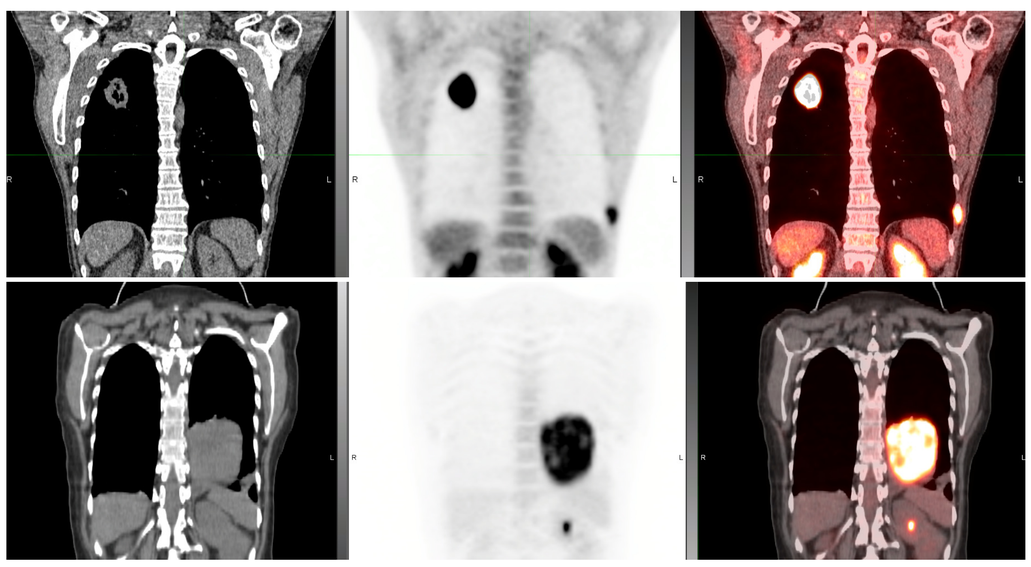
# Radiomics

## Using medical imaging based biomarker to predict outcome of cancer patients

## Background



CT | FDG PET | Fused FDG PET/CT

**Cancer** is a heterogeneous disease with respect to etiology, pathogenesis, therapy response and prognosis. Tumor response to therapy varies not only among patients but also within the tumor itself (illustrated in left figure). These two lung cancer patients received the same therapy scheme despite apparent large variation in tumor in terms of size, heterogeneity, etc.

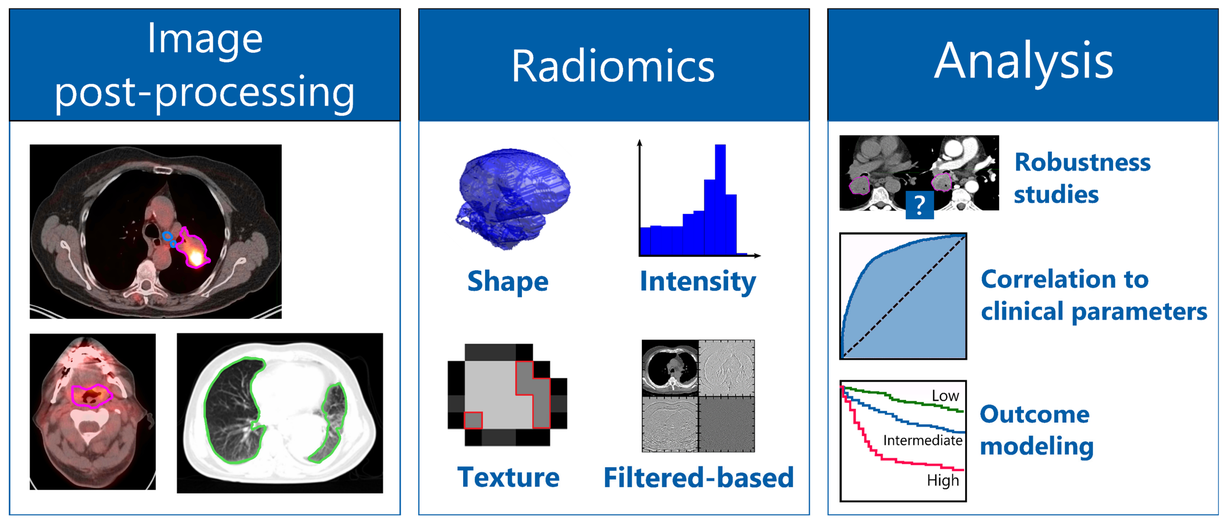
Today, increasing number of cancer treatment options are available due to rapid technical developments. Therefore, decision support systems are needed to offer the **right treatment to the right patient**. In recent years, **medical imaging** has become increasingly important due to its non-invasive nature for the identification of new prognostic biomarkers. Imaging datasets are expected to hold more information than visible to the human eye.

