Selective Erasures for High-Dimensional Robust Subspace Tracking

Daniel Pimentel-Alarcón
Georgia State University
Computer Science

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Subspace Tracking

Low-Rank
Subspace Tracking

Low-Rank
Subspace Tracking

Low-Rank
Subspace Tracking

Low-Rank
Subspace Tracking

Low-Rank
Subspace Tracking

Low-Rank

L
Low-Rank

Subspace Tracking
Subspace Tracking

Low-Rank
Robust Subspace Tracking

$L + S$

Low-Rank, Sparse
What is this good for?
Lots of Applications
Background segmentation
Update = \( U + \left( (\cos(\sigma \eta) - 1) \frac{\hat{u}}{\|\hat{u}\|} + \sin(\sigma \eta) \frac{r}{\|r\|} \right) \frac{\theta^T}{\|\theta\|} \)

Existing theory

Forget about errors for a second…
Existing theory

Forget about errors for a second…

Update = \( U + \left( (\cos(\sigma \kappa) - 1) \frac{\hat{u}}{\|\hat{u}\|} + \sin(\sigma \kappa) \frac{r}{\|r\|} \right) \frac{\theta^T}{\|\theta\|} \)
Existing theory

Now with sparse errors…
Existing theory

Too many errors?
Selective Erasures

Our solution
Main Idea

Remove coordinates that don’t help
Main Idea

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Main Idea

Remove coordinates that don’t help
Main Idea
Remove coordinates that don’t help
Main Idea
Recover full column
Main Idea

Recover full column

- $\mathbf{U}_\omega \theta = \mathbf{x}_\omega$
- $\theta = (\mathbf{U}_\omega^T \mathbf{U}_\omega)^{-1} \mathbf{U}_\omega^T \mathbf{x}_\omega$
- $\mathbf{u} = \mathbf{U} \theta$
Main Idea
Update Subspace as Before
WOW, AMAZING

PLEASE TELL ME MORE
Detecting Outliers
(The lighter the better)
Detecting Outliers

Error

Fraction of Outliers

Error

Fraction of Outliers

Detecting Outliers
Subspace Tracking

Error

40% of Outliers

50% of Outliers

90% of Outliers

Time

Error

Time

Time
Drawbacks?
No reason why it should work!

Drawbacks?
Drawbacks?

Still room for improvement
Thank you!

pimentel@gsu.edu
https://danielpimentel.github.io