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GLADE virtual institute

Digital Health

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Pr. Christine Fernandez-Maloigne, co-founder and co-director of I3M Laboratory



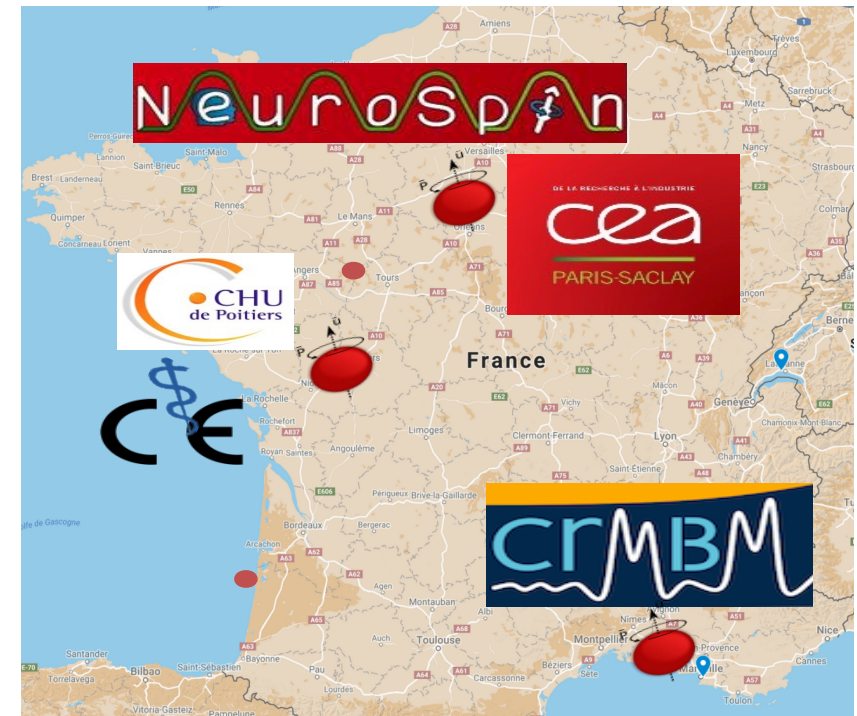
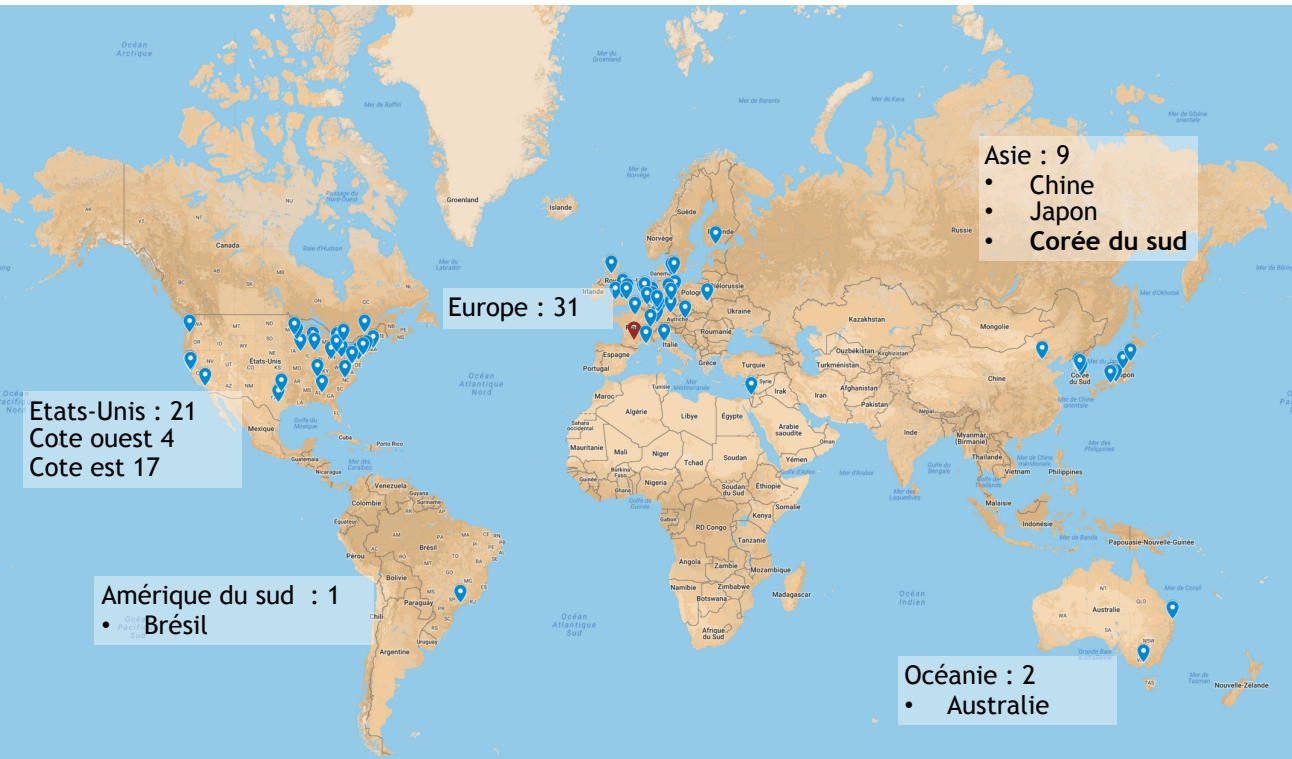
I3M : Multi-organ Multi-core Metabolic Imaging

