Pyradiomics

open-source python package for the extraction of Radiomics features from medical imaging. With this package, the aim is to establish a reference standard for Radiomic Analysis, and provide a tested and maintained open-source platform for easy and reproducible Radiomic Feature extraction. By doing so, we hope to increase awareness of radiomic capabilities and expand the community. The platform supports both the feature extraction in 2D and 3D and can be used to calculate single values per feature for a region of interest (“segment-based”) or to generate feature maps (“voxel-based”).

Sixty-eight <65 years old glioblastoma patients, with extensive enhancing portion (CET) resection, were selected. Resection was evaluated by manually segmenting CET on volumetric T1-weighted MRI pre and post-surgery (within 72 h). All patients underwent the same treatment protocol including chemoradiation. NET radiomic features were extracted with a custom version of Pyradiomics. Feature selection was performed with principal component analysis (PCA) and its effect on survival tested with the Cox regression model. Twelve months of OS discrimination was tested by t-test followed by logistic regression. Statistical significance was set at $p<0.05$. The most relevant features were identified from the component matrix.

Results: Five PCA components (PC1-5) explained 90% of the variance. PC5 resulted significant in the Cox model ($p = 0.002$; $exp(B) = 0.686$), at t-test ($p = 0.002$) and logistic regression analysis ($p = 0.006$). Apparent diffusion coefficient (ADC)-based features were the most significant for patient survival stratification.

Conclusions: ADC radiomic features on NET predict survival after standard therapy and could be used to improve patient selection for more extensive surgery [1)].

Rupture risk stratification is critical for incidentally detected intracranial aneurysms. Here we developed and validated an institutional nomogram to solve this issue. We reviewed the imaging and clinical databases for aneurysms from January 2015 to September 2018. Aneurysms were reconstructed and morphological features were extracted by the Pyradiomics in python. Multiple logistic regression was performed to develop the nomogram. The consistency of the nomogram predicted rupture risks and PHASES scores was assessed. The performance of the nomogram was evaluated by the discrimination, calibration, and decision curve analysis (DCA). 719 aneurysms were enrolled in this study. For each aneurysm, twelve morphological and nine clinical features were obtained. After logistic regression, seven features were enrolled in the nomogram, which were SurfaceVolumeRatio, Flatness, Age, Hyperlipemia, Smoker, Multiple aneurysms, and Location of the aneurysm. The nomogram had a positive and close correlation with PHASES score in predicting aneurysm rupture risks. AUCs of the nomogram in discriminating aneurysm rupture status was 0.837 in a separate testing set. The calibration curves fitted well and DCA demonstrated positive net benefits of the nomogram in guiding clinical decisions. In conclusion, Pyradiomics derived morphological features based institutional nomogram was useful for aneurysm rupture risk stratification [2)].

3: Zhang M, Tong E, Hamrick F, Lee EH, Tam LT, Pendleton C, Smith BW, Hug NF, Biswal S, Seekins J, Mattonen SA, Napel S, Campen CJ, Spinner RJ, Yeom KW, Wilson TJ, Mahan MA. Machine-Learning Approach to Differentiation of Benign and Malignant Peripheral Nerve Sheath Tumors: A Multicenter Study. Neurosurgery. 2021 Jun 15:nyab212. doi: 10.1093/neuros/nyab212. Epub ahead of print. PMID: 34131749.

4: Tam LT, Yeom KW, Wright JN, Jaju A, Radmanesh A, Han M, Toescu S, Maleki M, Chen E, Campion A, Lai HA, Eghbal AA, Oztekin O, Mankad K, Hargrave D, Jacques TS, Goetti R, Lober RM, Cheshier SH, Napel S, Said M, Aquilina K, Ho CY, Monje M, Vitanza NA, Mattonen SA. MRI-based radiomics for prognosis of pediatric diffuse intrinsic pontine glioma: an international study. Neurooncol Adv. 2021 Mar 5;3(1):vdab042. doi: 10.1093/noajnl/vdab042. PMID: 33977272; PMCID: PMC8095337.

5: Laukamp KR, Shakirin G, Baeßler B, Thiele F, Zopfs D, Große Hokamp N, Timmer M, Kabbasch C, Perkuhn M, Borggrefe J. Accuracy of Radiomics-Based Feature Analysis on Multiparametric Magnetic Resonance Images for Noninvasive Meningioma Grading. World Neurosurg. 2019 Dec;132:e366-e390. doi: 10.1016/j.wneu.2019.08.148. Epub 2019 Aug 30. PMID: 31476455.

6: Qian Z, Li Y, Wang Y, Li L, Li R, Wang K, Li S, Tang K, Zhang C, Fan X, Chen B, Li W. Differentiation of glioblastoma from solitary brain metastases using radiomic machine-learning classifiers. Cancer Lett. 2019 Jun 1;451:128-135. doi: 10.1016/j.canlet.2019.02.054. Epub 2019 Mar 13. PMID: 30878526.

[1)]
Pasquini L, Di Napoli A, Napolitano A, Lucignani M, Dellepiane F, Vidiri A, Villani V, Romano A, Bozzao A. Glioblastoma radiomics to predict survival: Diffusion characteristics of surrounding nonenhancing tissue to select patients for extensive resection. J Neuroimaging. 2021 Jul 7. doi: 10.1111/jon.12903. Epub ahead of print. PMID: 34231927.

[2)]
Liu Q, Jiang P, Jiang Y, Ge H, Li S, Jin H, Liu P, Li Y. Development and validation of an institutional nomogram for aiding aneurysm rupture risk stratification. Sci Rep. 2021 Jul 5;11(1):13826. doi: 10.1038/s41598-021-93286-6. PMID: 34226632.