AI applications in routine clinical imaging

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IMPACT ADDENDUM

The primary goal of the work presented in this thesis is to provide Radiomics methodologies for disease detection, localization, quantification, diagnosis, prognosis, and treatment outcome prediction. The proposed methods have been tested on external validation cohorts, with different imaging parameters and morphological information, to assess their generalizability and robustness, and to pave the way for a possible application in a real clinical setting.

SCIENTIFIC IMPACTS

The combination of AI-based auto-segmentation model and radiomics features extracted from the segmented lung GTV region on CT images described in **chapter 5** can be leveraged for gaining more insights on clinical endpoints like genetic mutation status in a tumor, progressive response to treatment, determining automated RECIST scoring, etc. Similar work has been done to predict HPV status from standard CT images of anal and vulvar cancer patients. [1], automatic RECIST score evaluation using diffusion MRI [2]. Furthermore, radiomic features extracted using such methodologies, in combination with genomic, and proteomic data can lead to Biomarker discovery in the future.

The AI model and the automatic labeler methodology described in **chapter 6** can be adapted to any application that requires the recording of localized information on images in a text format, linked for example to Electronic Health Records (EHR). This would greatly benefit an optimal connection between the AI-based system and patient records documentation.

The deep learning methodology for segmentation described in **chapter 8** can be reproduced for any application that requires delineation of regions on images and such a model can be used as a support tool for detection, localization, and quantification purposes in radiology. An adaptation of the model mentioned in the chapter was trained and validated on liver lesions [3].

Furthermore, all our studies are published in medical and technical peer-reviewed international journals such as, Diagnostics, Journal of Neurology, IEEE Access, Medical Research Reviews, Journal of Personalized Medicine, La radiologia medica, European Respiratory Journal, and Journal of Clinical Oncology and the publications are available as open access.

SOCIETAL IMPACTS

All the tools that were developed in the context of my research can be efficiently deployed and usable in a clinical setting. In actual fact, The AI-based tools developed in **chapter 2** called COVIA have been implemented at CHU-Liege and were used as an additional diagnostic research tool when the pandemic was at its peak in 2020. The methodology in **chapters 2 & 3** could be adapted to support incidental findings or to provide a second independent verification of the occurrence of the disease, inclusive and beyond the emergency status of this pandemic. Especially, the method for localization of abnormalities in lungs can be leveraged to analyze new unseen abnormalities if in-case another pandemic occurs.

Models and methodologies presented in the thesis have already been used in a research context by both Biotech and major pharmaceutical companies to explore possible improvements in drug development. One of the models has been filed as a novel invention and is currently being evaluated. To be accepted as an international patent application [4].

Finally, leveraging, and improvement of our methods can greatly benefit society by providing increased accuracy and efficiency concerning diagnosis, prognosis, and appropriate treatment selection and ultimately superior understanding of disease or biology of any type of abnormality presenting in our body.

REFERENCES

[1] R. T. H. Leijenaar *et al.*, "External validation of a radiomic signature to predict HPV (p16) status from standard CT images of anal and vulvar cancer patients.," *https://doi.org/10.1200/JCO.2021.39.15_suppl.e15502*, vol. 39, no. 15_suppl, pp. e15502–e15502, May 2021, doi: 10.1200/JCO.2021.39.15_SUPPL.E15502.

[2] E. Baidya Kayal, D. Kandasamy, R. Yadav, S. Bakhshi, R. Sharma, and A. Mehndiratta, "Automatic segmentation and RECIST score evaluation in osteosarcoma using diffusion MRI: A computer aided system process," *Eur J Radiol*, vol. 133, Dec. 2020, doi: 10.1016/J.EJRAD.2020.109359.

[3] A. Vaidyanathan *et al.*, "PO-1710: A novel AI solution for auto-segmentation of multi-origin liver neoplasms," *Radiotherapy and Oncology*, vol. 152, pp. S944–S945, Nov. 2020, doi: 10.1016/S0167-8140(21)01728-X.

[4] "BE1028836B1 - Methods and systems for biomedical image segmentation based on a combination of arterial and portal image information - Google Patents." https://patents.google.com/patent/BE1028836B1/en?inventor=Akshayaa+Vaidyanathan&oq=Akshayaa+Vaidyanathan (accessed Sep. 06, 2022).