Print this Page for Your Records Close Window

Control/Tracking Number: 2023-SP-2068-RSNA
Activity: Scientific Presentations
Current Date/Time: 5/2/2023 8:20:13 PM

Large Language-Image Model for Multi-Organ Segmentation and Cancer Detection from Computed Tomography

Author Block: JIE LIU; Yixiao Zhang; Jieneng Chen; Junfei Xiao; Yongyi Lu; Bennett A. Landman, PhD; Alan Yuille; Yucheng Tang; Zongwei Zhou, BSC

Abstract:
***Purpose:** To investigate the feasibility of using language-image models for the automated segmentation of 25 abdominal organs and the detection of six types of tumors in CT scans originating from various hospitals, institutes, and countries.
***Methods and Materials:** We proposed the CLIP-Driven Universal Model, which incorporates text embedding learned from Contrastive Language-Image Pre-training (CLIP) into segmentation models. This CLIP label encoding captures anatomical relationships, enabling the model to learn structured feature embedding and segment 25 organs and six types of tumors. As illustrated in the figure, our Universal Model consists of a text branch and a vision branch. The Universal Model was developed using an assembly of 14 public datasets, encompassing a total of 3,410 CT scans for training. We then evaluated its generalizability and transferability on 117 external CT scans from two external datasets, i.e., 3D-IRCADb and TotalSegmentator. In addition to public datasets, the Universal Model was independently evaluated on a large-scale dataset from Johns Hopkins Hospital, comprising 5,038 CT scans with 21 annotated organs, to investigate extensibility to novel classes. Dice Similarity Coefficient (DSC) and Normalized Surface Distance (NSD) were evaluated for organ/tumor segmentation; Sensitivity and Specificity were evaluated for tumor detection.
***Results:** We rank first on the Medical Segmentation Decathlon (MSD) public leaderboard and achieve state-of-the-art results on Beyond The Cranial Vault (BTCV). Six critical anatomical structures can be segmented by AI with a similar variance to two human experts. Furthermore, the Universal Model is computationally more efficient (6x faster) than previous dataset-specific models, generalizes better to CT scans from three different hospitals, and exhibits superior transfer learning performance on novel classes and image analysis tasks.
***Conclusions:** The proposed CLIP-Driven Universal Model, integrating image representation with language, possessed remarkable efficiency, generalizability, transferability, and extensibility in organ segmentation and tumor detection.
***Clinical Relevance/Application:** The ability to segment organs and detect tumors in CT scans through our AI algorithms will provide direct assistance to radiologists in a cooperative manner by combining the best of human and AI expertise. The high-performing AI can facilitate the creation of large datasets that are significantly larger than current medical datasets, thus promoting larger-scale studies for early cancer detection in real-world settings.

Category (Complete): Imaging Informatics -> INIPAIMQI - Image Processing and Analysis: Image Segmentation and Measurement, Quantitative Imaging
Format Preference (Complete): Oral Paper
Questions (Complete):
Trainee Research Prize: Not Applicable
Disclosure of "Off-Label" usage: No, I do not intend to discuss off-label uses
IRB / IACUC Response: Not applicable/None of the above (explain)
If needed, please explain: : public datasets were used.
Has this work been previously presented or published?: No
2nd Format Opportunity: Yes, I would be interested if accepted to showcase my work in an additional format (2 meter Hardcopy Backboard).

Attached Files: Overview of CLIP-Driven Universal Model. We have developed an AI model from an assembly of 14 public datasets, enabling multi-organ segmentation and tumor detection. (PDF, 6039079 bytes)

Status: Complete

Feedback

Powered by cOASIS, The Online Abstract Submission and Invitation System SM
© 1996 - 2023 CTI Meeting Technology All rights reserved. Privacy Policy