

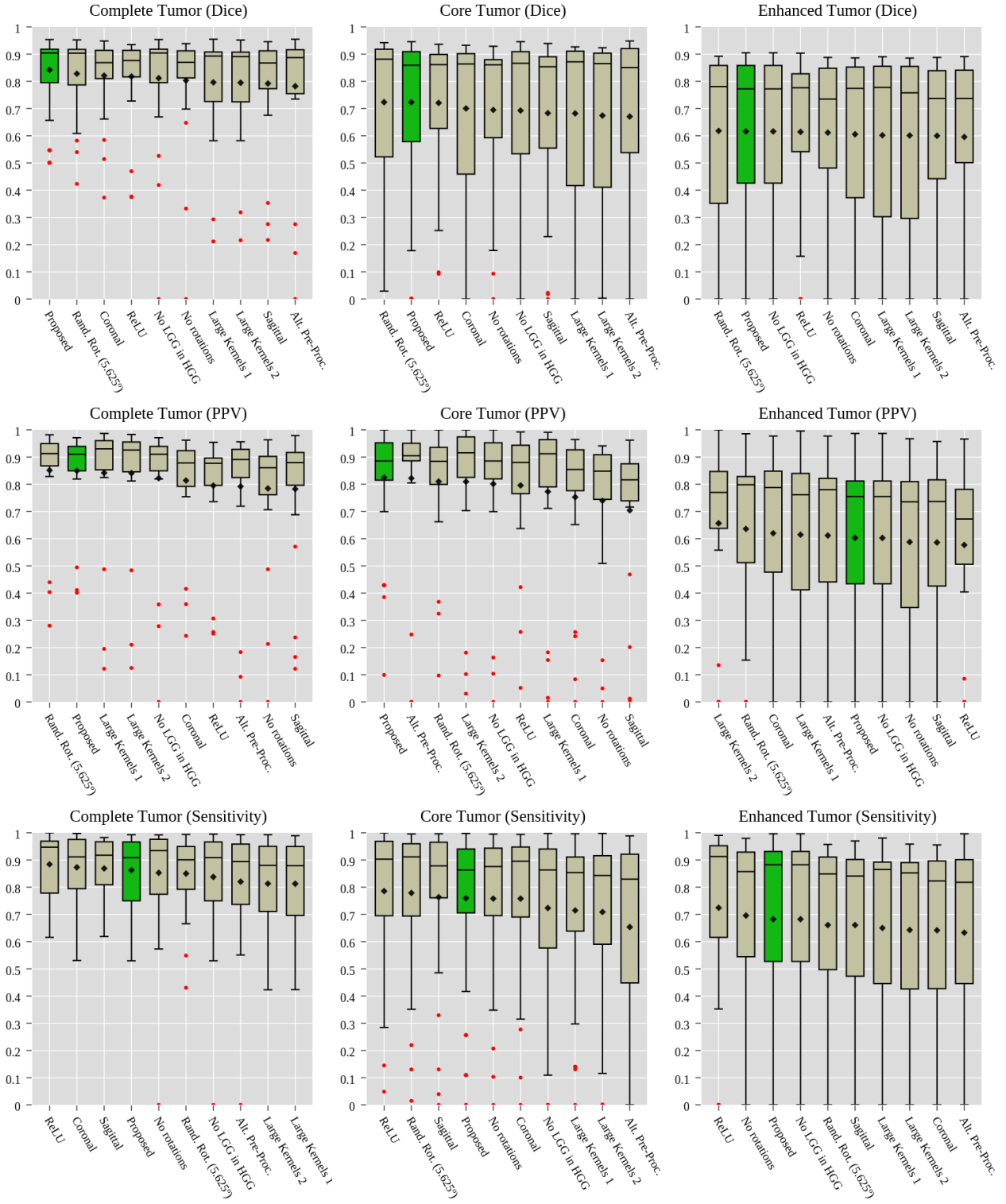


Fig. 2: Boxplot for each of the experiments in Table IV in the Leaderboard data set. The boxplot for the experiment of sampling training samples from HGG into LGG is not shown given the reduced number of subjects (4 LGG in 25 subjects for the Leaderboard data set). The diamond marks the mean.

