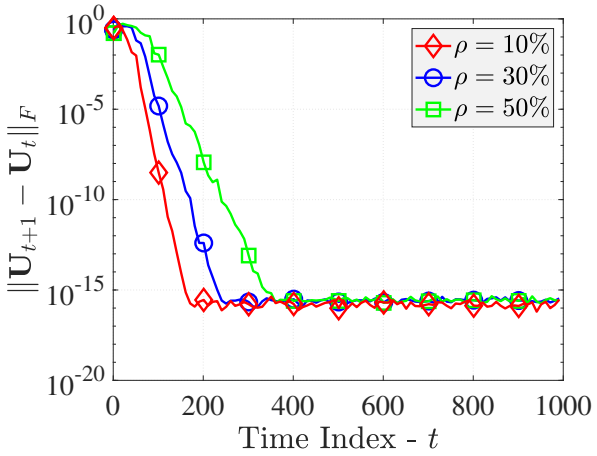
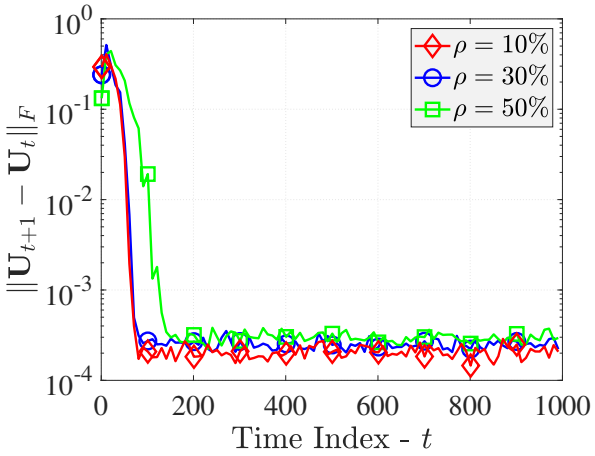
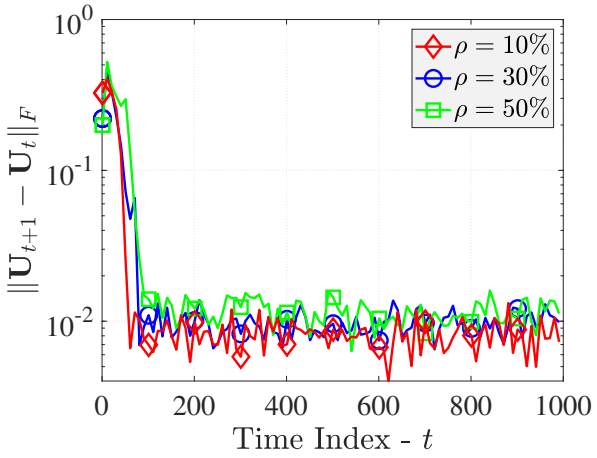
Supplemental Information



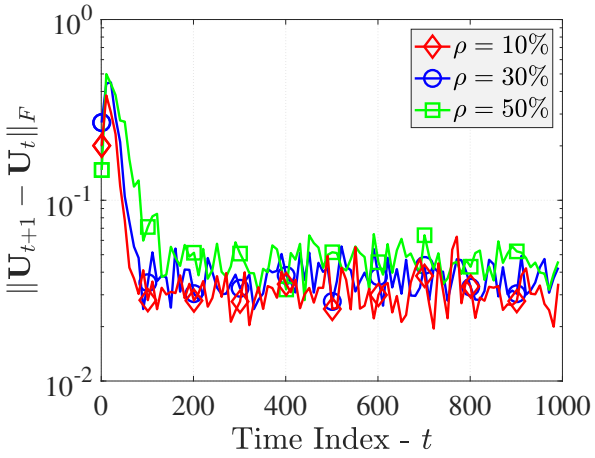
(a) Noise-Free & $\alpha = 0$.



(b) $\sigma = 10^{-3}$ & $\alpha = 0$.

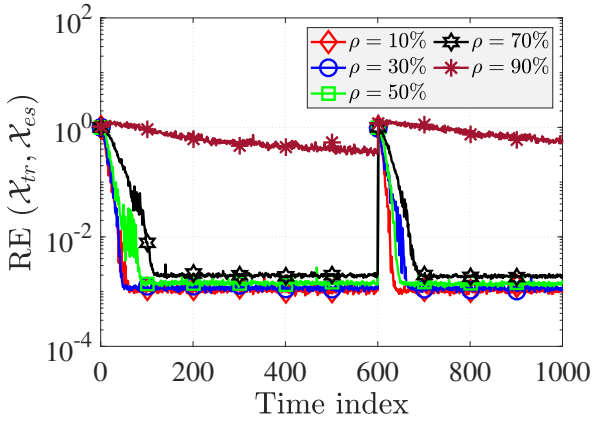


(c) $\sigma = 10^{-3}$ & $\alpha = \frac{\pi}{360}$.

