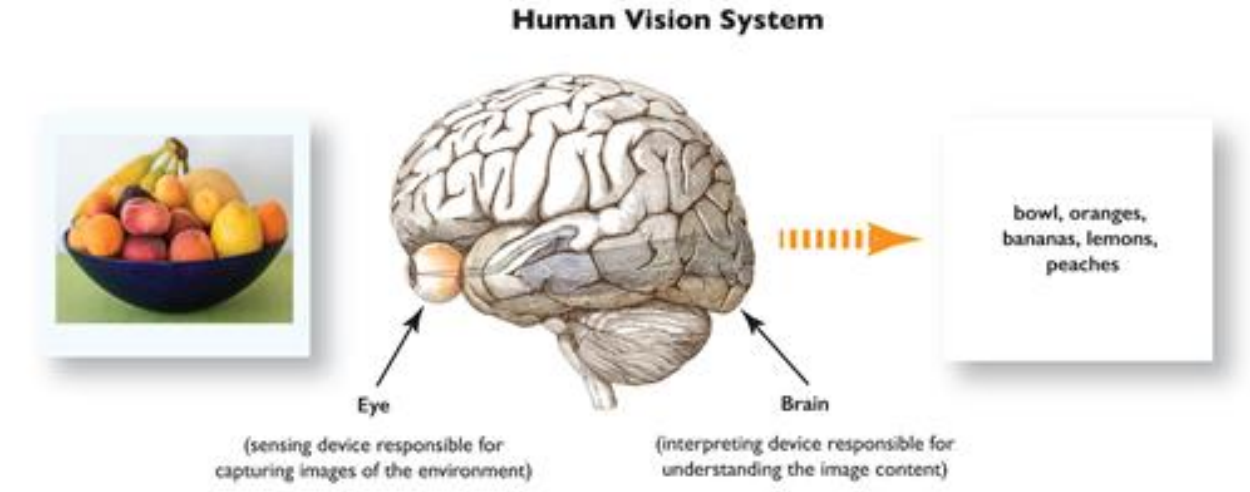
- Using only RGB information (human being classification):

- Using hyperspectral information for classification (machine classification):