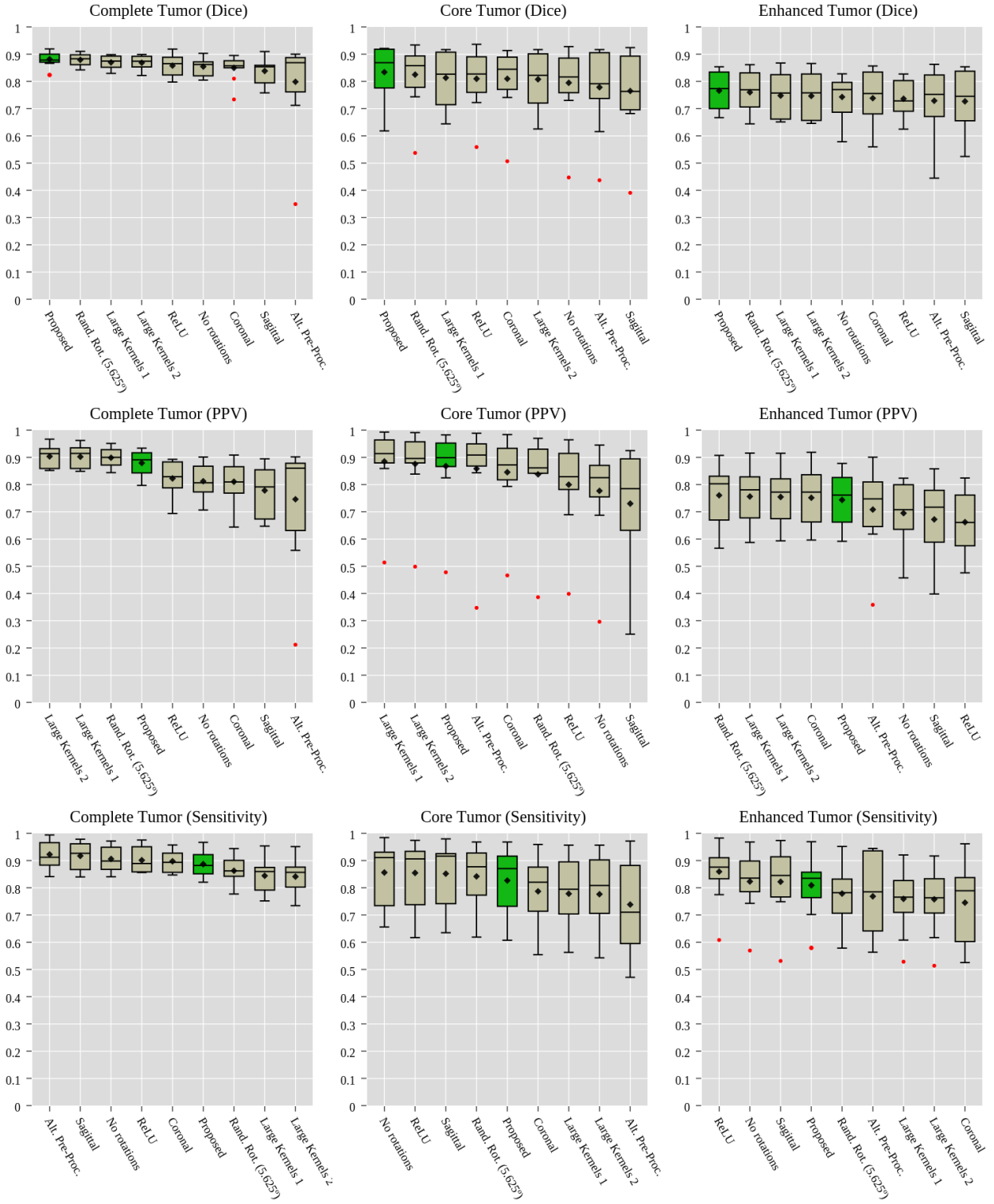
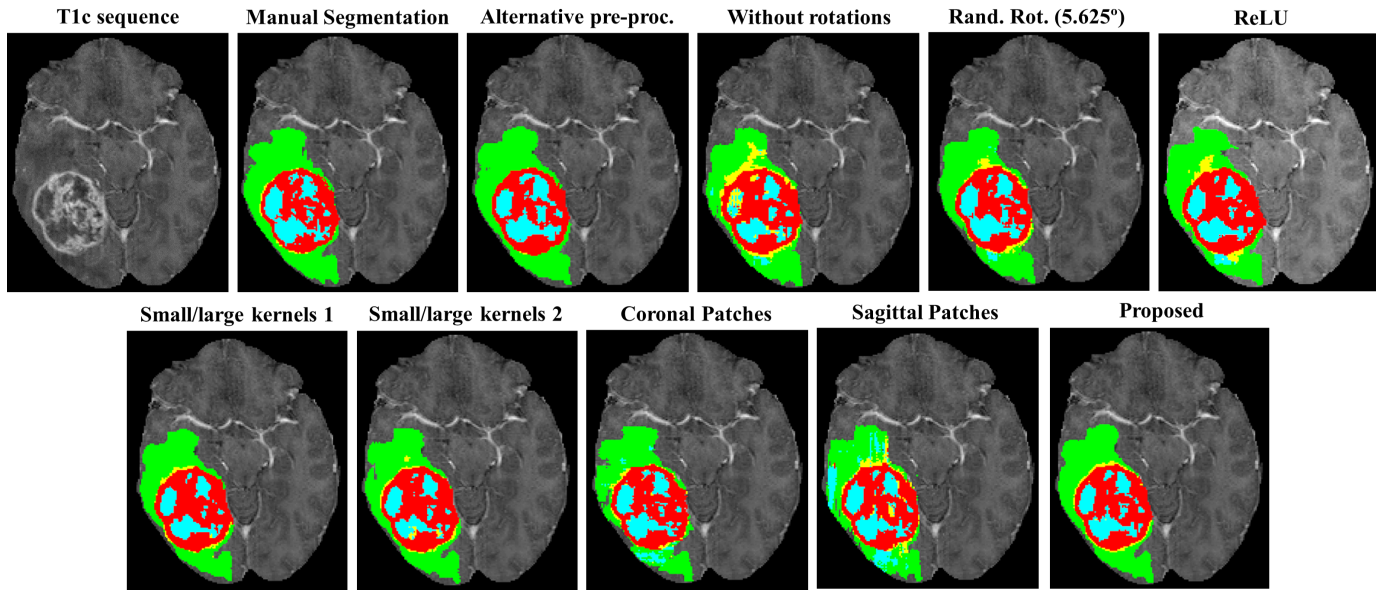