- **Virtual biopsy: the non-invasive in-vivo medical examination ("green" imaging)**
- **Study of cell metabolism in pathological processes (brain tumours, neurodegenerative diseases, psychiatric diseases, cardiovascular diseases,**)
- **Prediction of the evolution of pathologies taking into account contextual data (genetic, environmental, lifestyle, tests and other medical data) for a personalised patient follow-up**
- **Tools: MRI 3T and 7T, Mathematics, Image/Signal processing, Artificial Intelligence**



christine.fernandez@univ-poitiers.fr

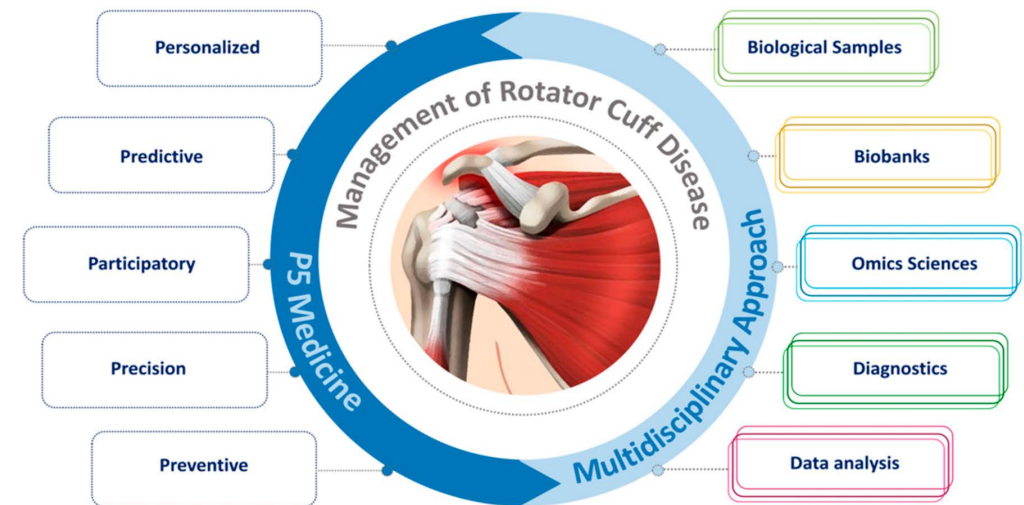
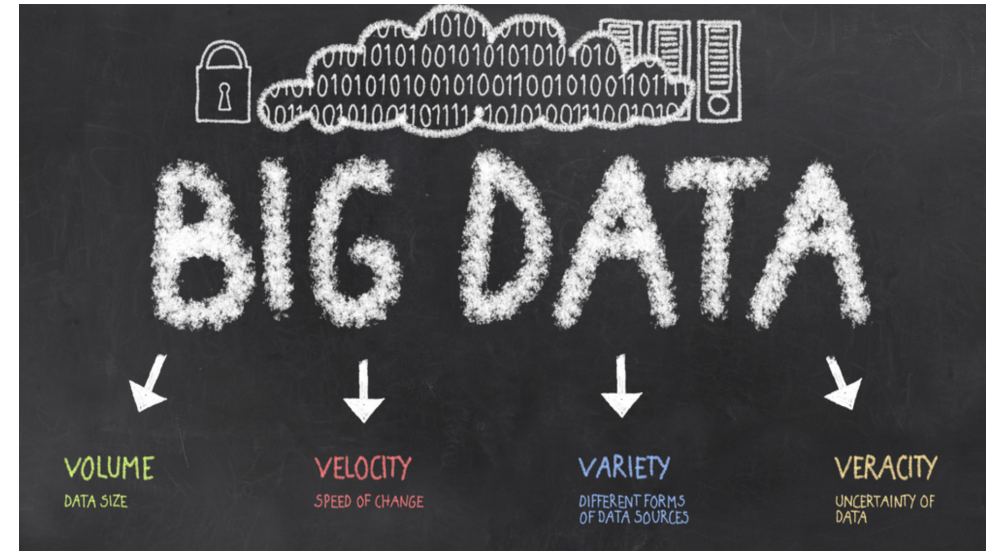
Ultra high field MRI: very high resolution, functional and metabolic imaging of organs and in particular the brain



3 equipments MRI 7T in France, one in Poitiers University Hospital, the lonely 7T MRI for clinical and research use in France



Digital health: the curse of the 4V and 5P medicine



The European Campus of City-Universities

GLADE: DIGITAL HEALTH OR E-HEALTH

1) Telehealth

- Telemedicine:

- **Telecommunications;**
- **Cybersecurity;**
- **AI**

-Mobile health or m-health:

- * **Applications for mobiles (Apps)**
- * **Connected objects**
- * **Implants and smart devices, 3D printing**

2) Computer-assisted diagnosis and help in therapy choice and monitoring

- **Medical imaging**
- **Big data**
- **AI**
- **Computer graphics**
- **Robotics**

3) Administration and training for Health

- **Health information systems (HIS) or hospital information systems (SIH)**
- **e-learning, serious game and simulation**



GLADE: Digital Health

