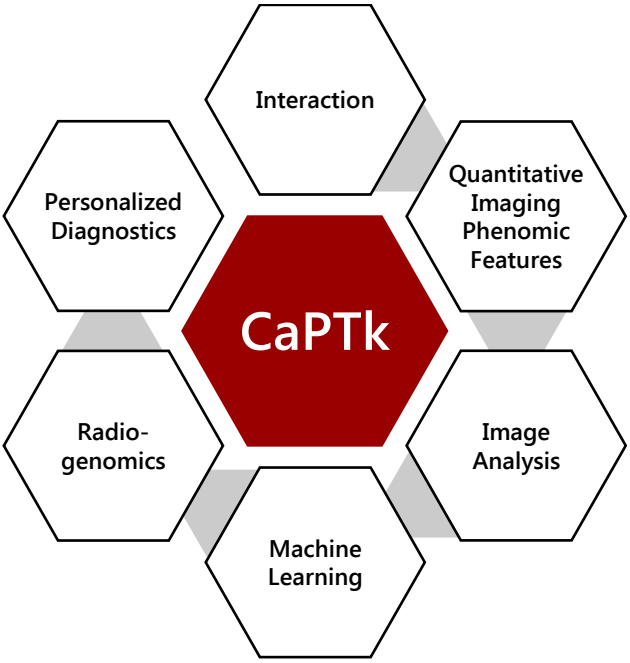
CaPTk:
Cancer Imaging Phenomics Toolkit



What is CaPTk?

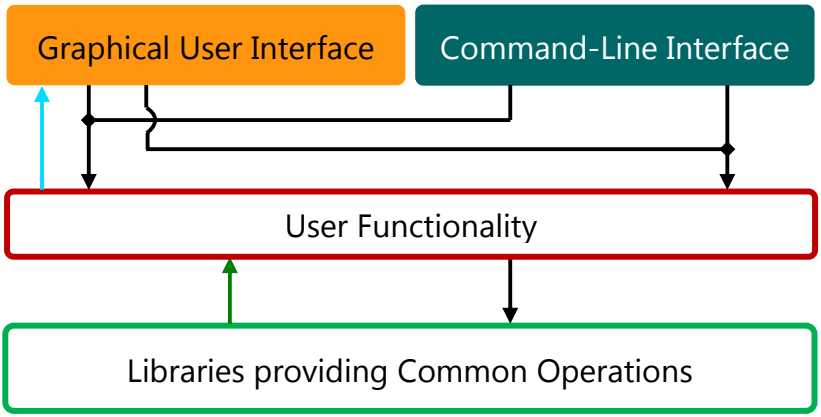
A dynamically growing software platform that facilitates clinical translation of computational algorithms without requiring substantial computational background. Current focus has been on radiographic images of brain, breast and lung cancer.

CaPTk can be seamlessly integrated into the typical quantification, analysis, and reporting workflow of a radiologist, underscoring its clinical potential.