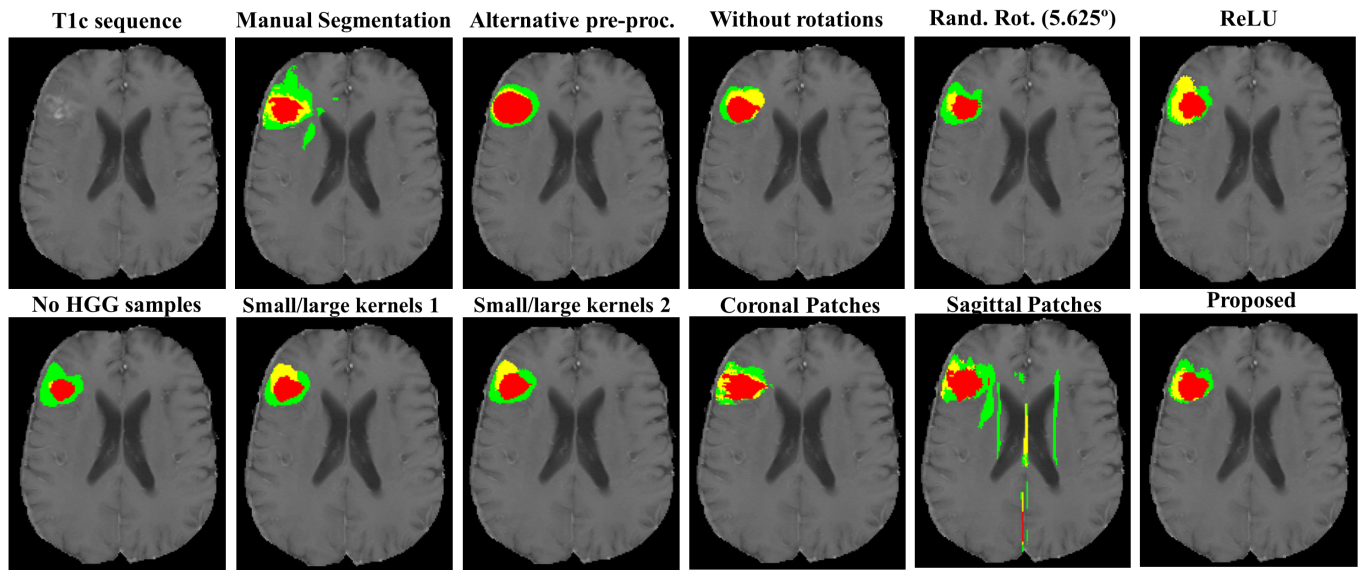