1.1) Telehealth: Telemedicine

Medical practice that brings together, through the use of new technologies, the patient and one or more healthcare professionals, or several health professionals



-Telecommunications;

-Cybersecurity;

-AI for Medical teleconsultation:

After asking a few questions, chatbots can make a pre-diagnosis and guide the consultation with a doctor, saving precious time. E.G.: The Vik chatbot, specialized in breast cancer, gives access to a lot of information on the disease and its treatment. Chatbots are also a precious help in the field of mental health: studies have shown that people confide in a robot more easily than in a human!

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1.2) Telehealth: Mobile health or m-health

- **applications for mobiles**
- **connected objects:** devices connected to the Internet that can collect, store, process and data or that can perform specific actions based on the information received
- **Implants and smart devices , 3D printing**



- a smart T-shirt that measures heart rate and respiratory data;
- a connected bandage that detects and prevents infections;
- a knee prosthesis that monitors biomechanical stresses;
- a bionic contact lens that assists the blind;
- a robotic hand controlled by thought



GLADE: Digital Health

2.1) Computer-assisted diagnosis and help in therapy choice and monitoring: Medical imaging

Using a variety of technologies, medical imaging is increasingly used to diagnose many diseases in addition to clinical examination and other investigations, such as biological examinations and neuropsychological tests.