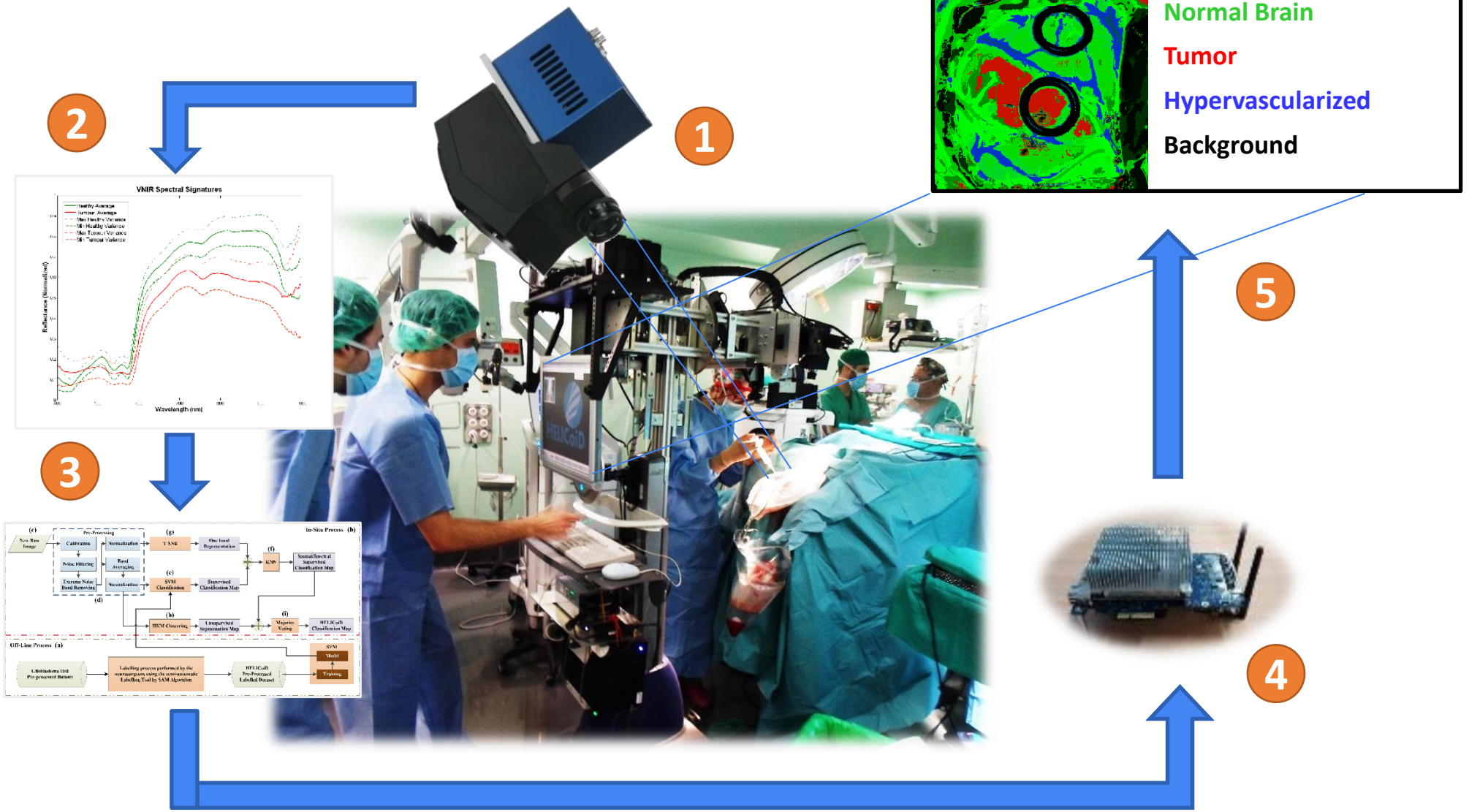




Hyperspectral camera

High Performance Dedicated system

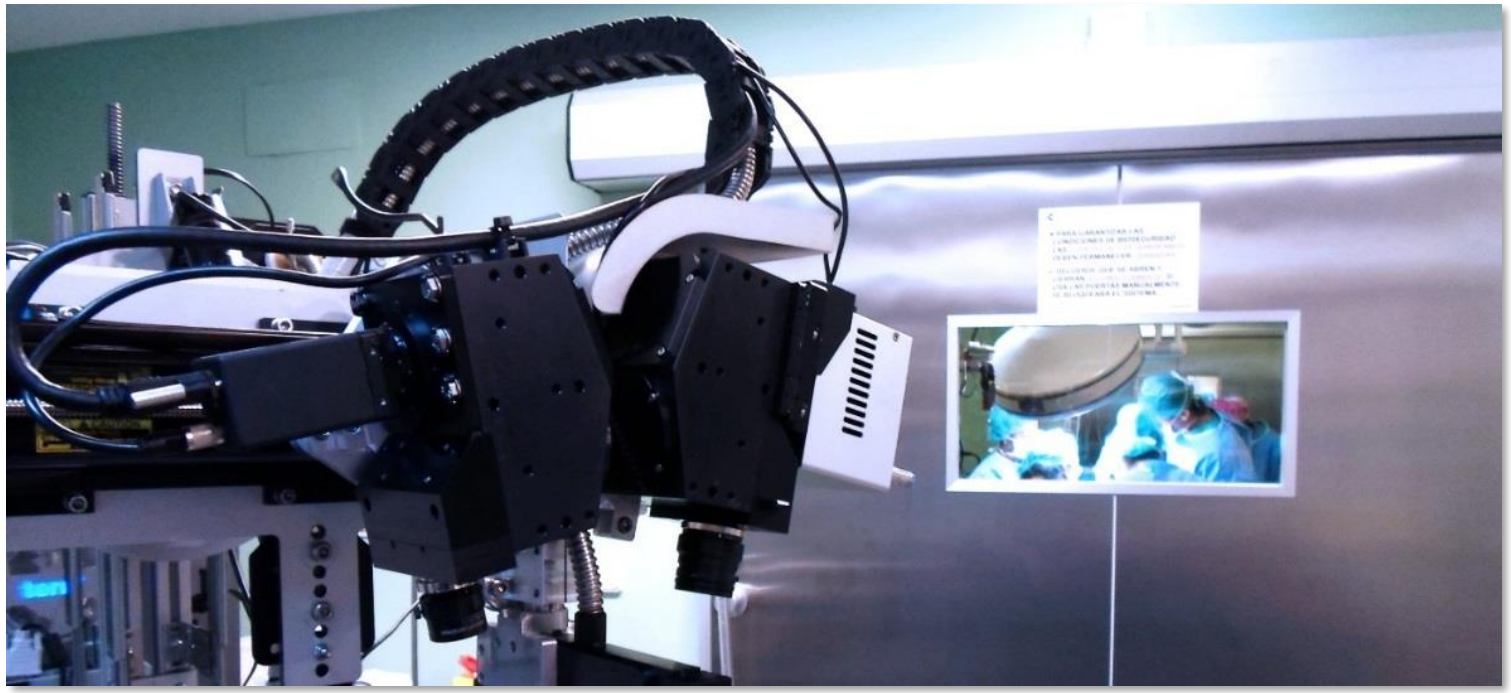
- Assist the surgeon in the identification of brain tumours in real-time