Fig. 3: Boxplot for each of the experiments in Table IV in the Challenge data set. The diamond marks the mean.



(a)



(b)

Fig. 4: Examples of segmentations obtained with cross-validation, showing the effect of each component of the proposed method. In the first row, we have a HGG, and in the bottom row a LGG. Each color represents a tumor class: green – edema, blue – necrosis, yellow – non-enhancing tumor and red – enhancing tumor.

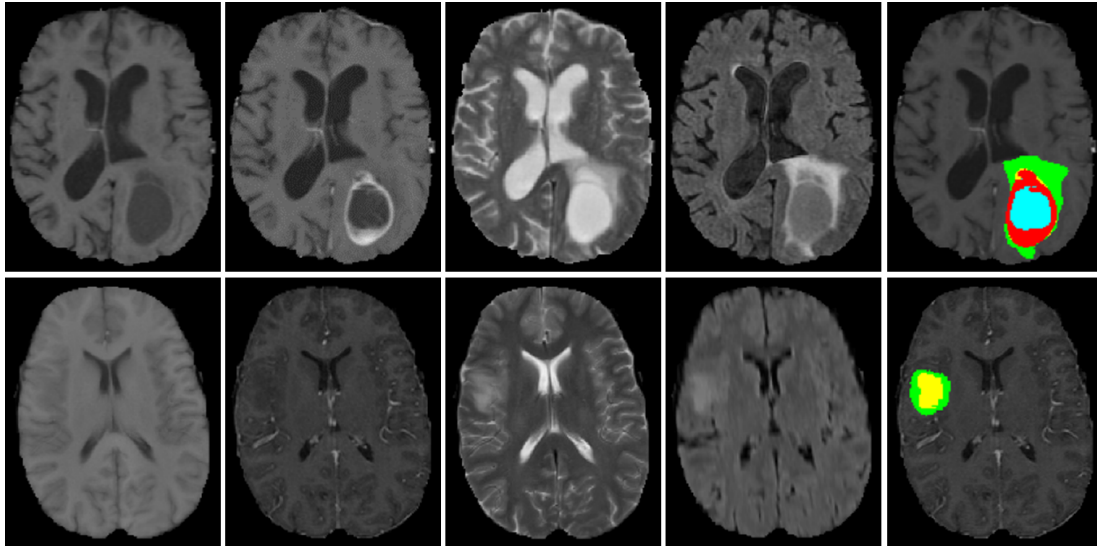


Fig. 5: Examples of segmentations in the Leaderboard data set, showing a HGG in the first row (subject id: 210) and a LGG in the bottom row (subject id: 105). From left to right: T1, T1c, T2, FLAIR, and the segmentation. Each color represents a tumor class: green – edema, blue – necrosis, yellow – non-enhancing tumor, and red – enhancing tumor.

