Introduction
- Re-interpret compressible SfM as a Block Sparse Dictionary Learning (BSDL) problem
- Theoretically characterize the uniqueness of BSDL
- Utilize the uniqueness of BSDL to recover the camera motion and 3D structures

NRSFIM = BSDL?

\[
S^t = \begin{bmatrix} \begin{array}{ccc} x_{11} & y_{11} & z_{11} \\ \vdots & \vdots & \vdots \\ x_{FP} & y_{FP} & z_{FP} \end{array} \end{bmatrix}, \quad S = \begin{bmatrix} \begin{array}{ccc} x_{11} & y_{11} & z_{11} \\ \vdots & \vdots & \vdots \\ x_{FP} & y_{FP} & z_{FP} \end{array} \end{bmatrix}, \quad W = \begin{bmatrix} \begin{array}{ccc} w_{11} & w_{1P} \\ \vdots & \vdots \\ w_{FP} & w_{FP} \end{array} \end{bmatrix}
\]

By assuming the 3D structure \(S^t\) is compressible, we found that the 2D measurement \(W\) is 2-by-3 block compressible.

NRSFIM
- Initialize BSDL by solving relaxed block 1-norm problem using Alternating Direction Method of Multipliers (ADMM)
- Solve BSDL by block K-SVD, block OMP, and block FOCUSS
- Estimate corrective matrix
- Estimate camera motion by enforcing camera consistency
- Estimate 3D structure
- Predict the confidence of the reconstruction by the coherence of the dictionary

Experiments
Performance vs. Rank of 3D structure

Performance vs. Noise

Visual performance

Sequence (a)

Sequence (b)

Sequence (c)

Sequence (d) — failure

Incoherence

Control incoherence

The proposed Dai. et.al

The uniqueness of BSDL

We show that if the dictionary \(B\) satisfies the block spark condition\(^*\), then any feasible block sparse factorization \((\hat{B}, \hat{W})\) of \(W\) satisfies that

\[
\begin{bmatrix} \begin{array}{ccc} C^3 \oplus I_3 \end{array} \end{bmatrix} \hat{B} = \begin{bmatrix} \begin{array}{ccc} \hat{W} \end{array} \end{bmatrix}
\]

\(^*\)Check our paper for definitions and the complete proof.