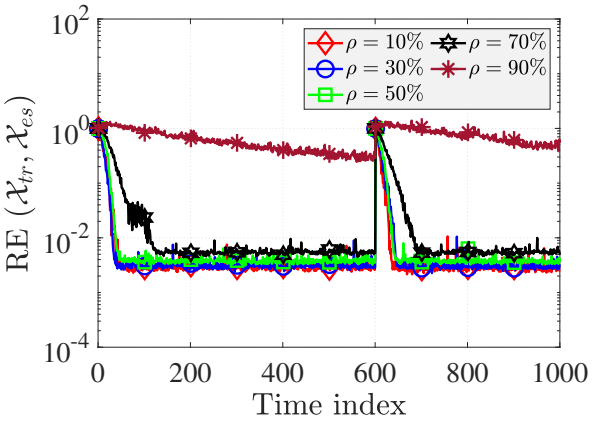


(d) $\sigma = 10^{-3}$ & $\alpha = \frac{\pi}{90}$.

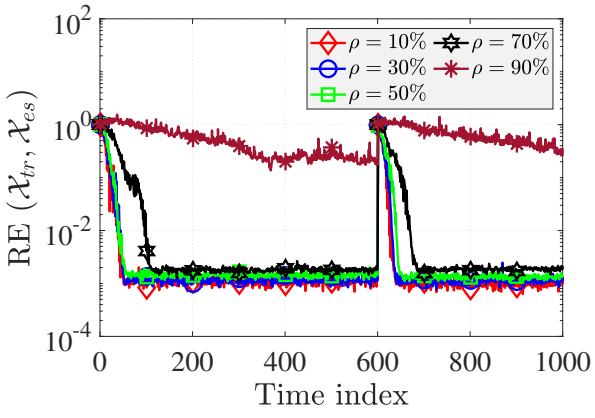
Fig. S1 – Convergence of ACP in terms of the variation $\|\mathbf{U}_{t+1} - \mathbf{U}_t\|_F$: On a synthetic tensor whose size is $20 \times 20 \times 20 \times 1000$ and its CP rank 5.



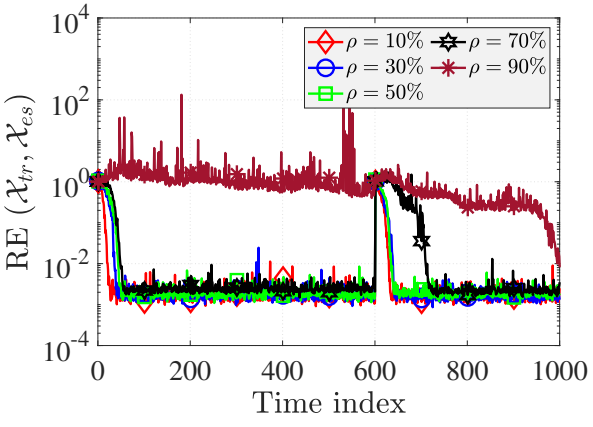
(a) Tensor $20 \times 20 \times 1000$ with rank $r = 5$ and $\sigma_n = 10^{-3}$