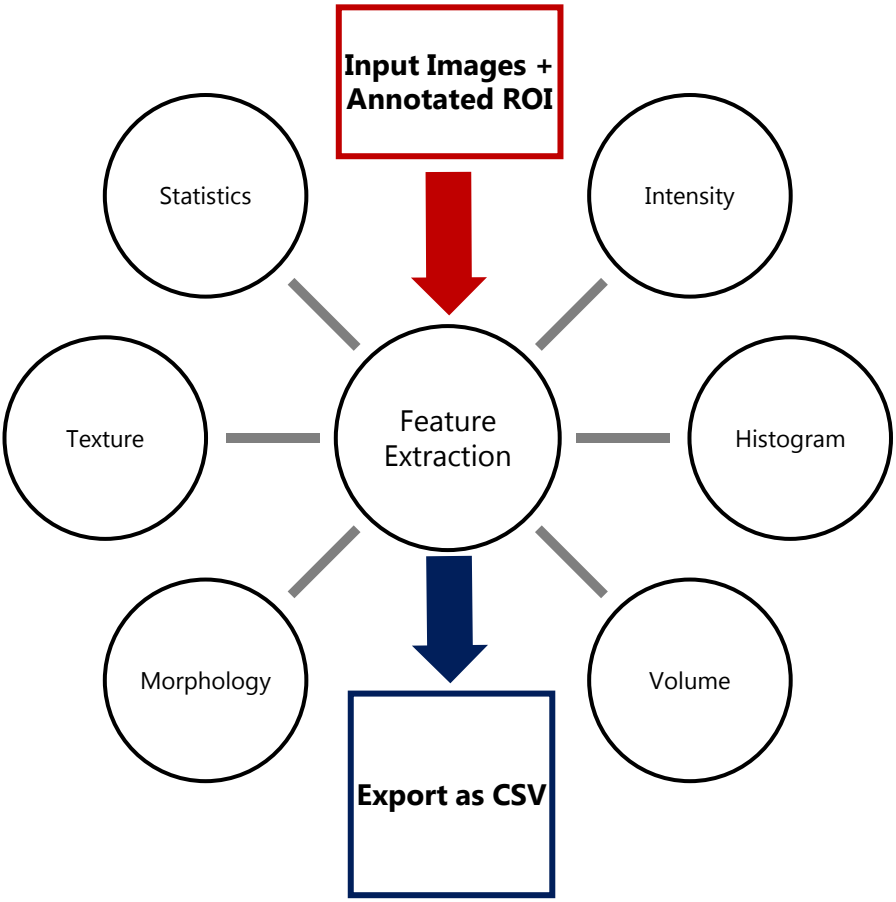
It has a two-tier functionality:

1. Extraction of extensive set of quantitative features (e.g., texture, morphology, kinetic, connectomics) from multimodal imaging.
2. Multivariate machine learning integrates these features into non-invasive diagnostic, prognostic and predictive biomarkers.

Software Architecture

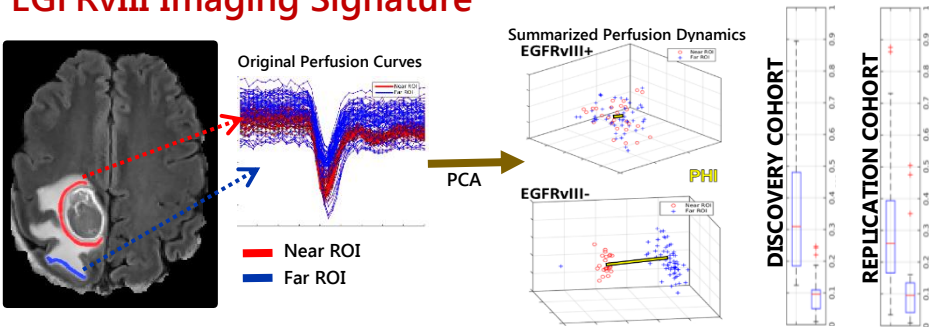


Quantitative Imaging Phenomic Feature Panel



- Extracted from multiple modalities and for multiple ROIs.
- Advanced customization of feature parameters.
- Batch processing of multiple subjects via command line.
- Pre-defined feature settings for specific applications.
- Pre-trained models allowing direct utilization in new data.

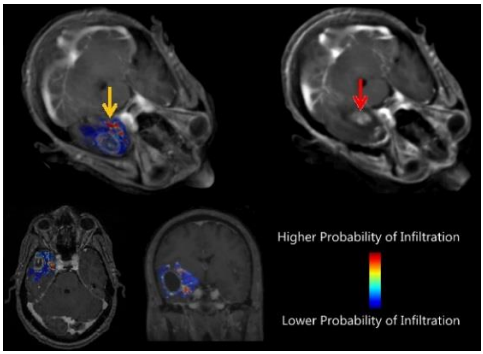
EGFRvIII Imaging Signature



- Statistical analysis of Perfusion Dynamics (DSC-MRI) is done to get the Peritumoral Heterogeneity Index (PHI, or φ-Index).
- Cross-validated results on the combined discovery and replication cohort of 142 subjects, a threshold is estimated that distinguishes between negative and positive EGFRvIII status (Accuracy: 89.92%, Specificity: 92.53%, Sensitivity: 83.77%).