Medical imaging is also an essential element in clinical research, the study of diseases and the development of new treatments.

There are many complementary imaging techniques. Imaging covers a wide variety of technologies developed through the exploitation of the great discoveries of 20th century physics:

- Radio waves and X-rays (radiography, scanner)
- Radioactivity of certain elements (single-photon scintigraphy , positron emission tomography - PET)
- Magnetic fields (magnetoencephalography, RMN).

Radiography



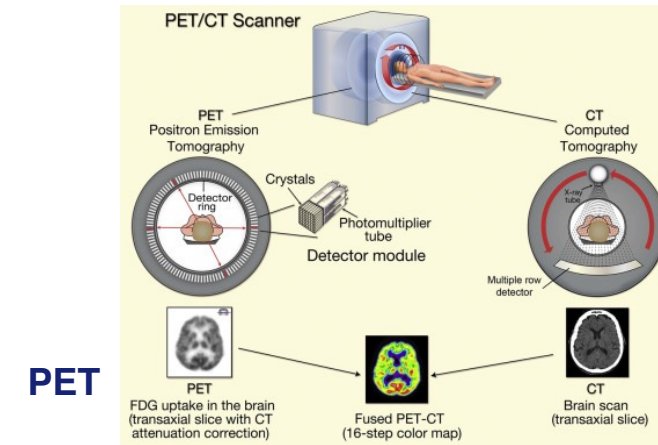
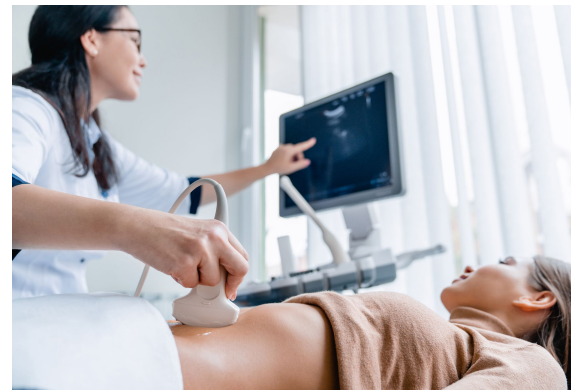
Scanner