(b) Tensor $20 \times 20 \times 1000$ with rank $r = 5$ and $\sigma_n = 10^{-2}$

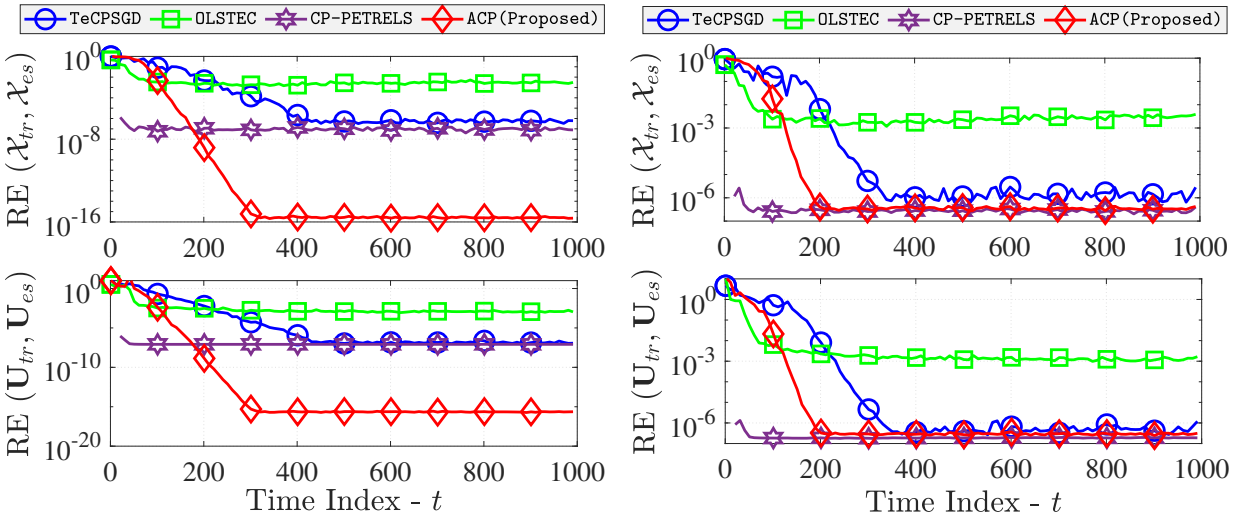


(c) Tensor $20 \times 20 \times 20 \times 1000$ with rank $r = 5$ and $\sigma_n = 10^{-3}$



(d) Tensor $20 \times 20 \times 20 \times 1000$ with rank $r = 5$ and $\sigma_n = 10^{-2}$

Fig. S2 – Effect of missing data on the performance of ACP with different levels of missing density from 10% to 90%.



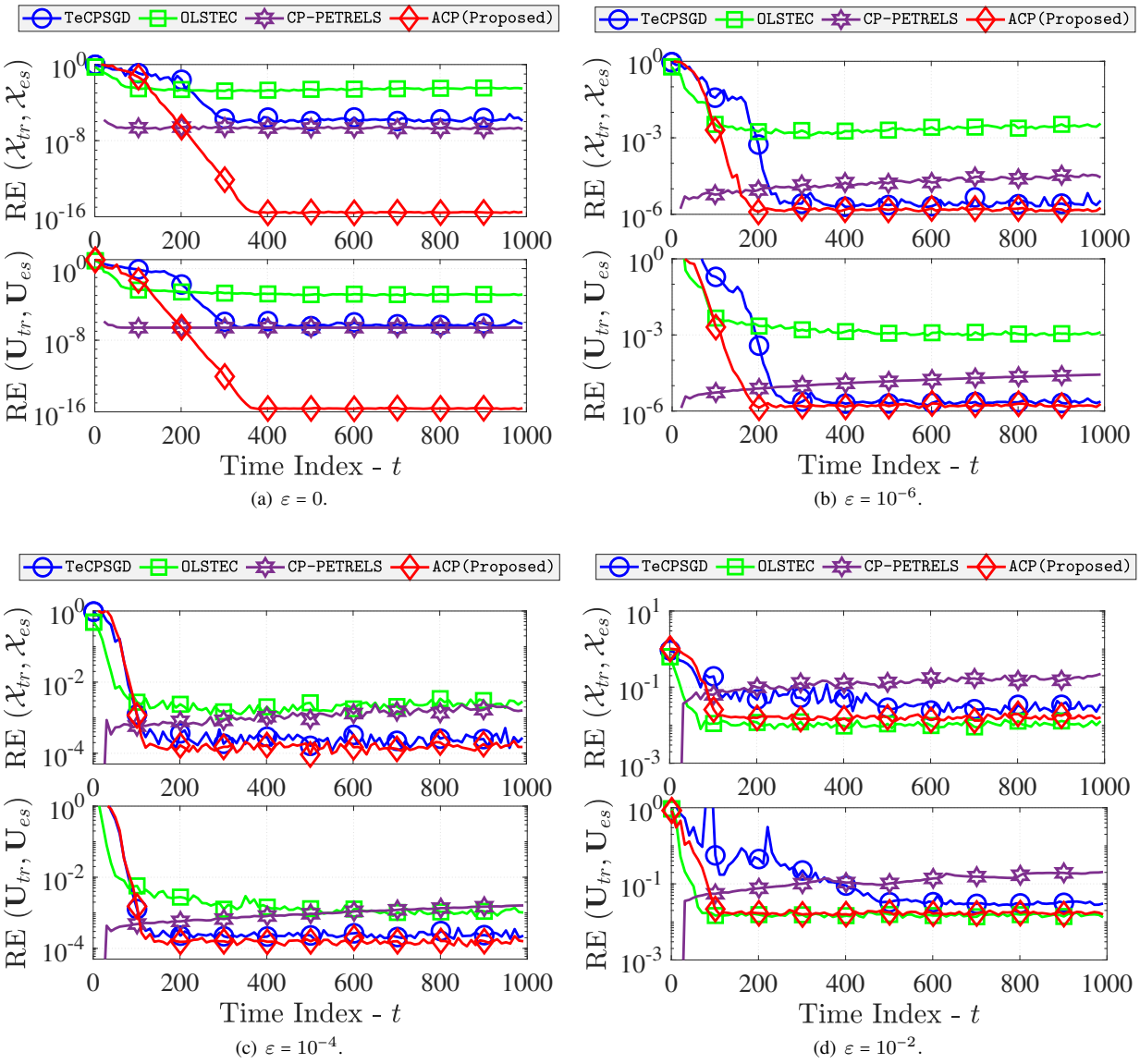
(a) Noise-Free.