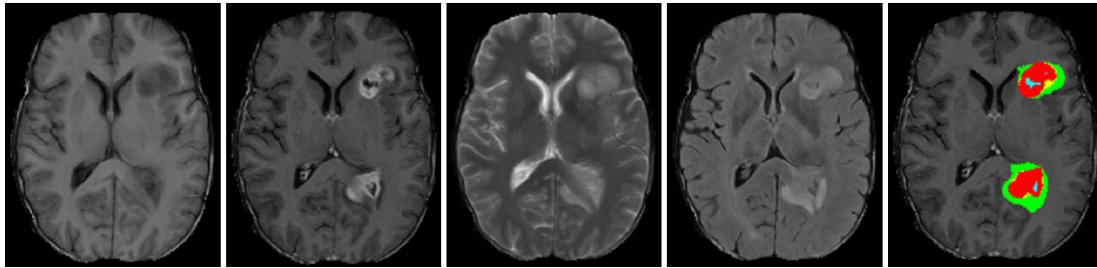


Fig. 6: Examples of segmentations in the Challenge data set (subject id: 310). From left to right: T1, T1c, T2, FLAIR, and the segmentation. Each color represents a tumor class: green – edema, blue – necrosis, yellow – non-enhancing tumor, and red – enhancing tumor.

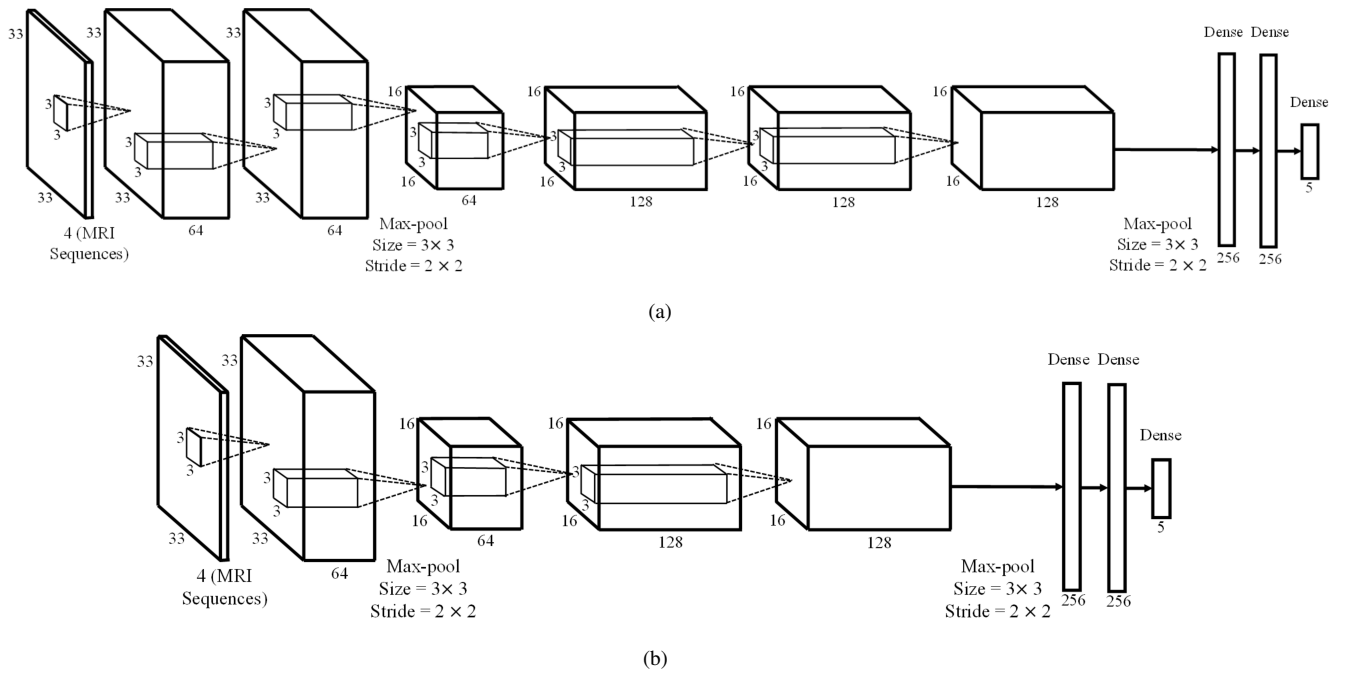


Fig. 8: Graphical architectures of the CNN for a) HGG and b) LGG.

TABLE VI: Study of artificial data augmentation using rotations of the patches. In each test, just the referred component was modified in the Proposed method. Results in bold represent metrics with p -value < 0.05 computed with the two-sided paired Wilcoxon Signed-Rank Test when comparing the results with each component of the Proposed method in each grade or combination of grades; underlined results represent the one with the highest metric for each region in each grade or combination of grades.