[S.Bakas, *et al.*, Clin Cancer Research, 2017. DOI: 10.1158/1078-0432.CCR-16-1871]

Recurrence & Tumor Infiltration Prediction

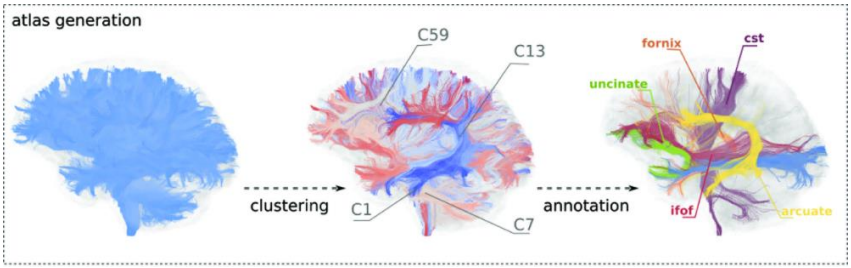


Clinical trial to commence soon!

- Pattern analysis of multi-parametric MRI (i.e., T1, T1-Gd, T2, T2-FLAIR, DTI, DSC) reveals distinctive imaging signatures of deeply infiltrating glioblastoma.
- Validation in independent prospective cohort revealed mean AUC: 0.84, Sensitivity: 91%, and Specificity: 93%.

[H.Akbari, *et al.*, Neurosurgery, 2016. DOI: 10.1227/NEU.0000000000001202]

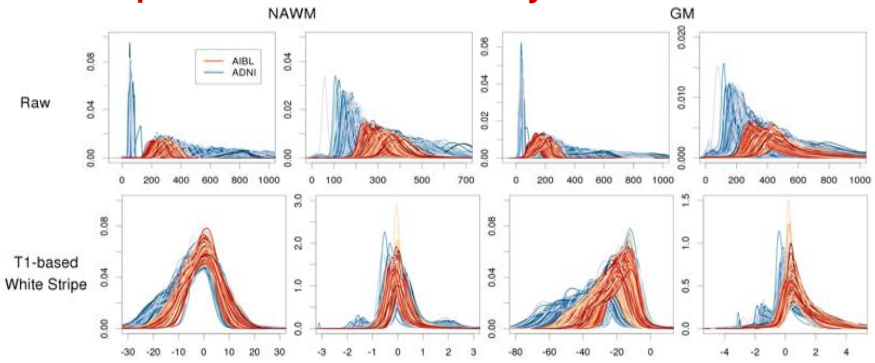
Connectivity-based Fiber Extraction and Identification



- **Confetti** automatically identifies white matter tracts without drawing inclusion and exclusion regions of interest.
- It can identify bundles of streamlines even in the presence of edema and mass effect (since it uses connectivity information rather than shape features).
- Significantly better than shape-based clustering

[B.Tunc, *et al.*, Neurosurgery, 2016. DOI: 10.1227/NEU.0000000000001183]

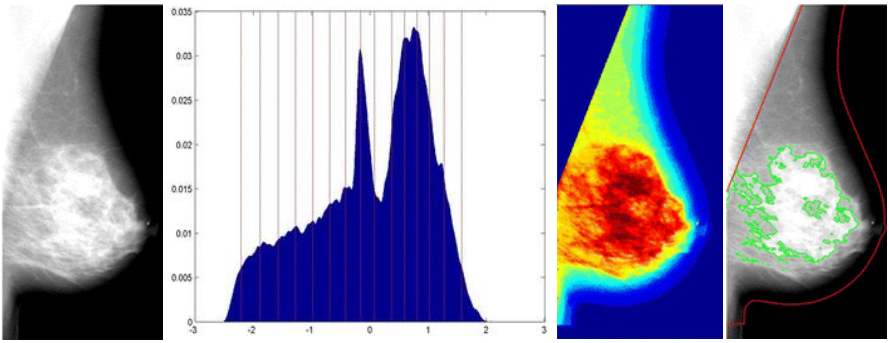
WhiteStripe (Automated Intensity Normalization)



- Using histogram analysis of a subject, considers a reference region that is normal appearing and normalizes over the image using a z-scoring approach.
- Essential part of pre-processing to improve radiographic modeling and prediction results; robust to pathology.