(b) The noise level $\sigma = 10^{-6}$.

(c) The noise level $\sigma = 10^{-4}$.

(d) The noise level $\sigma = 10^{-2}$.

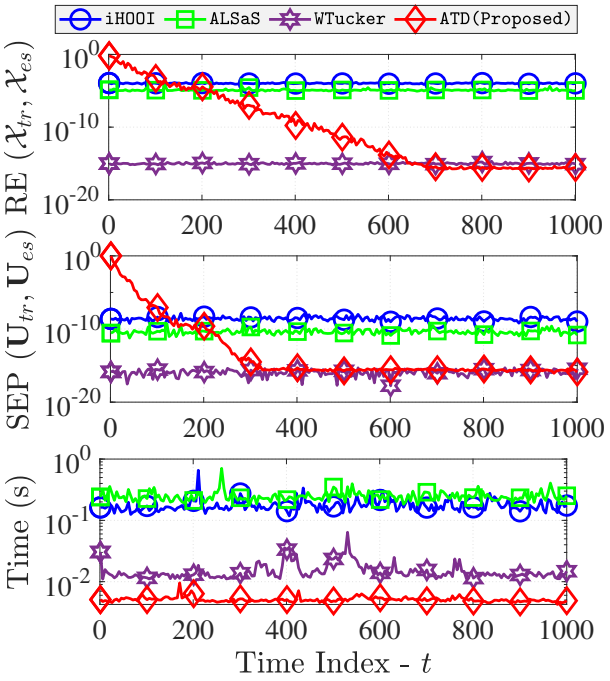
Fig. S3 – Performance of adaptive CP decompositions versus the noise level: On a static tensor whose size is $20 \times 20 \times 20 \times 1000$ and its CP rank 5; 50% observations are missing.



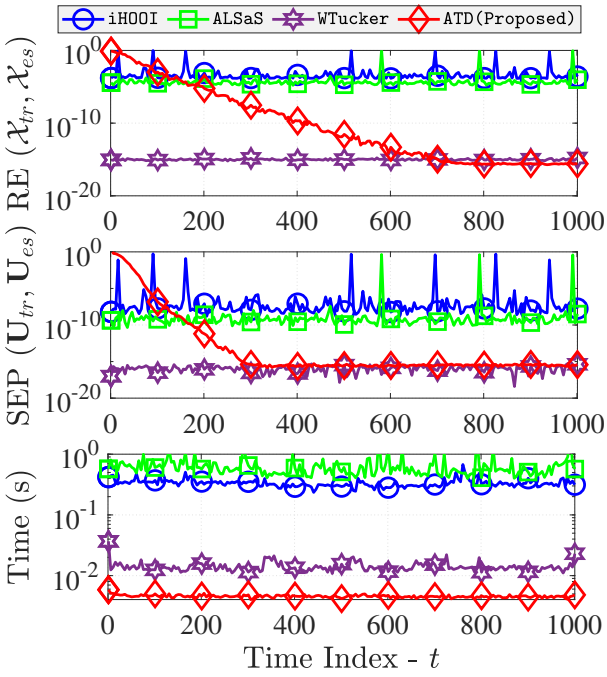
(a) $\varepsilon = 0$. (b) $\varepsilon = 10^{-6}$.

