Artificial intelligence in medical imaging

SUMMARY

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This thesis explored applications of AI in medical imaging for enhancing and streamlining cancer management. It comprises a composition of comprehensive review articles as well as research studies using various medical imaging data. Additionaly, it outlines the current challenges encountered when implementing AI in clinical settings and explores future prospects in the field.

Part 1: Applications of HRFs based ML methods in medical imaging

Part 1 starts with an introduction through **Chapter 2** where application of HRFs based models were explained and discussed, along with the challenges, limitations, and future prospects. **Chapter 3** utilizes the HRF in conjunction with clinical, molecular, and qualitative imaging data to explore the integrated performance of these features for prediction and prognosis in patients with Gliablostoma. **Chapter 4** continues the investigation of complimentary value of HRFs extracted from the MRI, it compares and combines handcrafted feature based models with models based on the automatically extracted deep features for predicting the ARE.

Part 2: Applications of Deep learning in medical imaging

Part 2 also starts with an introduction, **Chapter 5** explores existing methods for the medical imaging segmentation, ranging from fully manual to fully automatic. It provides an in depth explanation for the methods behind each solution and suggests the best suitable option based on the clinical scenario. **Chapter 6** continues the research of automatic medical imaging segmentation methods using AI. It incorporates multiple research objectives for enhancing the NSCLC management. It demonstrates that AI can be used for automatic NSCLC detection and segmentation on CT with the performance comparable to the manual annotators. It also serves as the evidence that AI could be used to streamline and enchance the radiotherapy workflows. **Chapter 7** shifts application of AI in medical imaging from automatic segmentation to classification. It explores the use of DL for detection of bone metastases on the bone scintigraphy images. It demonstrated the potential of AI to be used as clinical decision aid tool that could minimize the time needed by a nuclear physician to assess bone scans.

Part 3: Open source and patented contributions to the field

Part 3 shifts the focus from the research to the development of AI based and auxiliary applications. **Chapter 8** describes an open source initiative to improve the reproducibility of quantitative medical imaging research through standardisation of data curation and pre-processing. The developed python package provides various functionality for handling medical and clinical data including data exploration, curation, outlier detection and verification. **Chapter 9** presents the summary of the patent for the work on image data processing method, method of training a machine learning data processing model and image processing system. The patent claims were made as a part of the clinical software development process for the automatic segmentation of NSCLC on CT.

Part 4: General discussion and future perspectives

Part 4 and **Chapter 10** addresses the present challenges in the integration of the AI based applications in the clinic and concludes the thesis by discussing the future prospects.