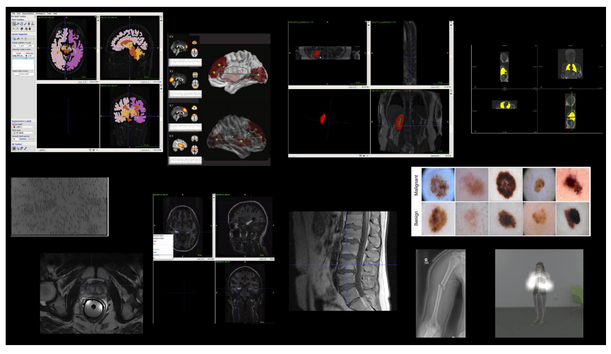
MMIV Centre in Bergen, Norway

N. N. Smit[1,2], S. Bruckner[1,2], H. Hauser[1,2], I. Haldorsen[1,3,4], A. Lundervold[1,5], A. S. Lundervold[1,6], E. Hodneland[1,7], L. Oltedal[1,3,4] , K. Specht[1,8], and E. R. Gruner[1,3,9]

The **Mohn Medical Imaging and Visualization** Centre (MMIV) is a collaboration between the University of Bergen, Norway, and the Haukeland University Hospital in Bergen with generous support from the Bergen Research Foundation (BFS), conducting cross-disciplinary research related to state-of-the-art medical imaging, including preclinical and clinical high-field MRI, CT, and hybrid PET/CT/MR. The overall goal of the Centre is to research new methods in quantitative imaging and interactive visualization to predict changes in health and disease across spatial and temporal scales. This encompasses research in feature detection, feature extraction, and feature prediction, as well as on methods and techniques for the interactive visualization of spatial and abstract data related to and derived from these features. With special emphasis on the natural and medical sciences, the long-term goal of the Centre is to excel in the interplay between medical imaging (physics, chemistry, radiography, radiology), and visualization (computer science and mathematics) and develop novel and refined methods that may ultimately improve patient care. The overall research of MMIV is organized in four core projects:

Computational Medical Imaging and Machine Learning

Over the past few years there has been a dramatic development in areas associated to machine learning and artificial intelligence. This is mainly caused by breakthroughs in deep learning, a collection of techniques that enable computers to uncover complicated patterns and connections in large data sets.

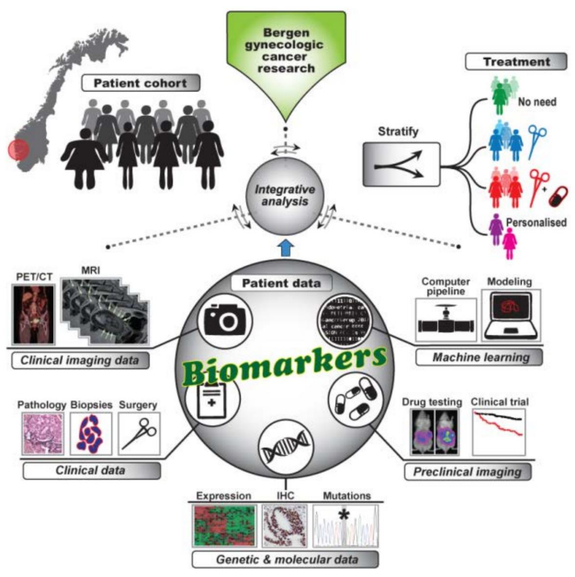


The project “Computational Medical Imaging and Machine Learning - methods, infrastructure and applications" develops, implements, disseminates and evaluates machine learning techniques in the analysis of medical images and image-related data. The project's objective is to contribute to an increased degree of personalized medicine and better decision support for diagnosis, prognosis and therapy in diseases and conditions where images are an important source of information.

More: mmiv.no/machinelearning/

Precision Imaging in Gynecologic Cancer

Gynecologic cancers have characteristic structural and functional imaging features reflected in clinical phenotypes, and these imaging biomarkers highlight pathogenic mechanisms potentially targetable by novel treatments. The challenge is now to integrate these imaging biomarkers into clinically relevant treatment algorithms by identifying molecular targets for treatment based on biomarker profiles.



Molecular, genetic and imaging biomarkers in gynecologic cancer are studied in patients and in preclinical gynecologic cancer models. Potential imaging/molecular/genetic biomarkers are to be identified using machine learning algorithms. The overall goal of this project is to improve patient care by providing better imaging tools with which to guide individualized and targeted treatment in gynecologic cancer patients.