(c) $\varepsilon = 10^{-4}$. (d) $\varepsilon = 10^{-2}$.

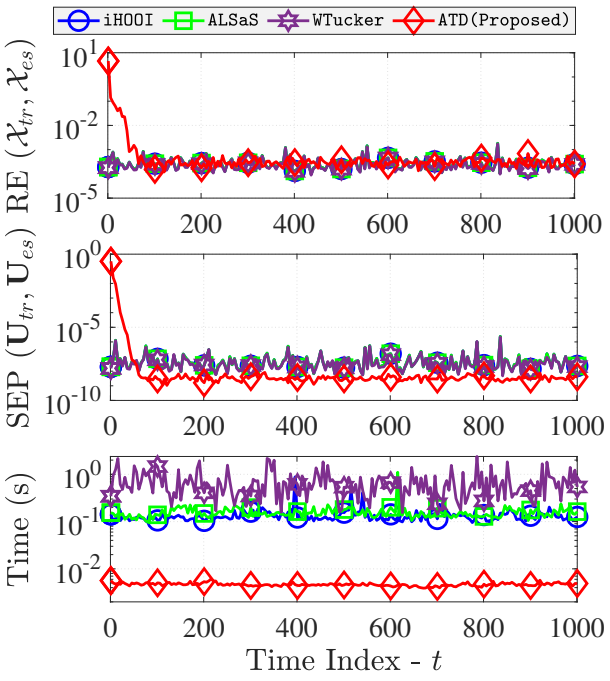
Fig. S4 – Performance of adaptive CP decompositions versus the time-varying factor ε: On a free-noise tensor whose size is $20 \times 20 \times 20 \times 1000$ and its CP rank 5; 90% observations are missing.



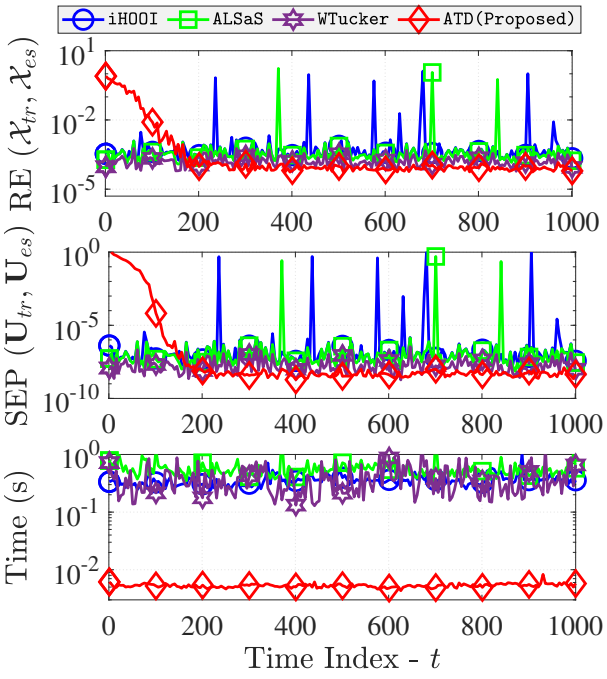
(a) Noise-free & 10% observations are missing.



(b) Noise-free & 70% observations are missing.

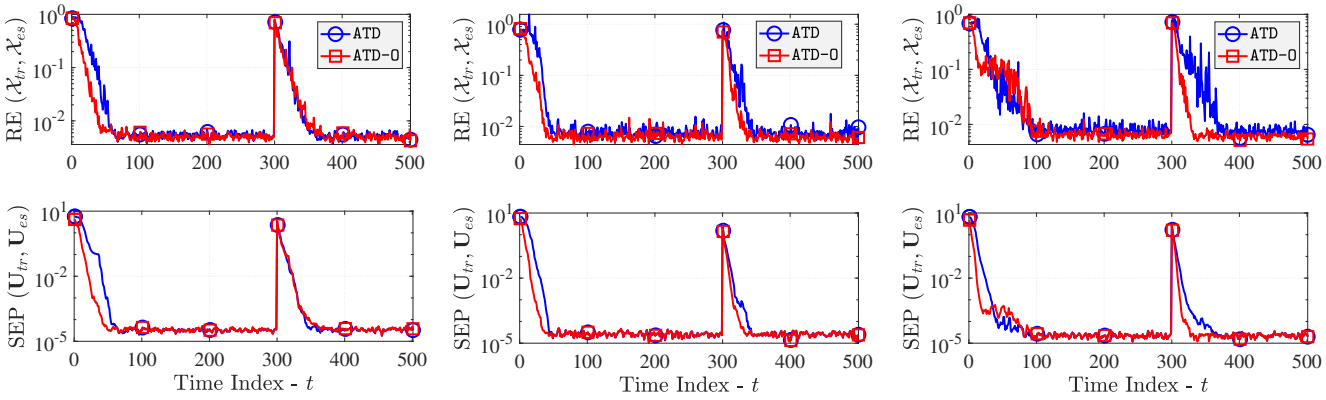


(c) The noise level $\sigma = 10^{-2}$ & 10% observations are missing.



