Explanation-driven Cyclic Learning for High-Quality Brain MRI Reconstruction from Unknown Degradation*
Supplementary Material

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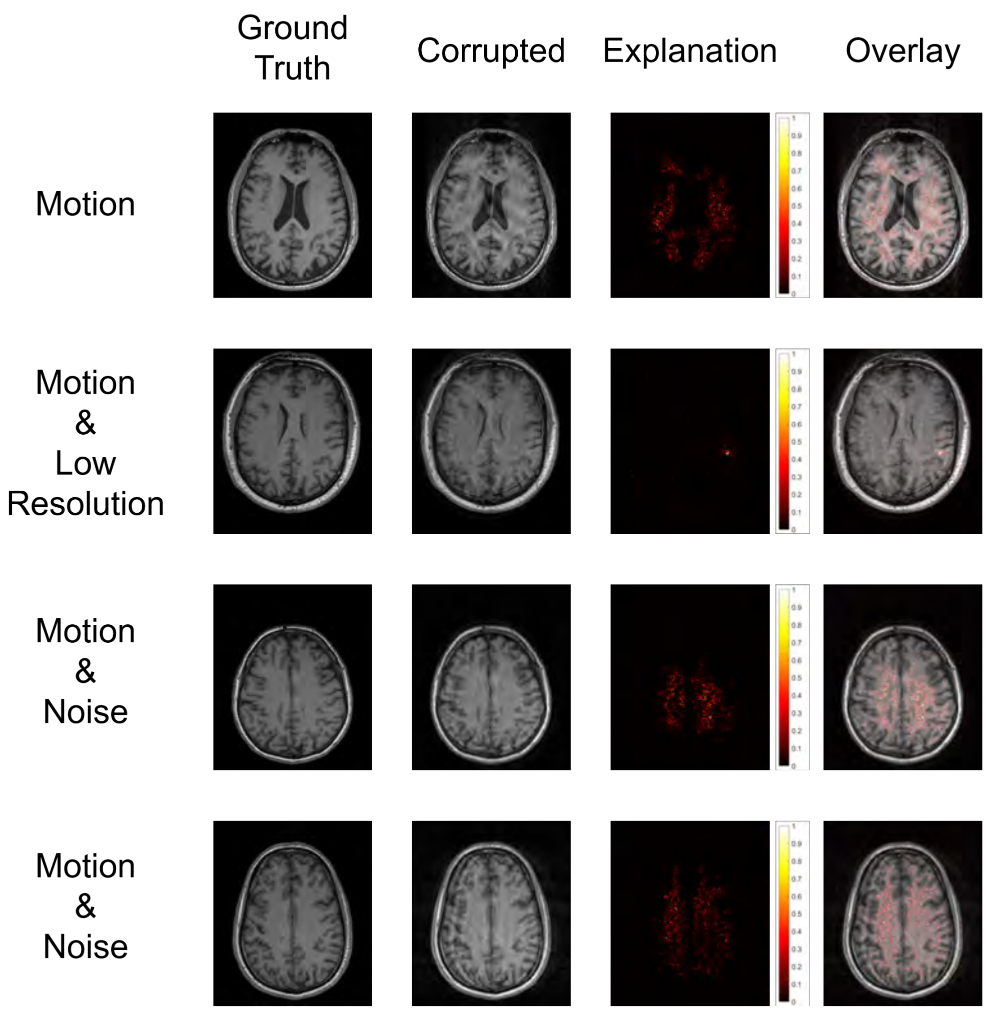

Fig. 1. Visualization of explanations generated by our proposed CAG. The larger the explanation value, the more the pixel at that location contributes to the degradation type classification result. Pixels with artefacts or blurred locations receive more attention.

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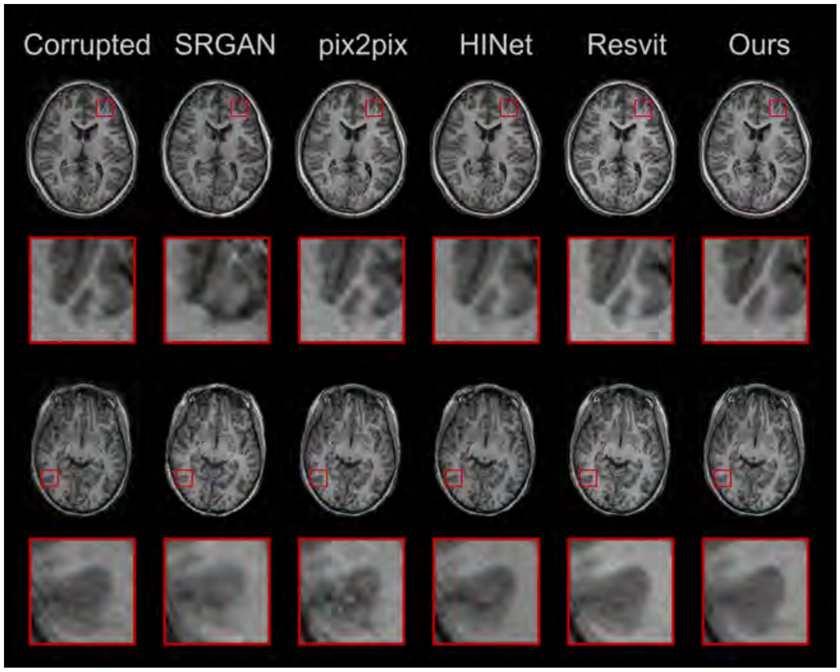

Fig. 2. Qualitative assessments of reconstructions on real motion data. Our method effectively removes motion artefacts while producing a sharper reconstruction than other methods.

Table 1. Degradation simulation strategies for five sources of degradation at different levels. The simulations are performed in the 3D k-space. We generate head motion by translations and rotations of a random sampling of phase-encoding lines. For the simulated low-resolution volumes, we cropped data and only kept data points in a central low-frequency region, and all the peripheral data points were zeroed out, degrading the image quality but leaving the image size unchanged. Besides, noisy images are simulated by adding white Gaussian noise to data points, and two mixed degradations are simulated by simultaneously corrupting the phase-encoding lines and data points.

Degradation Simulation Strategy							
Degradation Type	Degradation Level	Phase-Encoding Lines (in 3D k-space)				Data Points (in 3D k-space)	
		Corrupting Percentage (%)	Preserved Central Lines (%)	Translation (voxel)	Rotation (°)	Kept Central points (%)	Peripheral points
Motion	Mild	(10,30)	(-3.5,+3.5)	(-7,+7)	(-3,+3)	100	–
	Normal	(10,40)	(-3.5,+3.5)	(-10,+10)	(-5,+5)	100	–
Low Resolution	Downsample 2	0	–	–	–	25	zeroed out
	Downsample 3	0	–	–	–	11.1	zeroed out
	Downsample 4	0	–	–	–	6.25	zeroed out
Noise	Level 1	0	–	–	–	0	added white Gaussian noise noise_power = 100
	Level 2	0	–	–	–	0	added white Gaussian noise noise_power = 400
	Level 3	0	–	–	–	0	added white Gaussian noise noise_power = 1000
Motion & Noise	–	(10,30)	(-3.5,+3.5)	(-7,+7)	(-3,+3)	0	added white Gaussian noise noise_power = 400
Motion & Low Resolution	–	(10,30)	(-3.5,+3.5)	(-7,+7)	(-3,+3)	25	zeroed out