Single-photon Scintigraphy



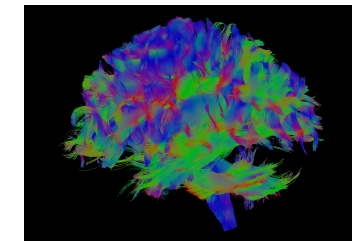
Ultrasound echography



Electroencephalography and Magnetoencephalography

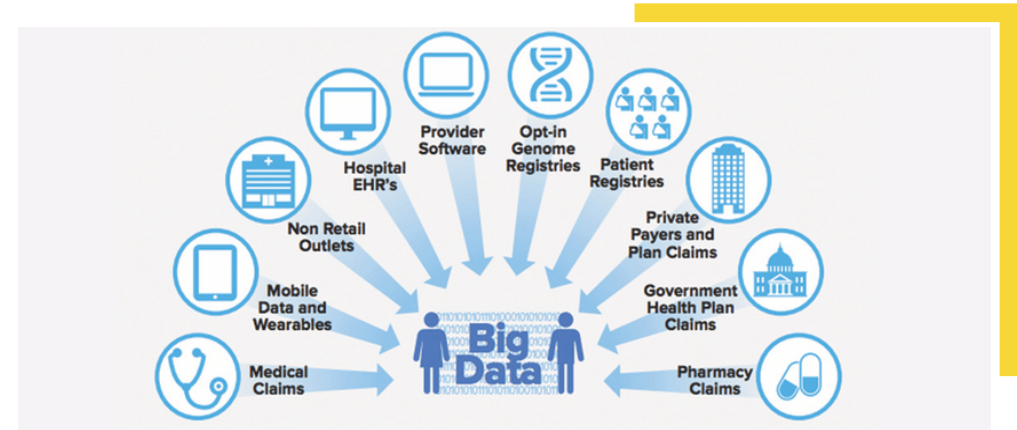
Magnetic Resonance Imaging MRI

- functional MRI
- diffusion MRI
- NMR spectroscopy



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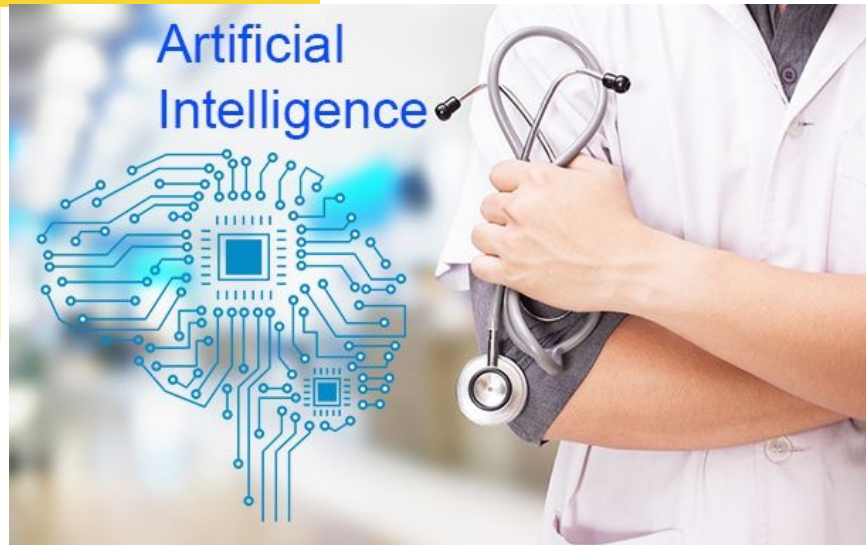
2.2) Computer-assisted diagnosis and help in therapy choice and monitoring: Big data in Health



Big Data = management of huge volumes of data in real time

Large-scale exploitation of data : fully applicable to the field of health and allows to process and analyze, at the same time, a multitude of data that human beings or traditional computer tools are not able to do.

Big Data can revolutionize tomorrow's medicine by enabling personalized, precise, predictive and preventive medicine



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2.3) Computer-assisted diagnosis and help in therapy choice and monitoring: AI

ability of a machine to reproduce actions or functions that are usually those of human beings

Medical data is an invaluable resource for predicting disease, diagnosing pathology or improving patient follow-up.

=> Machine learning , deep learning

But necessity of Explainable AI

The latest advances in AI for healthcare and the prospects for the future:

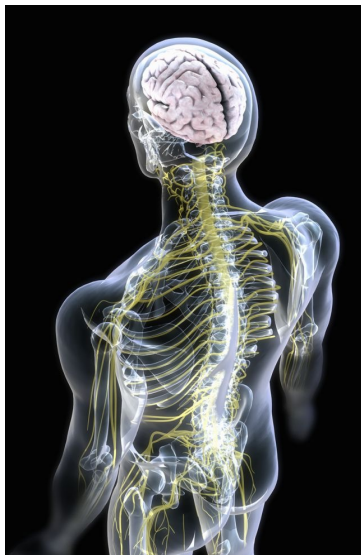
- Decision and prescription support by crossing billions of data or analyzing images (towards virtual biopsy)
- Epidemiological prevention, tracking of epidemics, pharmacovigilance
- Predictive medicine: detection of markers for early diagnosis (e.g. DeepMind for renal lesions; MIC and Alzheimer by analyzing brain images or a blood sample; cardiac accidents based on an ECG).
- Pharmacology : new drugs: by sifting through billions of molecules
- emotional ia for Care relationships: "animator robots" in retirement homes, humanoid robots that interact with children in pediatrics or child psychiatry, "reception robots" trained to interact with patients and detect their emotions in order to adapt their speech, virtual coaches, conversational agents in mental health, etc.



