Appendix I. Proof of the low-rank property between frames

Let $\mathbf{u}_{r,t}$ represents the dynamic image of the r-th coil at the t-th time frame, $\mathbf{u}_t$ is the coil-combined data. According to [9, 10], there exists $\mathbf{w}_t$ such that $\mathbf{u}_t \cdot \mathbf{w}_t = 0$, meaning $\mathbf{u}_1 \cdot \mathbf{w}_1 + \mathbf{u}_2 \cdot \mathbf{w}_2 + ... + \mathbf{u}_n \cdot \mathbf{w}_n = 0$. In a general scenario, for t_i and t_j, we have:

$$
\begin{aligned}
& \mathbf{u}_{i,t_i} \cdot \mathbf{S}_j \cdot \mathbf{w}_{t_i} + \mathbf{u}_{j,t_j} \cdot \mathbf{S}_i \cdot \mathbf{w}_{t_j} \\
= \; & \mathbf{S}_j \cdot \mathbf{S}_i (\mathbf{u}_{t_i} \cdot \mathbf{w}_{t_i} + \mathbf{u}_{t_j} \cdot \mathbf{w}_{t_j}) \\
= \; & \mathbf{S}_j \cdot \mathbf{S}_i \cdot 0 \\
= \; & 0
\end{aligned}
$$

So,

$$
\hat{\mathbf{u}}_{i,t_i} \cdot \hat{\mathbf{S}}_j \cdot \mathbf{w}_{t_i} + \hat{\mathbf{u}}_{j,t_j} \cdot \hat{\mathbf{S}}_i \cdot \mathbf{w}_{t_j} = 0
$$

$$
H(\hat{\mathbf{u}}_{i,t_i}, \hat{\mathbf{u}}_{j,t_j}) \begin{bmatrix} \hat{\mathbf{S}}_j \cdot \mathbf{w}_{t_i} \\ \hat{\mathbf{S}}_i \cdot \mathbf{w}_{t_j} \end{bmatrix} = 0
$$

Appendix II. Derivation of Perturbation Kernel

Based on Eqs. 5 and the SDE theory in [22], the perturbation kernel of the proposed SDE can be expressed as:

$$
p_{0t}(\mathbf{x}(t) \mid \mathbf{x}(0)) = \mathcal{N}(\mathbf{x}(t); e^{\frac{1}{2}\int_0^t \eta(s)\Phi ds}\mathbf{x}(0), \frac{1}{2}\int_0^t \beta(\tau)(e^{\int_\tau^t \eta(s)\mathrm{d}s}\mathrm{d}\tau e^{\Phi}\Omega_\Phi(e^{\Phi}\Omega_\Phi)^*), \quad t \in (0,1]
$$

By applying the Taylor expansion, the mean value μ is determined as:

$$
\begin{aligned}
\mu &= e^{\frac{1}{2}\int_0^t \eta(s)\Phi \mathrm{d}s}\mathbf{x}(0) \\
&= \left(\mathbf{I} + \frac{1}{2}\int_0^t \eta(s)\Phi \mathrm{d}s + \frac{1}{2!}\left(\frac{1}{2}\int_0^t \eta(s)\Phi \mathrm{d}s\right)^2 + \frac{1}{3!}\left(\frac{1}{2}\int_0^t \eta(s)\Phi \mathrm{d}s\right)^3 + \cdots\right)\mathbf{x}(0) \\
&= \mathbf{x}(0).
\end{aligned}
$$

we denote $\sigma = \sqrt{\frac{1}{2}\int_0^t \beta(\tau) e^{\int_\tau^t \eta(s)ds} d\tau}$, the standard deviation of the perturbation kernel is expressed as:

$$
\mathbf{\Sigma}^{\frac{1}{2}} = \sigma \cdot e^{\Phi}\Omega_\Phi(\mathbf{I}) = \sigma \cdot (\mathbf{I} + \Phi + \frac{1}{2!}\Phi^2 + \frac{1}{3!}\Phi^3 + \cdots)\Omega_\Phi(\mathbf{I}) = \sigma \cdot \Omega_\Phi(\mathbf{I})
$$

So,

$$
p_{0t}(\mathbf{x}(t) \mid \mathbf{x}(0)) = \mathcal{N}(\mathbf{x}(t); \mathbf{x}(0), \sigma^2 \Omega_\Phi {\Omega_\Phi}^*(\mathbf{I})), \quad t \in (0,1]
$$

Appendix III. Visual results of systole image

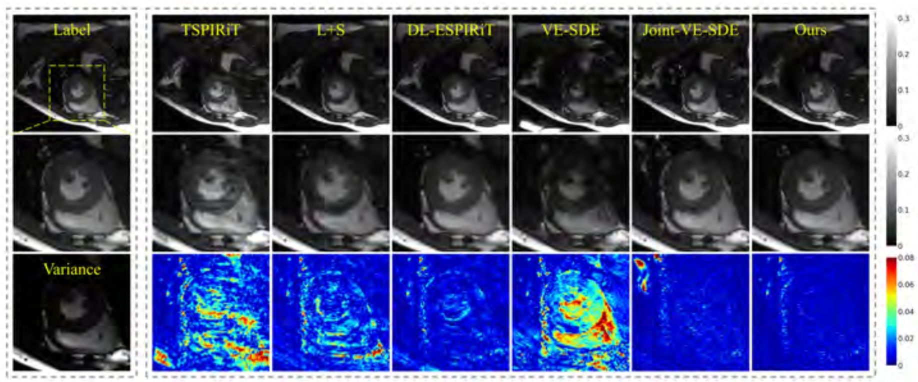

Fig. 1. Visualization of systole image at R = 12.