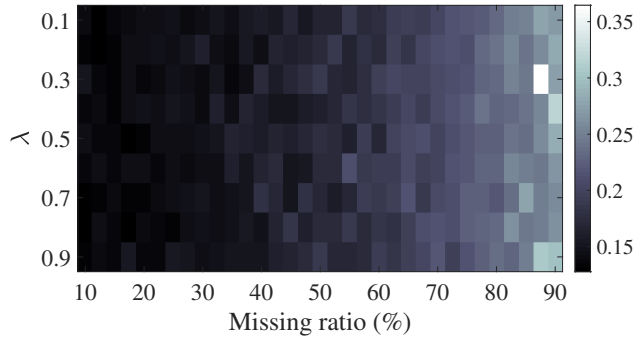
(d) The noise level $\sigma = 10^{-2}$ & 70% observations are missing.

Fig. S5 – Performance of Tucker decompositions for tensor completion: On a synthetic tensor whose size is $20 \times 20 \times 20 \times 1000$ and its Tucker rank $[3, 3, 3, 3]$.

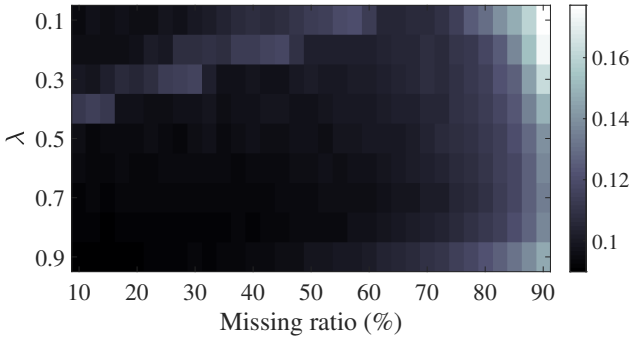


(a) The 3-order tensor. (b) The 4-order tensor. (c) The 5-order tensor.

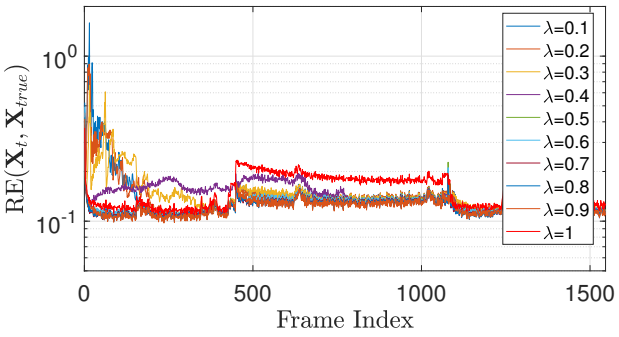
Fig. S6 – Performance comparison between the unconstrained ATD and orthogonal ATD: 30% observations are missing, the noise level $\sigma = 10^{-3}$ and the time-varying factor $\varepsilon = 10^{-3}$.



