Symmetric Line Graph Transforms for Inter Predictive Video Coding
Keng-Shih Lu and Antonio Ortega, Signal and Image Processing Institute

Bisymmetry Property for Speedup of GFTs

- Bisymmetric graph Laplacian matrix $L = \begin{pmatrix} A & C \\ C & JAJ \end{pmatrix}$
- Even/odd symmetric eigenvectors
- Computation reduction in the Graph Fourier Transform (GFT)

Symmetric Line Graph Transform (SLGT)

- Tridiagonal and bisymmetric graph Laplacian matrix

Example of a Fast SLGT

- Choose 2 graph Laplacian matrices with fast GFT algorithms
- Obtain $\tilde{L} = \begin{pmatrix} A & CT \\ C & JAJ \end{pmatrix}$, where $A - JC = L_1$ and $A + JC = L_2$
- $\tilde{G} : \begin{pmatrix} 1 & 1 & 1 & 0 & 5 & 1 & 1 & 1 \end{pmatrix}$ (from fast GFT of $L_2$)

Data-Driven SLGT for Video Coding

- Data: 8x8 inter predictive residual blocks
- Convex problem

Conclusions & Future Work

- Potentially useful SLGTs with fast algorithms can be explored based on the bisymmetry property
- We can learn SLGTs close to the KLTs that provide compression gains as compared to DCT. The number of multiplications they require is half of that required by KLT
- Future Work: Symmetries in 2D grids, general symmetric graphs