

Supplementary

Appendix 1: Supplementary methods

ACS-cine sequence: the ACS-cine is based on bSSFP sequence. In terms of data acquisition, the time-space sampling k-space undersampling scheme of this technology adopts a uniquely designed Latin hypercube sampling strategy (9). Based on the traditional Latin hypercube method, through variable spatial-temporal and echo-sharing function, the minimization of fluctuations in the time-space distribution under constrained conditions is achieved (11). The sequence diagram of Conv-Cine and ACS-Cine is shown in Figure S1. ACS-cine uses a deep-learning neural network called residual convolutional recurrent neural network (Res-CRNN) (10). This network has the ability to learn the temporal information of cardiac cine images to reconstruct high-quality cardiac cine images from highly undersampled MRI k-space data. This network emulates the iterative reconstruction workflow via a cascade of 5 sub-networks. Each sub-network features bidirectional convolutional GRU layers to capture temporal correlations across cardiac phases, 2D convolutional layers to refine spatial anatomical details, and a data consistency layer to guarantee consistency with actually acquired raw data (9,15). Residual connections enable the network to effectively learn fine high-frequency structures. This model was trained on 1,610 clinical cine datasets with a combined loss of mean squared error and structural similarity (SSIM).

In addition, the special design of the Res-CRNN of ACS-cine, completing the whole reconstruction in one single forward pass and drastically shortening reconstruction time, enables low-latency image reconstruction, significantly reduces memory consumption and accelerates the reconstruction process (9). Moreover, through AI-enabled online MOCO, respiratory motion artifacts caused by free breathing are reduced (14).

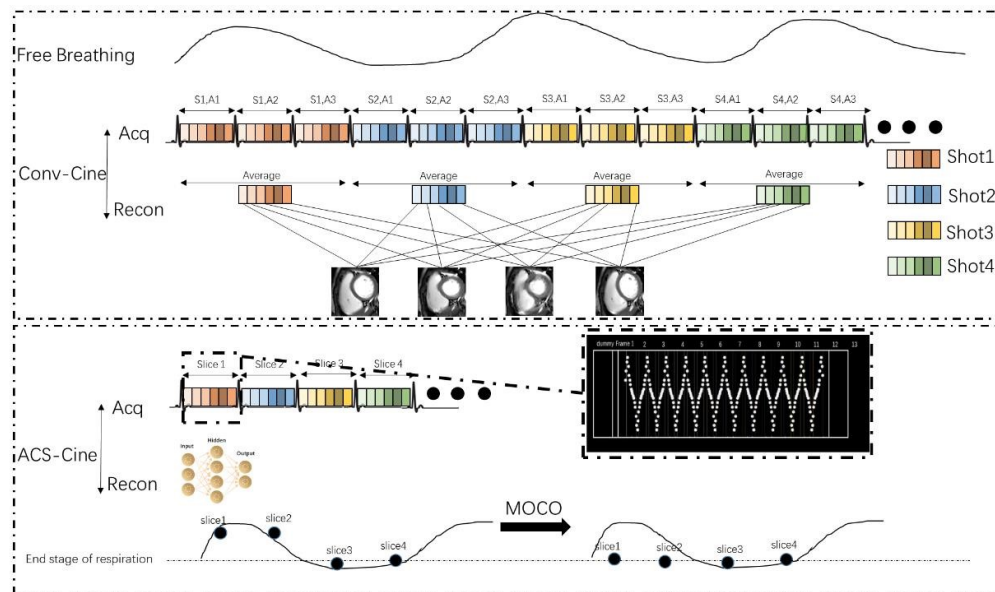


Figure S1 The sequence diagram of Conv-cine and ACS-cine. Acq, acquisition; ACS, artificial intelligence-assisted compressed sensing; Conv-cine, conventional cine; MOCO, motion correction; Recon, reconstruction.