## Radiomics

**Radiomics** describes the extraction of a large number of meaningful quantitative features from medical images, such as computed tomography, positron emission tomography or magnetic resonance imaging.

Using our in-house developed radiomics software (Z-Rad) we can extract more than **1000 radiomic features describing tumor shape, tumor intensity, tumor texture** from medical images (as depicted on the right).

These radiomic features are potential biomarkers of the cancer phenotype, and hence can be used for **patient outcome prognosis or for correlation to the tumor biology using advanced statistical methods**.



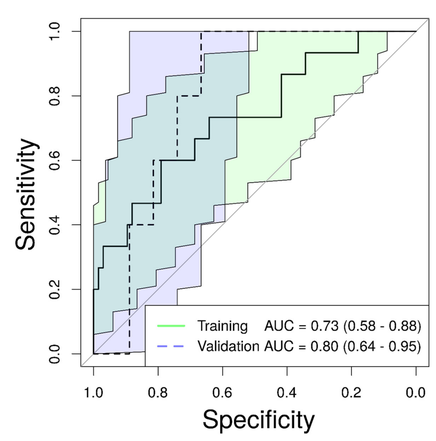

## Research

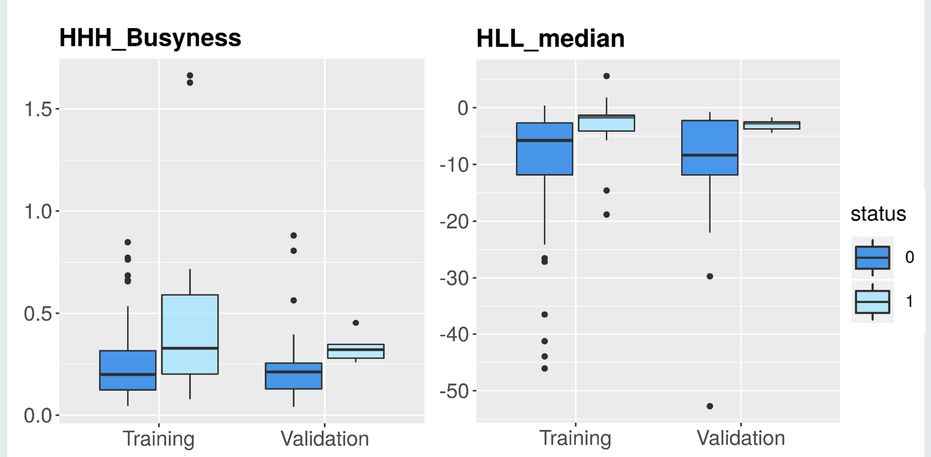
Our group is located in the radiation therapy department at the University Hospital of Zurich (USZ) which allows us to work in a highly interdisciplinary setting with the medical doctors and radiation biologists to address clinical needs.

Our research focuses on:

- the **robustness** of radiomic features against scanning and imaging uncertainties
- the correlation of radiomic features **to clinical parameters or patient outcome** modeling (figure 1) to stratify patients into different risk groups for different tumor types (such as brain, head and neck, melanoma and lung)
- the correlation of radiomic features with **tumor biology** (such Gleason score or Human Papillomavirus)
- the translation of preclinical radiomic signatures to clinical setting
- the **repetitive** tumor and organs art risk monitoring using the concept of **delta radiomics** (time variation in radiomic features) and recently installed **MRI-Linac**
- the implementation of **deep learning** concepts for medical image analysis and outcome modeling
- Privacy preserving **distributed learning** for outcome modelling.

**Figure 1:** Pre-treatment CT radiomics model to predict 12 months overall survival for locally non-small cell lung cancer. Good performance on training and validation patient cohort was observed. The final model consisted of only two features.
Higher HHH_Busyness (surrogate for heterogeneity) value is associated with poorer prognosis.




### Selection of publications


- Vuong D, Tanadini-Lang S, Huellner MW, Veit-Haibach P, Unkelbach J, Andratschke N, Kraft J, Guckenberger M, Bogowicz M. Interchangeability of radiomic features between [18F]-FDG PET/CT and [18F]-FDG PET/MR. Med Phys. 2019 Apr;46(4):1677-1685
- Bogowicz M, Riesterer O, Ikenberg K, et al. Computed Tomography Radiomics Predicts HPV Status and Local Tumor Control After Definitive Radiochemotherapy in Head and Neck Squamous Cell Carcinoma. International journal of radiation oncology, biology, physics. 2017;99(4):921-928.



Contact: Diem Vuong | diem.vuong@usz.ch
Rämistrasse 100, 8091 Zürich

Supervisors: Dr. Stephanie Tanadini-Lang | stephanie.tanadini-lang@usz.ch
Prof. Jan Unkelbach | jan.unkelbach@usz.ch