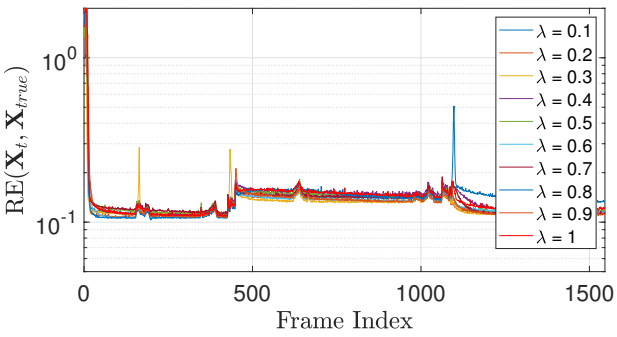
(a) ACP: Averaged Reconstruction Error



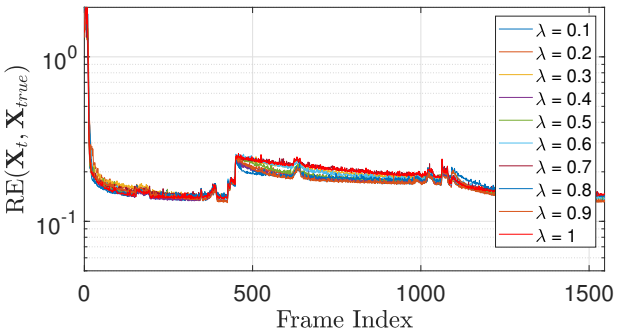
(b) ATD: Averaged Reconstruction Error



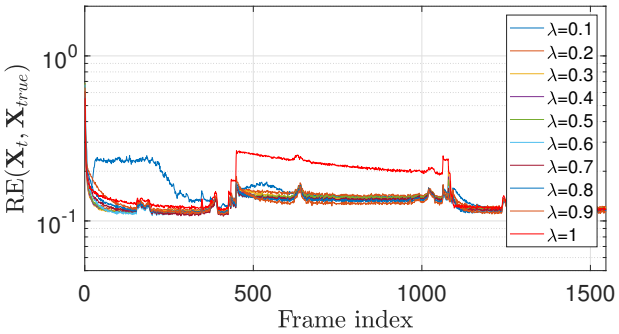
(c) ACP: full observations



(d) ATP: full observations

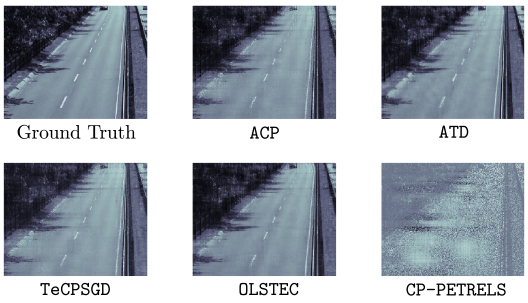


(e) ACP: 50% observations

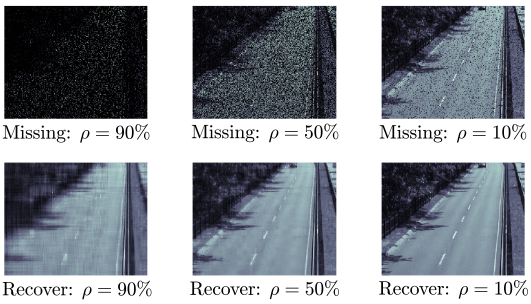


(f) ATD: 50% observations

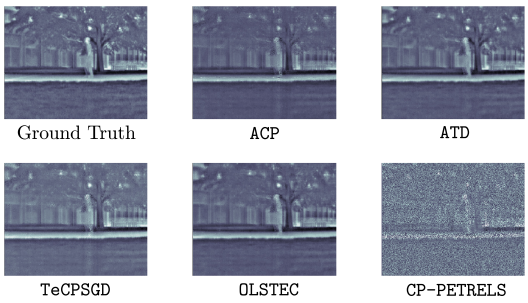
Fig. S7 – Effect of the forgetting factor λ on the video completion accuracy of ACP and ATD on `Lobby` data.



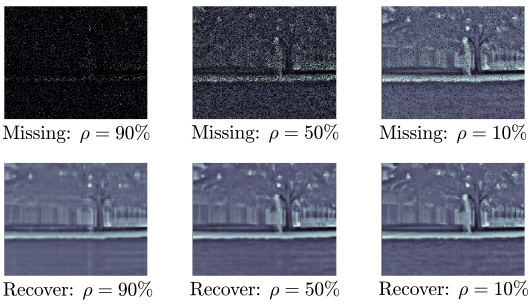
(a) `Highway` video: 50% missing.



(b) `Highway` video: ATD.

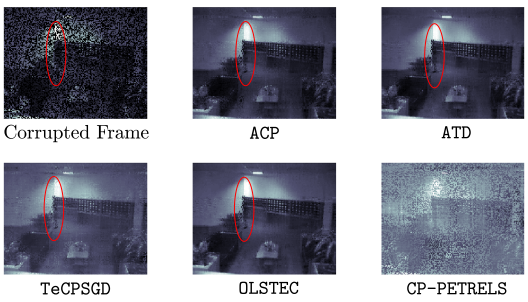


(c) `Park` video: 50% missing.

