UNIVERSITY OF SOUTH FLORIDA

Defense of a Doctoral Dissertation

Spatial Heterogeneity Utilization in CT Images for Lung Nodule Classification

by

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For the Ph.D. degree in Computer Science and Engineering

This dissertation introduces new algorithms designed to increase the performance of patient diagnostic systems as well as lung cancer tumor's aggressiveness categorization. Due to the variance of reported nodule sizes, the dataset was split into size categories and each CAD system for a size-group was designed individually. As an extension for the size split project, delta features were computed and added into the feature set. Delta features characterize temporal changes in a nodule. A novel habitat revealing algorithm was presented and its utilization for lung cancer diagnosis and lung cancer aggressiveness classification is provided in detail. Considering the beneficial usage of the developed approaches as a set of independent methods, a delta habitat revealing algorithm was designed. Finally, we designed several experiments to show that size is an important feature not only in clinical practice and Radiomics but also for Convolution Neural Networks that process only image data.

Examining Committee

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Wednesday, April 8th, 2020
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Publications

1) Cherezov, D., Hawkins, S.H., Goldgof, D.B., Hall, L.O., Liu, Y., Li, Q., Balagurunathan, Y.,Gillies, R.J. and Schabath, M.B., 2018. Delta radiomic features improve prediction for lungcancer incidence: A nested case control analysis of the National Lung Screening Trial. Cancer medicine, 7(12), pp.6340-6356.
2) Cherezov, D., Goldgof, D., Hall, L., Gillies, R., Schabath, M., Mller, H. and Depeursinge, A.,2019. Revealing Tumor Habitats from Texture Heterogeneity Analysis for Classification ofLung Cancer Malignancy and Aggressiveness. Nature. scientific reports, 9(1), p.4500.
3) Cherezov, D., Paul. R., Fetisov, N., Gillies, R.J., Schabath, M.B., Goldgof, D. and Hall L.,2020. Lung Nodule Sizes are Encoded when Scaling CT Image for CNN's. Tomography. (ACCEPTED).
4) Cherezov, D., Hawkins, S., Goldgof, D., Hall, L., Balagurunathan, Y., Gillies, R.J. and Sch-abath, M.B., 2016, October. Improving malignancy prediction through feature selection informed by nodule size ranges in NLST. In 2016 IEEE International Conference on Systems,Man, and Cybernetics (SMC) (pp. 001939-001944). IEEE.
5) Kalpathy-Cramer, J., Mamomov, A., Zhao, B., Lu, L., Cherezov, D., Napel, S., Echegaray, S.,Rubin, D., McNitt-Gray, M., Lo, P. and Sieren, J.C., 2016. Radiomics of lung nodules: a multi-institutional study of robustness and agreement of quantitative imaging features. Tomography,2(4), p.430.
6) Balagurunathan, Y., Beers, A., KalpathyCramer, J., McNittGray, M., Hadjiiski, L., Zhao,B., Zhu, J., Yang, H., Yip, S.S., Aerts, H.J. and Napel, S. [et al, including Cherezov D.],,2018. Semiautomated pulmonary nodule interval segmentation using the NLST data. Medicalphysics, 45(3), pp.1093-1107.
7) Hawkins S, Wang H, Liu Y, Garcia A, Stringfield O, Krewer H, Li Q, Cherezov D, GatenbyRA, Balagurunathan Y, Goldgof D. Predicting malignant nodules from screening CT scans.Journal of Thoracic Oncology. 2016 Dec 1;11(12):2120-8.
8) Alahmari, S.S., Cherezov, D., Goldgof, D.B., Hall, L.O., Gillies, R.J. and Schabath, M.B.,2018. Delta Radiomics Improves Pulmonary Nodule Malignancy Prediction in Lung CancerScreening. IEEE Access, 6, pp.77796-77806.
9) Tunali I., Hall L., Napel S., Cherezov, D., Guvenis A., Gillies R., Schabath M.B. Stabilityand reproducibility of computed tomography radiomic features extracted from peritumoral regions of lung cancer lesions. Medical Physics. 2019.
10) Paul, R., Cherezov, D., Schabath, M.B., Gillies, R.J., Hall, L.O. and Goldgof, D.B., 2019,March. Towards deep radiomics: nodule malignancy prediction using CNNs on feature images.84In Medical Imaging 2019: Computer-Aided Diagnosis (Vol. 10950, p. 109503Z). International Society for Optics and Photonics.

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