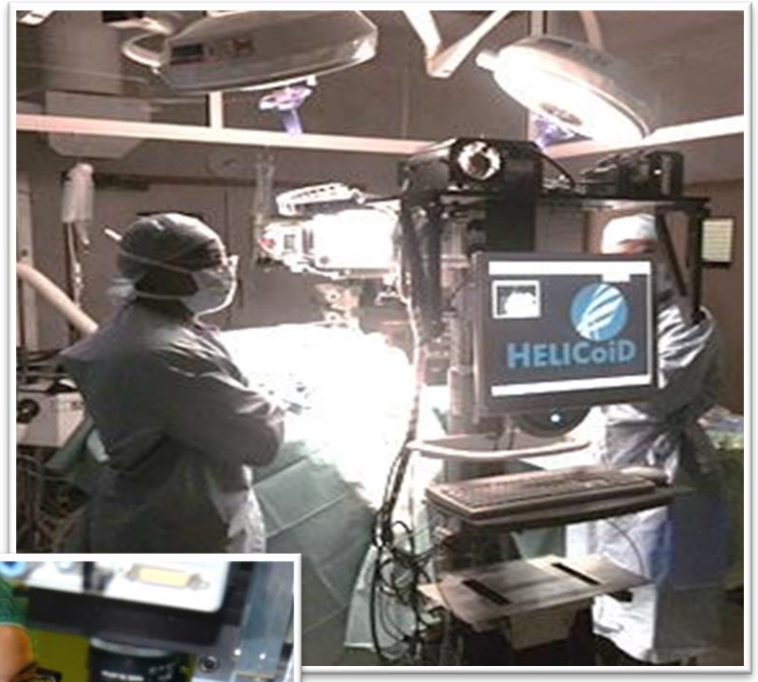


Hyperspectral cameras (Pushbroom)

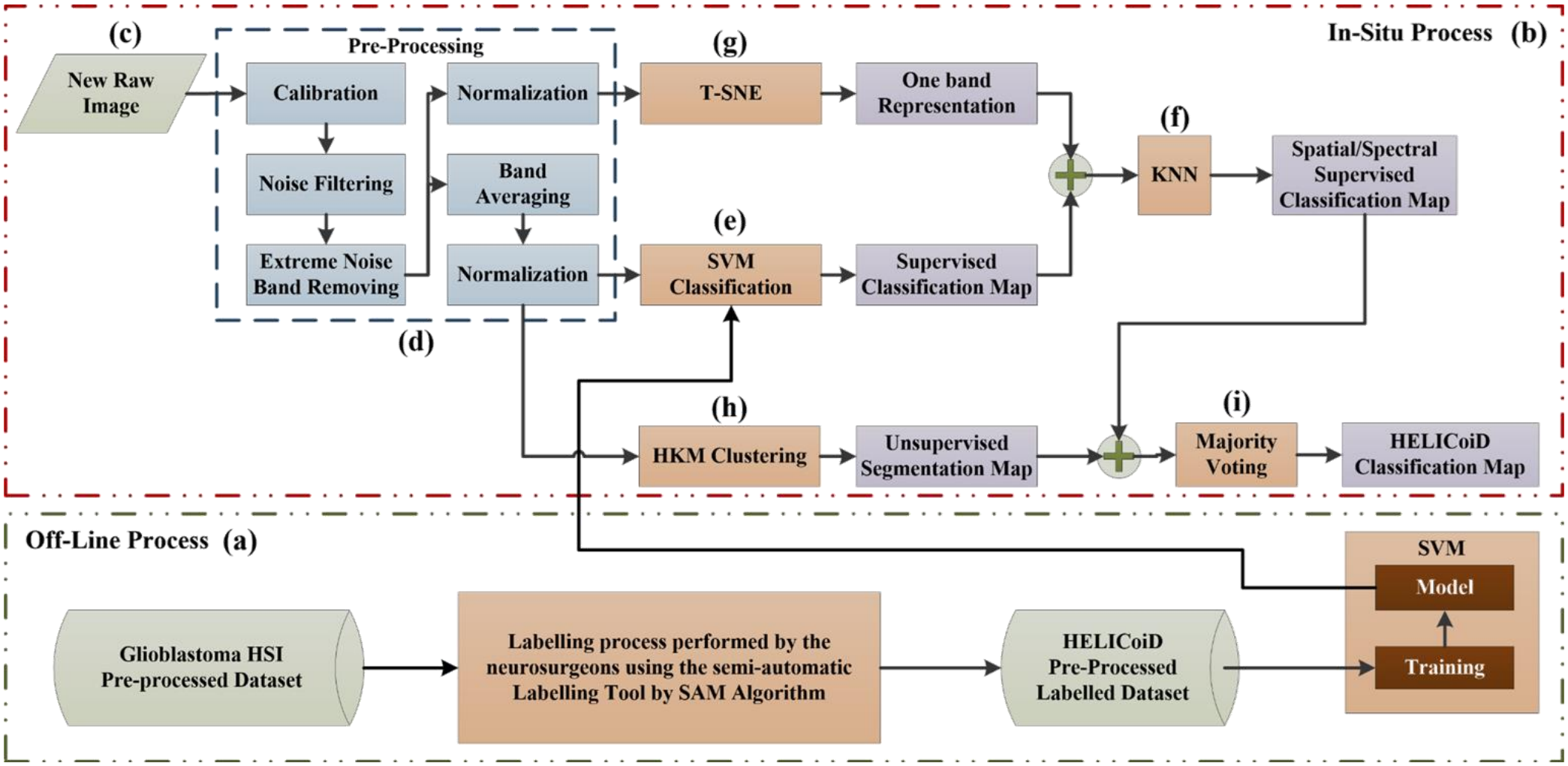
- **Hyperspec® VNIR A-Series**
  - **400 – 1000 nm** (VNIR)
  - **826** spectral bands
  - **1004** spatial pixels