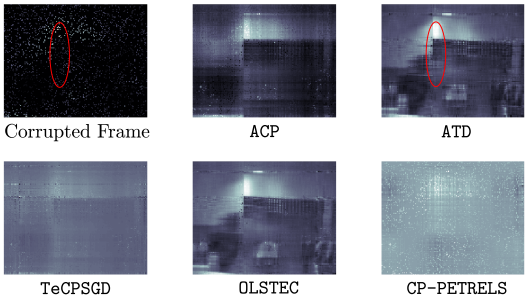


(d) `Park` video: ATD.

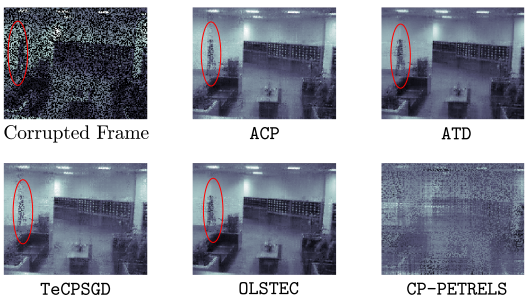
Fig. S8 – Performance of adaptive tensor decompositions on surveillance video sequences.



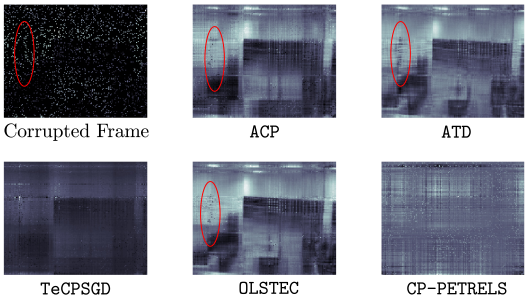
(a) 1018-th Video Frame: 50% missing.



(b) 1018-th Video Frame: 90% missing.

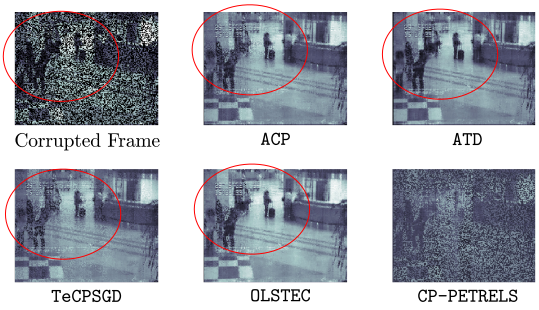


(c) 1246-th Video Frame: 50% missing.

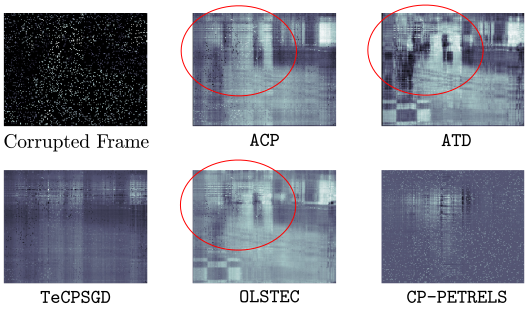


(d) 1246-th Video Frame: 90% missing.

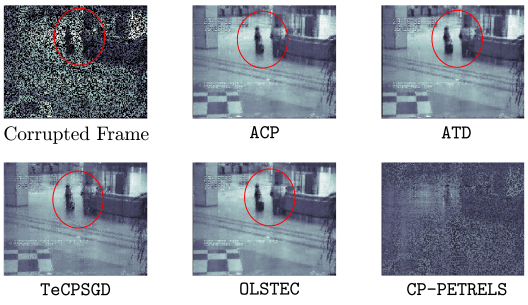
Fig. S9 – Performance of adaptive tensor decompositions on `Lobby` data.



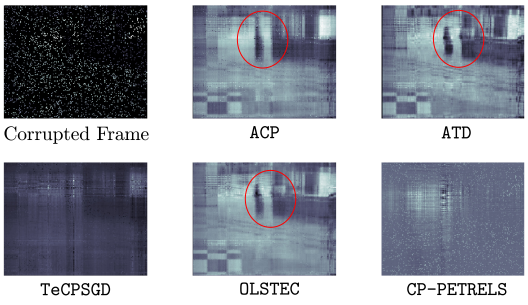
(a) 2009-th Video Frame: 50% missing.



(b) 2009-th Video Frame: 90% missing.



(c) 3000-th Video Frame: 50% missing.



(d) 3000-th Video Frame: 90% missing.

Fig. S10 – Performance of adaptive tensor decompositions on `Hall` data.