Dataset	Method	Grade	DSC			PPV			Sensitivity		
			Complete	Core	Enhancing	Complete	Core	Enhancing	Complete	Core	Enhancing
Leaderboard	Proposed	HGG	<u>0.88</u>	0.76	0.73	0.91	<u>0.90</u>	0.72	0.86	0.74	0.81
		LGG	<u>0.65</u>	0.53	0.00	<u>0.54</u>	<u>0.42</u>	0.00	0.86	0.86	0.00
		Combined	<u>0.84</u>	0.72	<u>0.62</u>	0.85	<u>0.82</u>	0.60	0.86	0.76	0.68
	Using no rotations	HGG	0.87	<u>0.77</u>	0.73	0.86	0.83	0.70	0.89	0.78	<u>0.83</u>
		LGG	0.47	0.31	0.00	0.39	0.25	0.00	0.68	0.66	0.00
		Combined	0.80	0.69	0.61	0.78	0.74	0.59	0.85	0.76	<u>0.70</u>
	Totally random rotations	HGG	0.86	0.76	0.73	0.92	0.84	0.75	0.83	0.75	0.77
		LGG	0.63	0.49	0.00	0.50	0.39	0.00	<u>0.92</u>	0.84	0.00
		Combined	0.84	0.70	0.60	0.83	0.79	0.58	<u>0.87</u>	0.72	0.69
	Random rotations (90°/4)	HGG	0.87	<u>0.77</u>	<u>0.74</u>	0.93	<u>0.90</u>	0.76	0.84	0.76	0.78
		LGG	0.64	<u>0.54</u>	0.00	0.51	<u>0.42</u>	0.00	0.91	<u>0.89</u>	0.00
		Combined	0.83	<u>0.73</u>	<u>0.62</u>	0.86	<u>0.82</u>	0.64	0.85	0.78	0.65
	Random rotations (90°/8)	HGG	0.87	<u>0.77</u>	<u>0.74</u>	0.92	0.88	0.79	0.84	0.76	0.78
		LGG	0.57	0.45	0.00	0.43	0.34	0.00	<u>0.92</u>	<u>0.89</u>	0.00
		Combined	0.82	0.72	<u>0.62</u>	0.84	0.80	0.67	0.85	0.78	0.65
	Random rotations (90°/16)	HGG	0.87	<u>0.77</u>	<u>0.74</u>	0.92	0.89	0.76	0.84	0.76	0.79
		LGG	0.62	0.49	0.00	0.49	0.38	0.00	0.91	0.87	0.00
		Combined	0.83	0.72	<u>0.62</u>	0.85	0.81	0.64	0.85	0.78	0.66
	Random rotations (90°/32)	HGG	0.86	0.76	0.73	<u>0.93</u>	0.84	0.74	0.82	0.75	0.77
		LGG	0.54	0.42	0.00	0.41	0.32	0.00	<u>0.92</u>	0.84	0.00
		Combined	0.81	0.71	0.61	0.84	0.76	0.62	0.84	0.76	0.64
Challenge	Proposed	HGG	<u>0.88</u>	<u>0.83</u>	<u>0.77</u>	0.88	<u>0.87</u>	0.74	0.89	0.83	0.81
	Using no rotations	HGG	0.85	0.79	0.74	0.81	0.78	0.70	0.91	0.86	<u>0.82</u>
	Totally random rotations	HGG	0.87	<u>0.83</u>	<u>0.77</u>	0.85	0.87	0.74	0.89	0.82	<u>0.82</u>
	Random rotations (90°/4)	HGG	<u>0.88</u>	0.82	0.76	<u>0.90</u>	0.85	<u>0.77</u>	0.86	0.83	0.77
	Random rotations (90°/8)	HGG	<u>0.88</u>	0.82	0.75	0.89	0.83	0.76	0.87	0.83	0.77
	Random rotations (90°/16)	HGG	<u>0.88</u>	0.82	0.76	<u>0.90</u>	0.84	0.76	0.86	0.84	0.78
	Random rotations (90°/32)	HGG	<u>0.88</u>	<u>0.83</u>	0.76	<u>0.90</u>	0.84	0.76	0.86	0.84	0.78