- **Hyperspec® NIR 100/U**
  - **900 – 1700 nm** (NIR)
  - **172** spectral bands
  - **320** spatial pixels



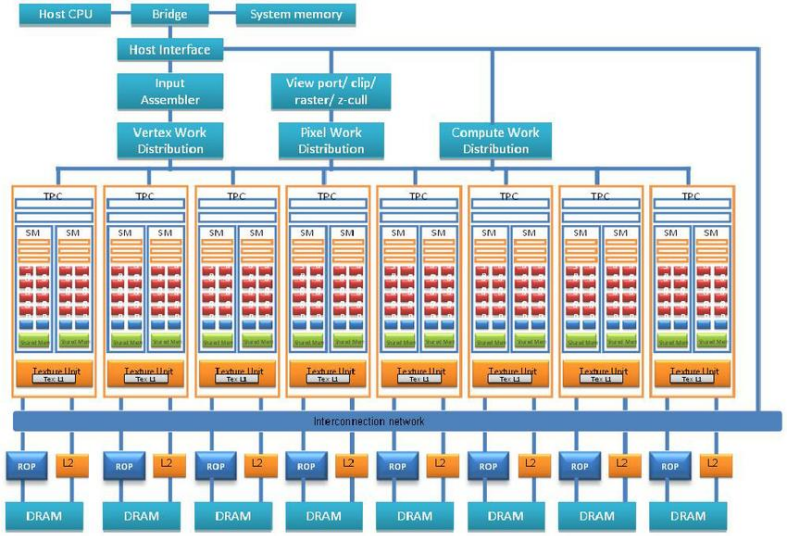

HELICoiD

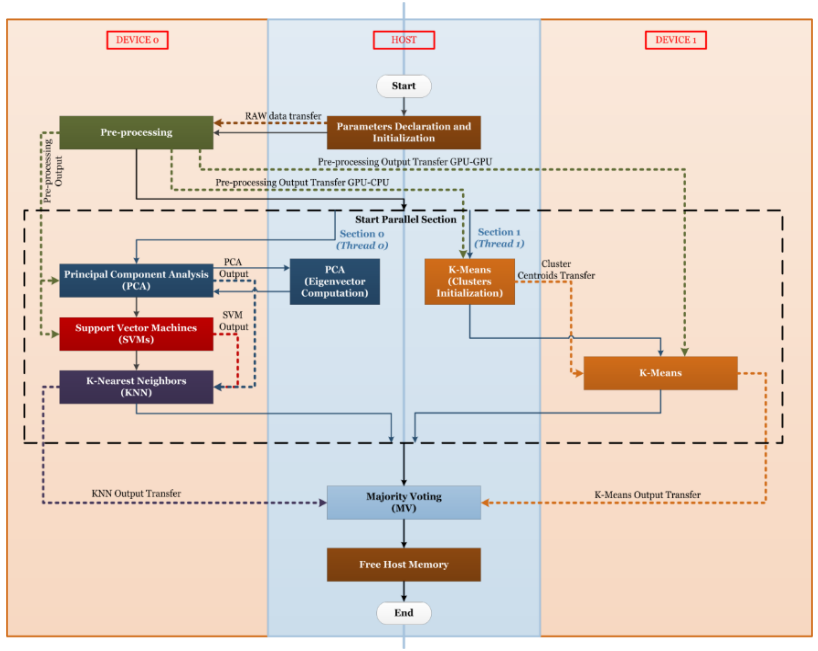
- Brain cancer detection algorithm



Full System Parallelism

K40 : 2880 cores





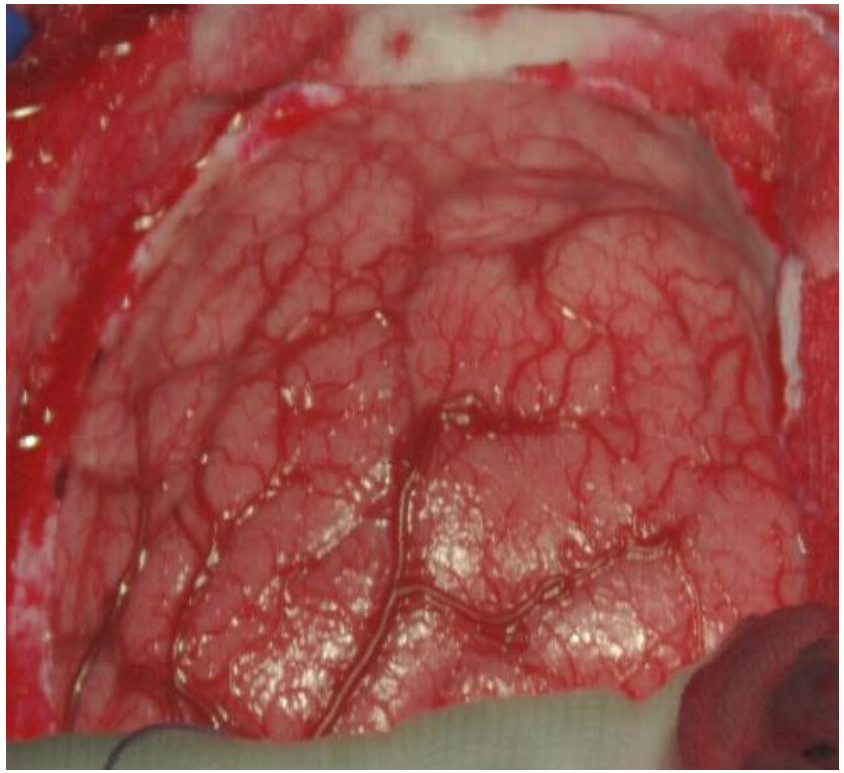
- Intel i7: **~480 s** (~8 min)
