

Junior Faculty Chair

Lead institution/organization : Inria

Head of institution/organization : Bruno Sportisse

Site : Lyon

Academic region : Auvergne-Rhône-Alpes

Partner institutions/organizations : Centre Léon Bérard/Université Claude Bernard Lyon 1

Project name:

Cancer: Artificial Intelligence for Multiomics ANALyses

Acronyme : **CAIMAn**

Keywords : give 5 keywords *characterizing the scientific projec*

Artificial Intelligence; Oncology; MultiOmic Data; Precision Medicine; Next Generation Sequencing

Duration : 5 years

Scientific theme: Digital Health

Related CNU/CoNRS/CSS section(s): CNU 26/27, CoNRS 6/41- CSS 5/6

Institutional strategy

Despite large progress in their prevention, understanding and healthcare management, cancers remain the major cause of death in France with 382,000 new cases each year and 150,000 deaths. It is estimated that more than 60% of French people will develop a cancer during their lifetime. The growing understanding of the genomic and immunological basis of cancer, leading to the development of precision medicine, has led to a significant improvement in the treatment of several types of cancer, and the new 10-year French Cancer Plan aims to amplify this trend, also generating new impetus in the field of prevention in all its aspects.

Digital Health is a field of major societal impact in which Inria has been actively involved at the national and international levels for several years, notably through a program to create joint Inria-Inserm teams. The Inria site in Lyon, created in 2021, has made this area one of its highest priorities and aims, in the long term, to create new joint teams within the Lyon medical ecosystem. This ecosystem is currently organized around three major areas where Lyon is a national and international leader: infectiology/virology, immunology, and cancer. While the Inria center in Lyon has historically established links with the first two areas, particularly through the creation of modeling teams, contacts with cancer research have not yet been formalized and constitute a major strategic challenge for the center. The skills, already developed in current Inria teams, in the fields of machine learning, artificial intelligence and management of large volumes of data on one hand as well as modeling and simulation of biological systems on the other hand, will be strong assets to develop new scientific approaches in the context of cancer research within a joint team with the Léon Bérard Center. Significant engineering support for the development of software tools will also be at the heart of the project.

Host Laboratory strategy

Lyon has a unique combination of expertise, teaching programs and scientific production in oncology, bringing together one of the largest cluster of cancer researchers in France, located mainly at the Lyon Cancer Research Center (CRCL), clinical research teams in university hospitals, a comprehensive cancer center, Léon Bérard (CLB), and the WHO International Agency for Research on Cancer. Lyon is a site of excellence for cancer research, as evidenced by:

- the LAbEx "DEVweCAN", which aims to link tumor progression and the reactivation of embryonic processes,
- the PLAsCAN Convergence Institute, and
- the Synergie Lyon-Cancer scientific cooperation foundation.

The CLB is also a key partner in the Auragen health cooperation group (GCS), which is one of the two national platforms selected under the Plan France Médecine Génomique 2025 (PFMG) for the implementation of precision medicine (whole genome sequencing) in rare diseases and oncology.

The CLB, with its partners Hospices Civils de Lyon (HCL) and Université Claude Bernard Lyon 1 (UCBL), also has one of the first two "Integrated Cancer Research Sites" (SIRIC), called LYriCAN, which is certified as a "phase I center" for children and adults for setting up first-in-human studies. LYriCAN also has an

international network on the topics of rare tumors, leading, for example, the European Reference Network for adult rare cancers (EURACAN), and a unique national network through the presidency of the Unicancer network, a federation of French cancer centers.

The CLB's ambition is to promote innovative translational research programs, new paradigms for understanding the biology of cancer, based on the intensive use of clinical and omics data aimed at developing universal precision medicine