More: mmiv.no/cancerimaging/

Visual Data Science for Imaging Biomarker Discovery

Research of *new data-centric methods* (visual data science) for the

- *exploration*,
- *representation*,
- *management*,
- and *study*

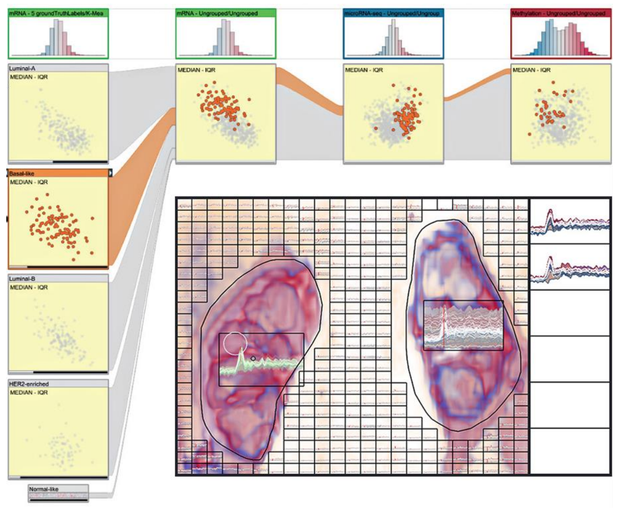
of potentially large sets of candidates for **new imaging biomarkers**,

based on *multi-aspect medical imaging data* from MRI (and other modalities)

and oriented to help with the *diagnosis* of

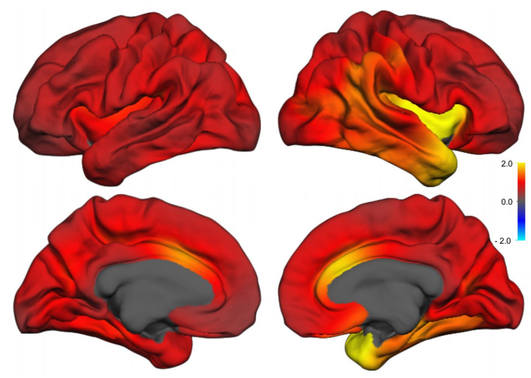
- certain early-stage cancer cases
- as well as selected mental disorders.

More: MMIV.no/visualdatascience



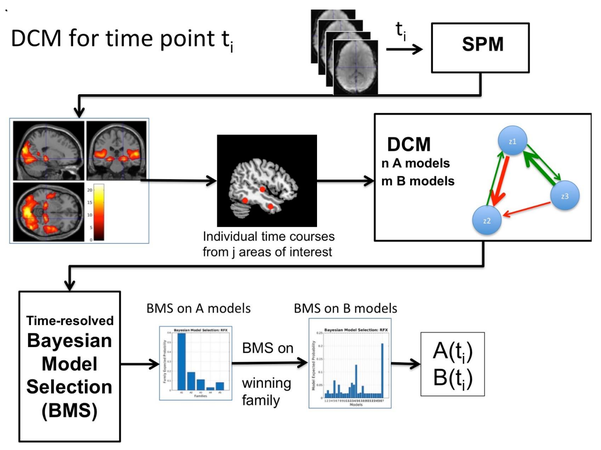
Advanced Neuroimaging

The aim of the project is to develop and apply novel approaches of quantitative neuroimaging. There are currently three subprojects: (1) The Global ECT-MRI Research Collaboration (GEMRIC) - aims at identifying treatment mechanisms of electroconvulsive therapy (ECT) and predictors of clinical response. (2) The multimodal neuroimaging subproject includes development and application of novel imaging approaches targeted at investigating the integrity of the microvasculature and neuro-inflammation in selected neurological and neuropsychiatric applications.



Volumetric change map (mean of n = 19) illustrating the changes occurring across the cortex of the human brain following ECT treatment. The map has not been thresholded by statistical methods. The results can be used for hypothesis testing - e.g. for relating the volume change to the treatment outcome

(3) The final subproject, financed through an advanced grant from the Norwegian Research Council, aims at improving reliability of fMRI and dynamic functional connectivity measures.



More: mmiv.no/advanced-neuroimaging/

Acknowledgements

This work was supported by the Bergen Research Foundation [grant number 811255]

Affiliations

1 Mohn Medical Imaging and Visualization Centre, Haukeland University Hospital and University of Bergen, Norway
2 Dept. of Informatics, University of Bergen, Norway 3 Dept. of Radiology, Haukeland University Hospital, Norway
4 Dept. of Clinical Medicine, University of Bergen, Norway 5 Dept. of Biomedicine, University of Bergen, Norway
6 Dept. of Computing, Mathematics and Physics, HVL, Norway 7 Christian Michelsen Research, Norway
8 Dept. of Biological and Medical Psychology, University of Bergen, Norway
9 Dept. of Physics and Technology, University of Bergen, Norway

HELSE BERGEN Haukeland universitetssjukehus

UNIVERSITY OF BERGEN

MMIV