- Intel i7+MPPA:
  - Speedup: **~10x**
  - Processing time: **~47 s**
- Intel i7+Single-GPU:
  - Speedup: **~34x**
  - Processing time : **~14 s**
- Intel i7+Multi-GPU:
  - Speedup: **~45x**
  - Processing time : **~10 s**

Op35C1

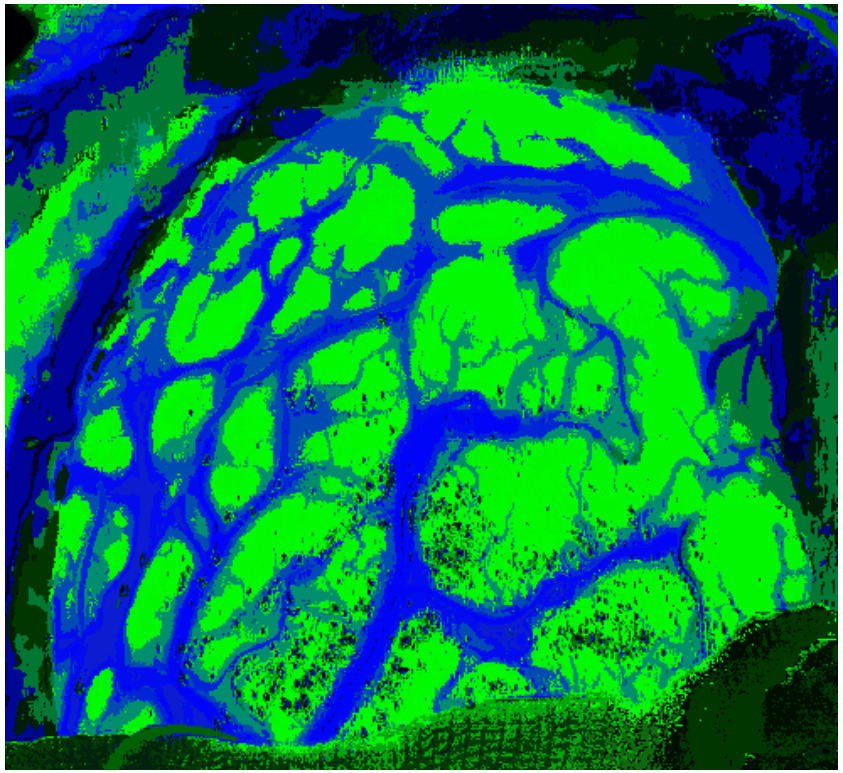
Normal Brain

Operation ID	Number of Pixels	Size (MB)	Processing time (s)
Op35C1	224,770	362.62	68.76