Summary of the scientific project

While most of the leading applications of AI in oncology are essentially in the field of medical imaging (radiomics) or natural language processing (NLP), with a predictive objective, we would like to explore a different (but complementary) dimension, that of multi-omics data (genomics, transcriptomics, metabolomics,...) which is still underdeveloped. The CLB is already strongly invested in the collection and structuring of these data, notably through participation in the Consore (automatic extraction of clinical data) and Osiris (structuring of clinical and genomic data) projects. In addition CLB also hosts the "Gilles Thomas" bioinformatics facility, which has developed a strong expertise (notably through the projects of the International Cancer Genome Consortium) in the field of whole genome data processing. This project therefore focuses on the development of methodologies in the field of AI (Deep Learning) aimed at matching clinical information (pathology, response to treatment, ...) and multi-omics (genomic alterations, gene or metabolites expression). The main application is therefore the annotation of the pathogenicity (clinical consequences) of observed genomic or expression alterations. In practice, it aims at providing tools to assist biologists (genome analysts) and clinicians during Molecular Tumor Board. It should be pointed out that it does not aim at replacing them but at augmenting them, i.e. to allow analysts to focus on the most significant results from a biological or clinical standpoint. From this point of view, the project is therefore placed in a predictive but also a cognitive perspective. A particular attention will be paid to the interpretability of the models, a crucial condition to gain the confidence of practitioners. Finally, the Auragen project, within the framework of PFMG 2025, will constitute a direct field of application for these new tools.

From an organizational point of view, the project aims at creating a joint Inria-CLB team dedicated to these methodologies and relying on the recruitment of two permanent staff:

- the junior chair which is the subject of this application and
- a more senior researcher who will be the subject of an AO piloted by the Synergie-Lyon Cancer foundation.

A joint Inria-CLB-UCBL search committee will be set up for these two recruitments

Summary of the teaching project

The recruited person will participate in the teaching related to precision health within the framework of the Precision Diagnosis and Personalized Medicine track at UCBL by bringing its specific expertise (data sciences, artificial intelligence). This program is open to physicians, veterinarians, pharmacists and doctoral students in biological, mathematical and epidemiological sciences, as well as to computer scientists and bioinformaticians in order to train the next generation of practitioners with a dual expertise. The teacher will set up training modules within the medical, pharmaceutical and veterinary curricula on these themes, and will develop a Master's course in Biology and Health (M2) and a doctoral program, open to the national scientific community as well as to practitioners who want to integrate these new paradigms. The teaching will be structured around interactive seminars on current cutting-edge technologies and approaches (bioinformatics, AI, mathematical modeling, innovative therapies, health economics and ethics, ...).

Financial summary

Total financed on CPJ (including ANR package)	962 k€
Co-financing	720 k€
Total	1,682 k€

Scientific dissemination

The Chairholder is expected to promote the work and results obtained both in methodological (computer science) and biological/clinical journals. The targets for the second category are rank A journals and international congresses of reference in Oncology (ESMO -European Society for Medical Oncology-, ASCO -American Society of Clinical Oncology-, ...). The pluridisciplinary nature of the research carried

out must lead to publication in high-impact generalist journals (Nature, Science). It will also be important to ensure that knowledge is disseminated to caregivers, patients, patient associations and the general public.

Open Science

The project is expected to bring about a significant change in the practices of oncologists: initially at the level of the Léon Bérard Center, and rapidly within the 18 Unicancer centers, to eventually be disseminated more widely within this community. To this end, the methodological developments carried out will have to be implemented by software tools dedicated to the target communities. The source codes will be made available through open platforms (gitlab). The development of interfaces dedicated to health professionals (web portals) will be considered at a later stage in collaboration with the IT services department of the Léon Bérard Center and, possibly, a service provider. The data produced by the research will also be made available in compliance with the regulatory standards (GDPR).

Science and society

Communication towards the general public can immediately be envisaged at the level of: caregivers and patients (via the CLB and Unicancer websites, the CLB's internal distribution media and the organization of open seminars); patient associations (via the websites of these associations, social networks and through participation in dedicated seminars). Finally, in a second phase, a wider public could be reached through national organizations (INCa) and international networks and learned societies (EURACAN, ESMO).

Indicateurs : préciser les indicateurs de suivi du déploiement du projet et la méthodologie de leur suivi

Priority indicators	
Early indicators (<2 years)	<ol style="list-style-type: none"> 1. Recruitment of engineers, doctoral students and post-doctoral fellows making up the Chair. 2. Participation in the submission of national "health" proposals (ANR, INCa, FRM...)
Medium term (2-5 years)	<ol style="list-style-type: none"> 1. Publications in general scientific journals with high impact 2. Establishment of a specific teaching program (DIU type) (structured by the chairholder) 3. Involvement in setting up clinical research projects 4. Participation in setting up European or international projects, ERC
Secondary indicators	
Early (<2 years)	<ol style="list-style-type: none"> 1. Publications in specialized computer and medical journals 2. Participation to international congresses of learned societies
Medium term (2-5 years)	<ol style="list-style-type: none"> 1. Integration in international research networks 2. Organization of an international scientific seminar 3. Establishment of partnership contracts