Radiomics

From Unstructured Data to Medically Relevant Information

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Research for a Life without Cancer

Dark Data

Unstructured data from heterogeneous sources

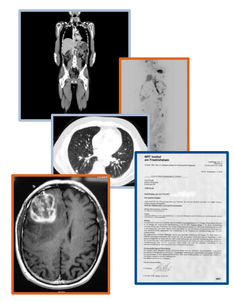
Incoherent representation of information

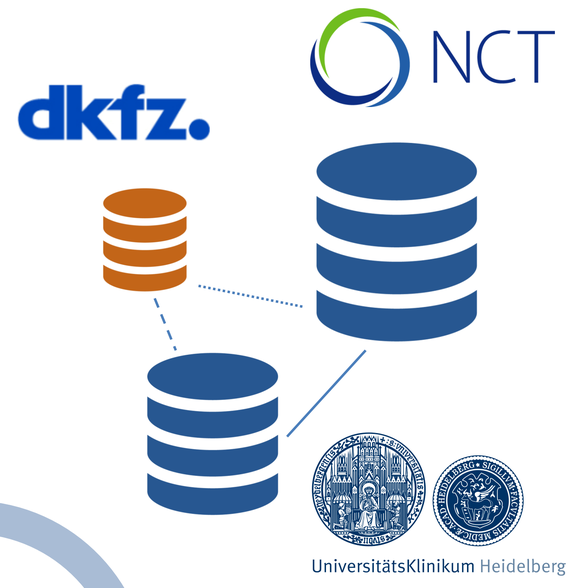
Rich Data

Unexplored correlations and causalities

Untapped potential for patient benefit

Image Data





Deep Learning

Learning from Sparse Annotations

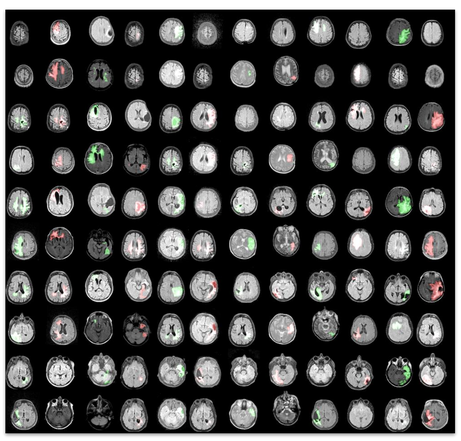
Interactive Segmentation

3D Statistical Shape Models

Uncertainty Handling

Case Study 1

Recurrent Glioblastoma



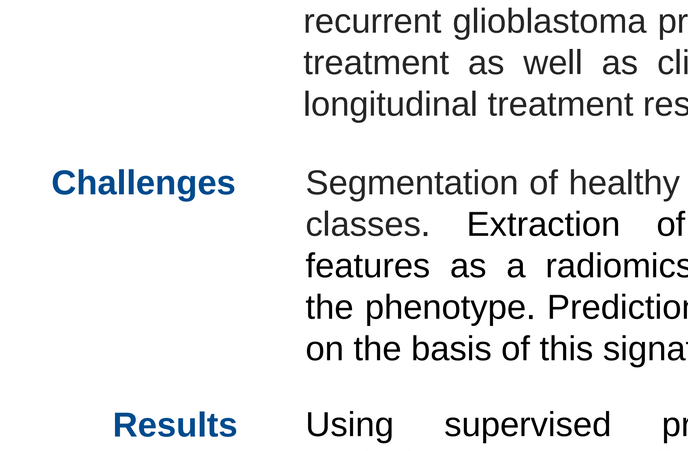
In Cooperation with

Prof. Dr. Wolfgang Wick
Prof. Dr. Martin Bendszus
Prof. Dr. Heinz-Peter Schlemmer
PD Dr. David Bonekamp
Dr. Philipp Kickingereder

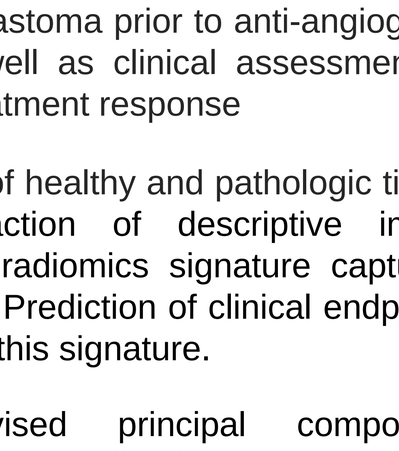
Data Multi-sequence MRI of 172 patients with recurrent glioblastoma prior to anti-angiogenic treatment as well as clinical assessment of longitudinal treatment response

Challenges Segmentation of healthy and pathologic tissue classes. Extraction of descriptive image features as a radiomics signature capturing the phenotype. Prediction of clinical endpoints on the basis of this signature.