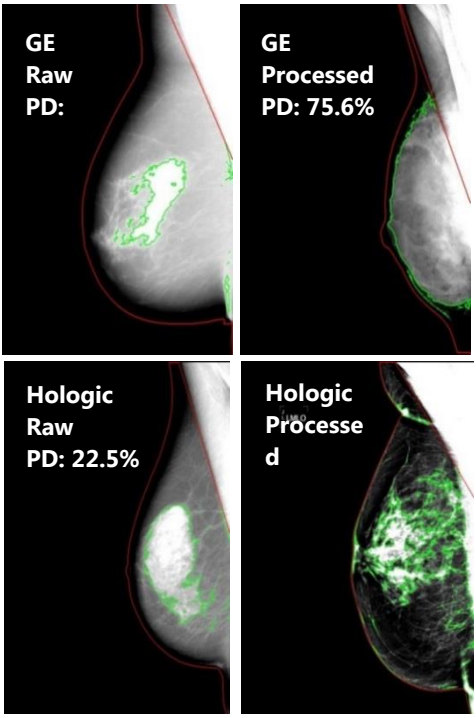
[R.T.Shinohara, *et al.*, Neuroimage Clin., 2014. DOI: 10.1016/j.nicl.2014.08.008]

Breast Cancer Screening



LIBRA: Automated breast density assessment from digital mammograms
[B. Keller, *et al.*, Breast Cancer Research, 2015. DOI: 10.1186/s13058-015-0626-8]

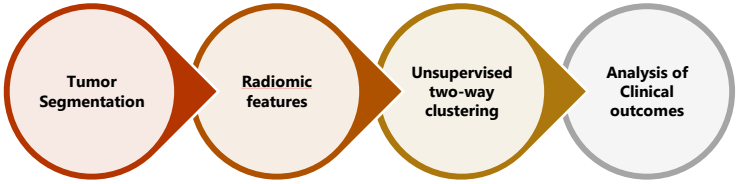
- Multi-vendor support.
- Applicable to both raw and vendor-processed images.



- Density assessment in strong agreement with radiologist-reported *BI-RADS* density and *Cumulus*-acquired calculations.
- Multiple case-control studies consistently showed significant associations of density measures with *breast cancer risk*.
- Used in *large epidemiologic and clinical studies* with breast density.

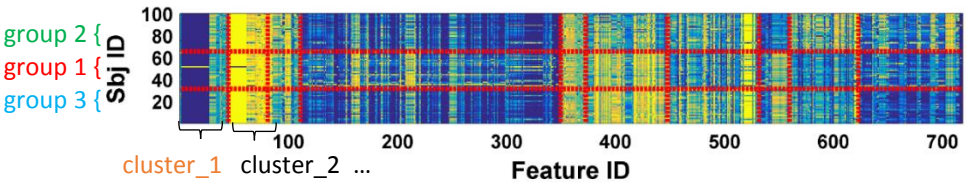
Applied to more than 50,000 mammography screening exams.

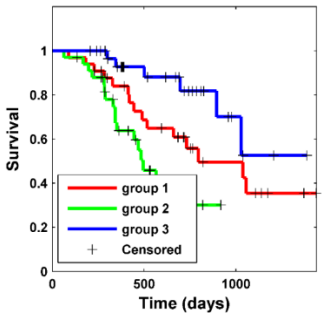
Lung Oncology

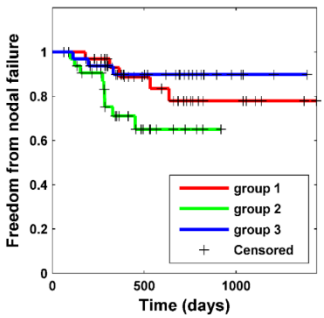


- Radiomic analysis has been widely applied to lung cancer studies.
- Feature selection/dimensionality reduction is crucial to relieve curse of dimensionality in radiomic analysis.
- Patient stratification and feature reduction benefits from each other.
- Unsupervised two-way clustering method can achieve promising performance for distinguishing patients with different outcomes and extracting informative meta-features.

[H. Li, *et al.*, Int J Radiat Oncol Biol Phys, 2017. DOI: 10.1016/j.ijrobp.2017.06.092]







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