sRGB



HELICoiD TMD Map

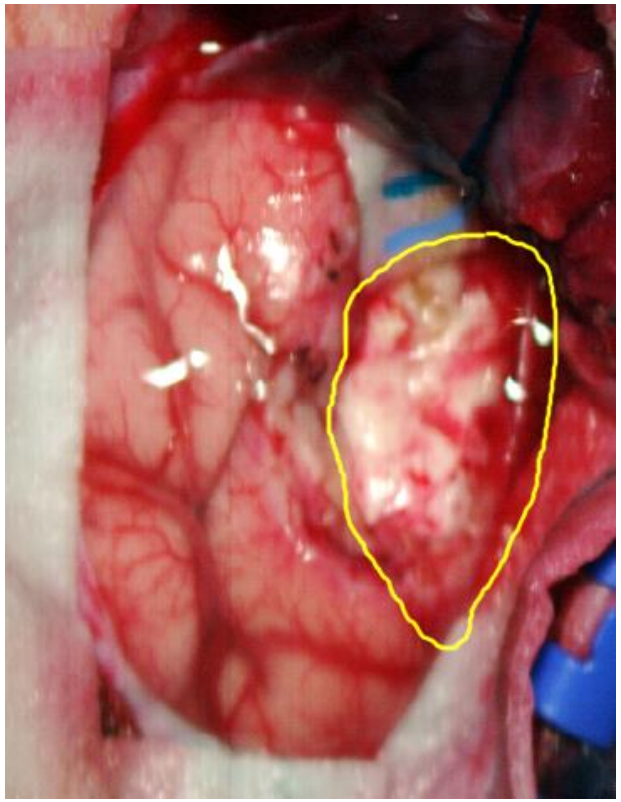


Op36C2

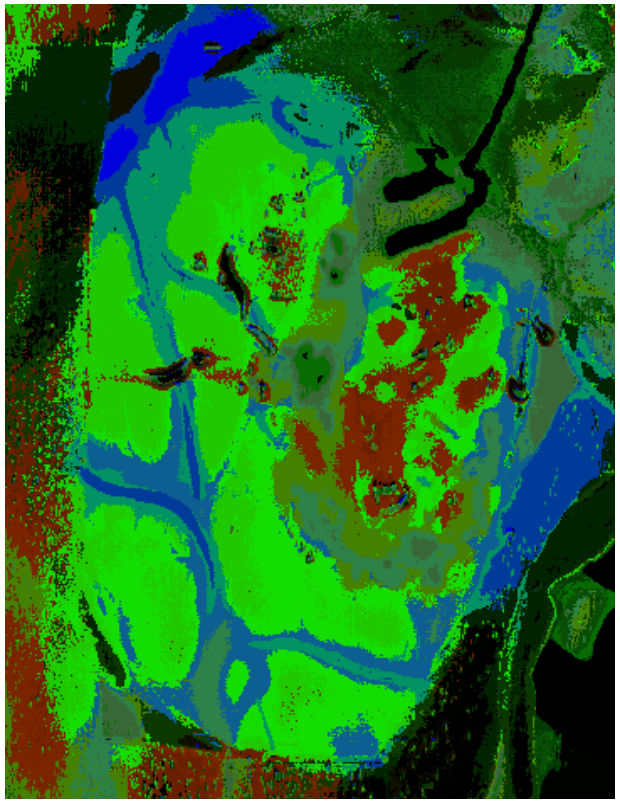
Glioblastoma (GIV)