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2.4) Computer-assisted diagnosis and help in therapy choice and monitoring: Computer graphics

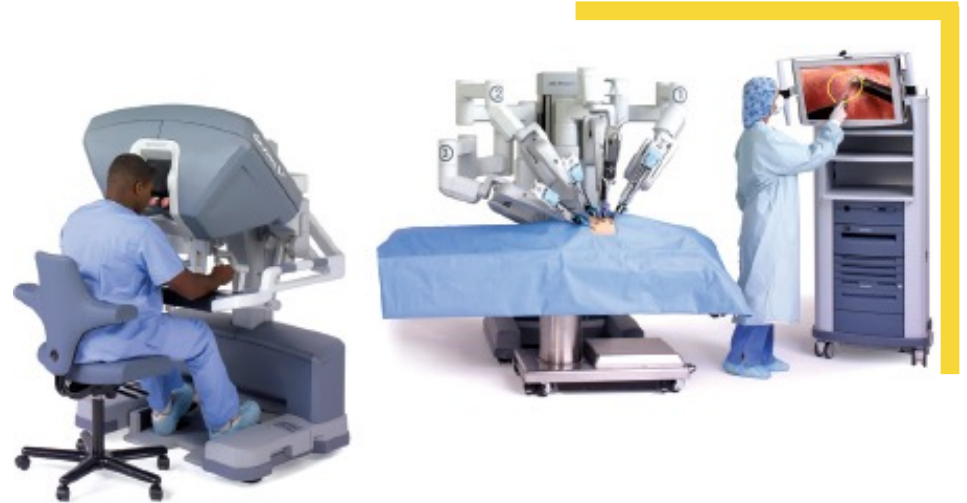
Key words : Image synthesis, 3D reconstruction, 3D animation, virtual reality, augmented reality with the help of artificial intelligence.



- Computer graphics in medicine: from visualization to surgery simulation
- The use of computer graphics for medical diagnosis has provided an extraordinary ability to visualize, measure and evaluate structures in a non-intrusive manner.
- One of the most important areas in medicine where computer graphics have had a positive impact is training

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2.5) Computer-assisted diagnosis and help in therapy choice and monitoring: Robotics



Surgical robots more and more widespread in operating rooms.

More precise and reliable than the human hand, they reduce risks and limit complications and scars. Thanks to their articulated arms, they can perform minimally invasive surgery or even link operations remotely.

In 2001, a French surgeon in New York removed the gallbladder of a patient hospitalized in Strasbourg! Beyond the operation, CAD (computer-assisted surgery) also allows surgeons to train and practice on virtual patients.

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3.1) Administration and Training for Health

- Health information systems (HIS) or hospital information systems (SIH)
- Data protection and security



Secure information exchanges between city medicine and hospitals, or between departments within the same hospital or between hospitals (shared medical records, etc.)

GLADE: Digital Health

3.2) Administration and Training for Health: e-learning, serious games and simulation



- Providing **elearning** to educate and train the health and social care workforce: use of new multimedia technologies and Internet to improve the quality of education. the quality of learning by facilitating access to resources and services on the one hand, and distance exchanges and remote collaborations.
- **Simulation**: use of hardware, virtual reality or a so-called standardized patient to reproduce situations or care environments, to teach diagnostic and therapeutic procedures and to allow the rehearsal of processes, clinical situations or decision making by a health professional or a team of professionals.



Thank you !

contact@ec2u.eu

www.ec2u.eu

