Prediction of acute ischemic stroke using multimodal MRI and deep learning networks

CHUN-LIN LAI[1]、FAN-PEI Gloria YANG[*2,3,4,5]、JENG-YUAN CHIOU[6]、CHUNG-YU LAI [7]、GIIA-SHEUN PENG[8]、JIU-HAW YIN[9]、YUEH-FENG SUNG[10]、YUN-HSIANG WU [3]

[1] Department of Medical Informatics Chung Shan Medical University, Taiwan、[2]Artificial Intelligence Center, National Tsing Hua University, Taiwan、[3] Department of Foreign Languages & Literature, National Tsing Hua University, Taiwan、[4] Center for Cognition and Mind Sciences, National Tsing Hua University、[5]Department of Radiology, Graduate School of Dentistry, Osaka University, Japan、[6]Department of Health Policy and Management, Chung Shan Medical University, Taiwan、[7] Department of Intelligent Technology and Application, Hung Kuang University, Taiwan、[8] Department of Medical Affair & Planning, Taipei Veterans General Hospital, Taiwan、[9] Division of Neurology, Department of Internal Medicine, Taipei Veterans General Hospital, Hsinchu Branch、[10] Department of Neurology, TRI-SERVICE GENERAL HOSPITAL, Taiwan

[*]：corresponding authors

Objective: Acute ischemic stroke refers to the type of stroke caused by vascular infarction, which can lead to brain dysfunction and even death. Besides, assessment of the core and penumbra volume is crucial in the decision of thrombectomy or thrombolysis. Manual assessment of location and volume of core and penumbra might pose the questions of imprecision and inefficiency. To solve this problem, the present study explores artificial intelligence approaches to identification of ischemic core and penumbra in magnetic resonance imaging (MRI) and provides the calculation of volumes.

Methods: This study focuses on the prediction and volume segmentation of acute ischemic stroke. We compared the methods of Mask R-CNN and YOLOv5 to determine which network is more suitable for ischemia segmentation.

Results: We collected MRI images of 150 patients with acute ischemic stroke and manually labeled ischemic regions by physicians and students. We split the dataset into 70% training data, 20% validation data, and 10% test data. Comparing YOLOv5 and Mask R-CNN results (Figure 1), they yielded 95% and 94% precision, 95% and 93% recall, and 96% and 92% mean precision, respectively.

Conclusions: The results (Table 1) show that the 95% accuracy of YOLOv5 is greater than 94% of Mask R-CNN, and the average accuracy of 96% is greater than 92%. YOLOv5 showed a superior performance to Mask R-CNN.

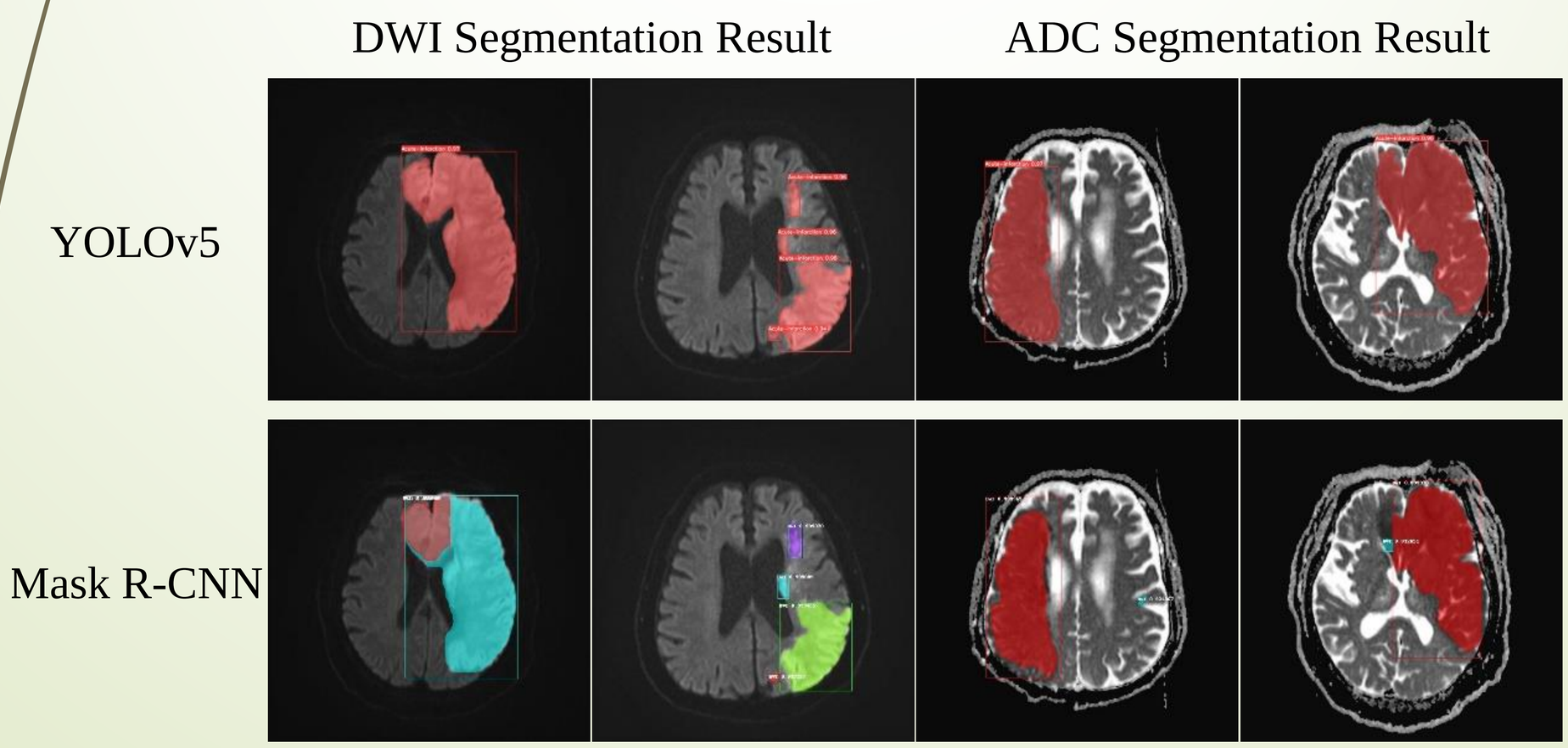

Fig 1、DWI & ADC Segmentation Result

Table 1、YOLOv5 and Mask R-CNN Result

Confusion Matrix	YOLOv5 vs Mask R-CNN Result		
	Precision	Recall	Average Precision
DWI	95% vs 94%	95% vs 93%	96% vs 92%
ADC	98% vs 91%	93% vs 92%	95% vs 90%

Table 2、Confusion Matrix

	Actual Positive	Actual Negative
Predicted Positive	TP	FP
Predicted Negative	FN	TN

* **Accuracy**: TP / (TP + FP) The proportion of true cases among all samples predicted by the model as positive cases (with disease).
* **Recall**: TP / (TP + FN) Among all samples that are actually positive (with disease), the proportion of the model correctly predicting as positive.