Operation ID	Number of Pixels	Size (MB)	Processing time (s)
Op36C2	171,699	276.99	52.61

sRGB



HELICoiD TMD Map

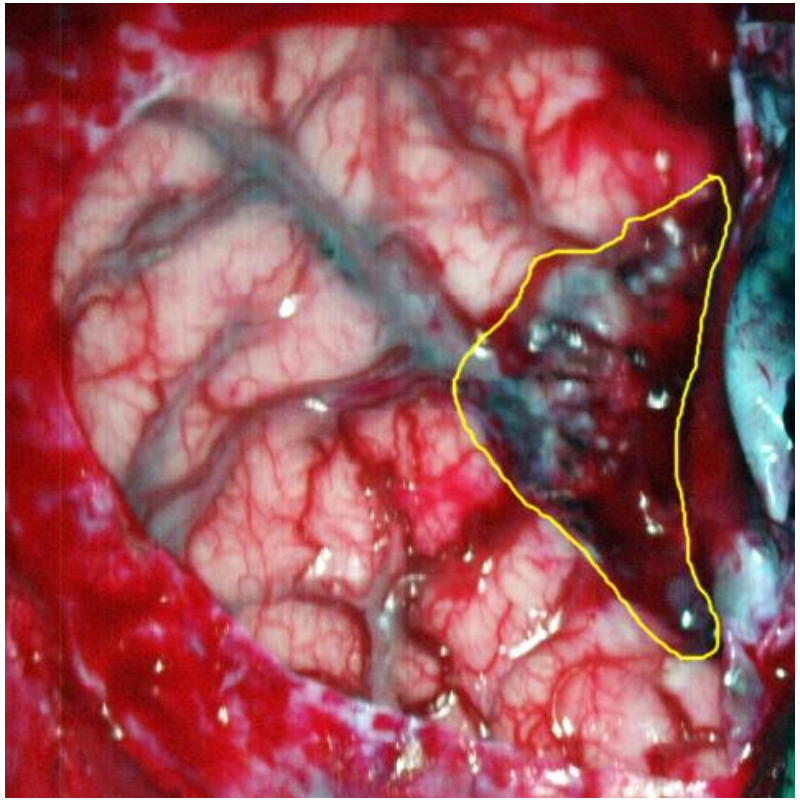


Op38C1

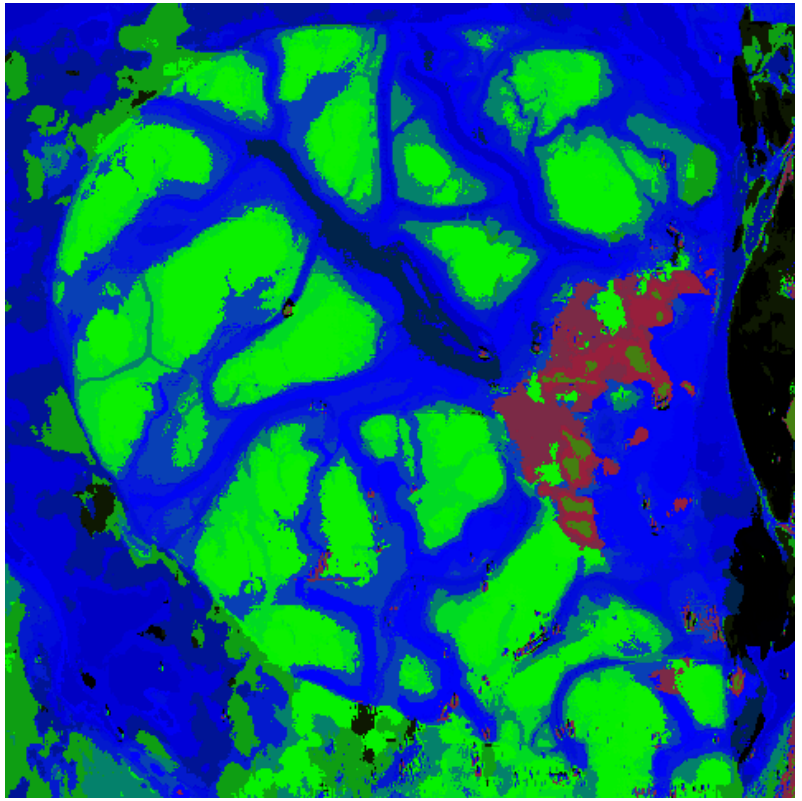
Meningioma (GI)

Operation ID	Number of Pixels	Size (MB)	Processing time (s)
Op38C1	230,878	372.47	67.79