Results Using supervised principal component analysis on 4,842 Radiomics image features we were able to stratify patients into **low and high risk groups** for both **progression-free survival** (hazard ratio = 1.85; p = 0.030) and **overall survival**
(hazard ratio = 2.60; p = 0.001).



Kaplan-Meier plot for probablility of overall survival of stratified patient groups



Heatmap of radiomic features selected by the supervised principal component analysis.

Patient Individual Therapy

Case Study 2

Prostate Cancer

In Cooperation with

Prof. Dr. Markus Hohenfellner
Prof. Dr. Boris Hadaschik
Prof. Dr. Heinz-Peter Schlemmer
PD Dr. David Bonekamp
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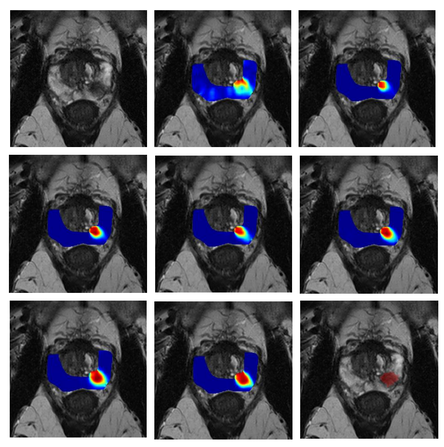
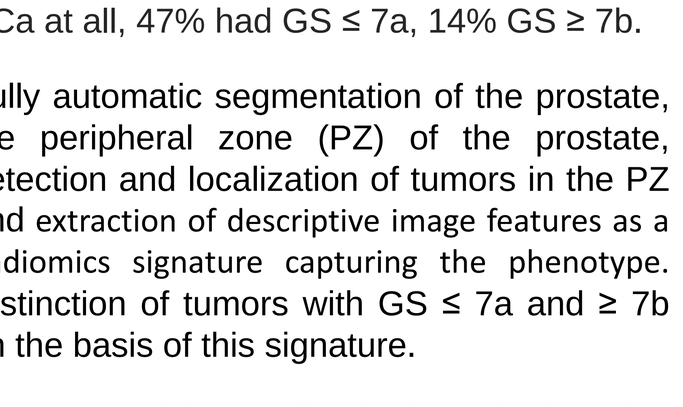
Dr. Jan Philipp Radtke



Data Multi-parametric MRI images of 197 consecutive patients with clinical suspicion for PCa that underwent MRI/TRUS-fusion targeted biopsy to obtain Gleason-Score (GS). 39% of all patients did not suffer from PCa at all, 47% had GS ≤ 7a, 14% GS ≥ 7b.

Challenges Fully automatic segmentation of the prostate, the peripheral zone (PZ) of the prostate, detection and localization of tumors in the PZ and extraction of descriptive image features as a Radiomics signature capturing the phenotype. Distinction of tumors with GS ≤ 7a and ≥ 7b on the basis of this signature.

Results Computer aided radiomics-based detection **(CARD) detects 95.1% of all tumors with GS >= 7b** with a maximum center of mass shift of 6 mm. Patch-based classification of the PZ yields an accuracy of 96.8%, sensitivity of 90.2%, specificity of 96.3% and ROC-AUC of 98.7%.



Sensitivity of center-of-mass-shift for different MRI contrasts

P Kickingereder, M Götz, J Muschelli, A Wick, U Neuberger, RT Shinohara, M Sill, M Nowosielski, HP Schlemmer, A Radbruch, W Wick, M Bendszus, KH Maier-Hein and D Bonekamp:
"Large-scale Radiomic Profiling of Recurrent Glioblastoma Identifies an Imaging Predictor for Stratifying Anti-Angiogenic Treatment Response"
Clinical Cancer Research 2016