sRGB



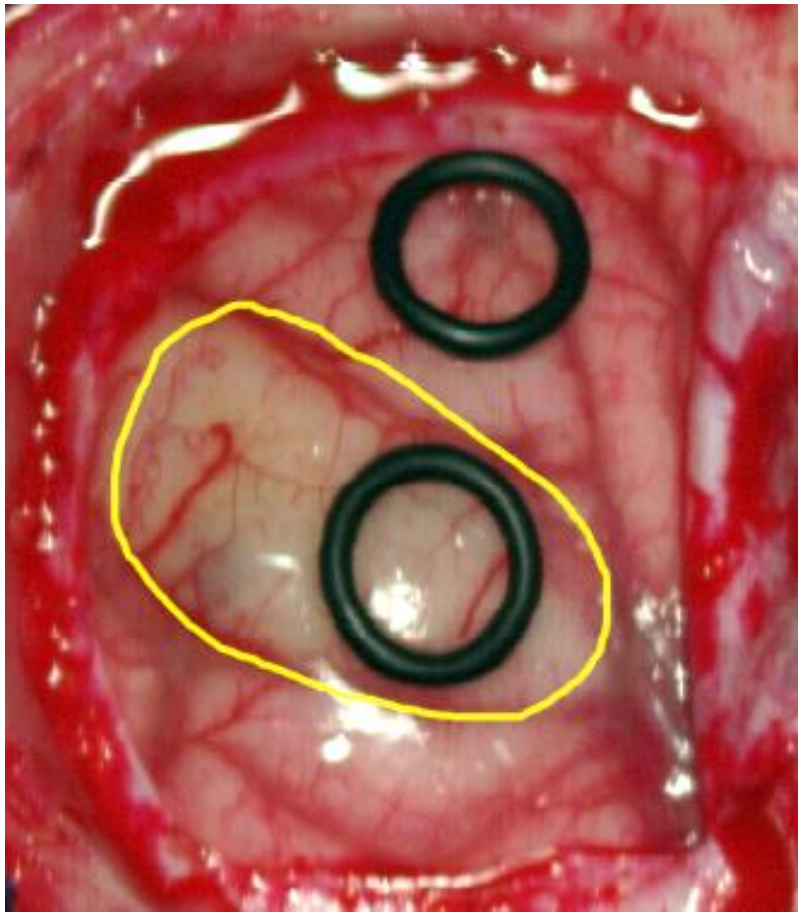
HELICoiD TMD Map



Op20C1

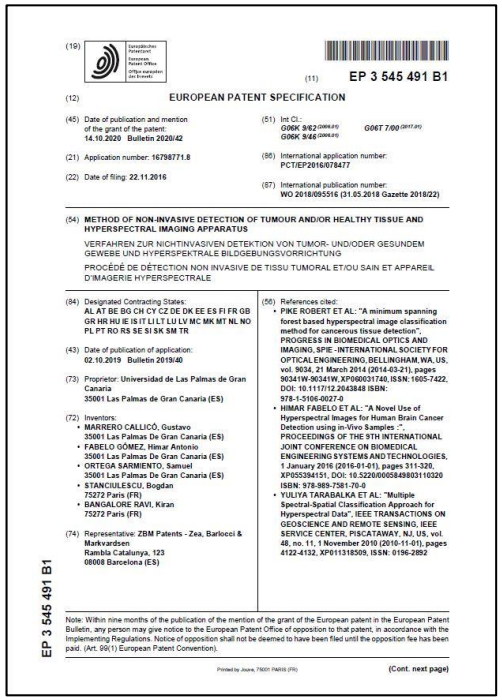
Glioblastoma (GIV)

sRGB



HELICoiD TMD Map

HSI system patented



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(87) International publication number: WO 2018/095516 (31.05.2018 Gazette 2018/22)

(54) METHOD OF NON-INVASIVE DETECTION OF TUMOUR AND/OR HEALTHY TISSUE AND HYPERSPECTRAL IMAGING APPARATUS

VERFAHREN ZUR NICHTINVASIVEN DETEKTION VON TUMOR- UND/ODER GESUNDEM GEWEBE UND HYPERSPEKTRALE BILDGEBUNGSVORRICHTUNG

PROCÉDÉ DE DÉTECTION NON INVASIVE DE TISSU TUMORAL ET/OU SAIN ET APPAREIL D'IMAGERIE HYPERSPECTRALE

(84) Designated Contracting States: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

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(56) References cited:
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- HIMAR FABELO ET AL: "A Novel Use of Hyperspectral Images for Human Brain Cancer Detection using in-Vivo Samples .", PROCEEDINGS OF THE 9TH INTERNATIONAL JOINT CONFERENCE ON BIOMEDICAL ENGINEERING SYSTEMS AND TECHNOLOGIES, 1 January 2016 (2016-01-01), pages 311-320, XP055394151, DOI: 10.5220/0005849803110320 ISBN: 978-989-7581-70-0
- YULIYA TARABALKA ET AL: "Multiple Spectral-Spatial Classification Approach for Hyperspectral Data", IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. 48, no. 11, 1 November 2010 (2010-11-01), pages 4122-4132, XP011318509, ISSN: 0196-2892

EP 3 545 491 B1

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(Cont. next page)

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