OPTIMIZED SAMPLING FOR VIEW INTERPOLATION IN LIGHT FIELDS WITH OVERLAPPING PATCHES

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MOTIVATION

dense
(225 samples)

uniform sparse
(64 samples)
RELATED WORK

- Coded sampling with local dictionaries

[Schedl et al., ICCP 2015]

[Schedl et al., CVIU 2017]
RELATED WORK

- Coded sampling with local dictionaries
- Compressed Sensing

[Marwah et al., TOG 2013]  [Cao et al., Opt. Express 2014]
RELATED WORK

- Coded sampling with local dictionaries
- Compressed Sensing
- Depth-based view interpolation
- Learning-based methods

[Kalantari et al., TOG 2016]
RELATED WORK

- Coded sampling with local dictionaries
- Compressed Sensing
- Depth-based view interpolation
- Learning-based methods
- Other

[Shi et al., TOG 2014]

[Vagharshakyan et al., PAMI 2015]
CONTRIBUTIONS

- New sampling quality metric
- A reduced search space for sampling mask estimation
- An enhanced upsampling technique supporting maximal patch overlaps
**SAMPLING QUALITY METRIC**

\[ E_{\text{min}} = d_{\text{min}} \]
SAMPLING QUALITY METRIC

minimum distance

interpolation

extrap.

\[ E_{\text{min}} = d_{\text{min}} \]
SAMPLING QUALITY METRIC

\[ E_{\text{our}} = \sum_{i=1}^{N} d_i |\lambda_i| \]
SAMPLING QUALITY METRIC
SAMPLING QUALITY METRIC

sampling mask
SAMPLING PATTERN ESTIMATION

Constraints:
- regular
- symmetric

sampling mask
(64 samples; 15x15 grid)
SAMPLING PATTERN ESTIMATION

sampling mask  
(only guidance)

basis grid permutations
SAMPLING PATTERN ESTIMATION

basis grid permutations

E: 0.188 0.184 0.191
SAMPLING PATTERN ESTIMATION

final sampling mask

basis grid permutations

$E: \quad 0.188\quad 0.184\quad 0.191$
RECONSTRUCTION

sampling mask

\( \mathbf{D} \) ... dictionary
RECONSTRUCTION

minimize \[ \alpha \mid l' - \Phi D\alpha \mid_2^2, \]

\[ l = D\alpha \]

\[ l' \] ... sub-sampled light-field

\[ l \] ... reconstructed light-field
RECONSTRUCTION

\[
\begin{align*}
\text{minimize} & \quad \| l' - \Phi D\alpha \|_2^2, \\
1 &= D\alpha
\end{align*}
\]
RECONSTRUCTION

\[
\begin{align*}
\text{minimize } & \| l' - \Phi D\alpha \|^2_2, \\
\text{subject to } & \quad l = D\alpha
\end{align*}
\]
RESULTS: SAMPLING MASKS

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unsupported  unsupported  unsupported
## RESULTS

<table>
<thead>
<tr>
<th>Scenes (N)</th>
<th>Marwah '13</th>
<th>Shi '14</th>
<th>Schedl '15</th>
<th>Kalantari '16</th>
<th>Schedl '17</th>
<th>Ours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amethyst (64)</td>
<td>37.77dB</td>
<td>-</td>
<td>-</td>
<td>40.11dB</td>
<td>41.86dB</td>
<td>42.08dB</td>
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<tr>
<td>Lego (64)</td>
<td>28.79dB</td>
<td>-</td>
<td>-</td>
<td>32.87dB</td>
<td>35.63dB</td>
<td>37.26dB</td>
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<tr>
<td>Lego (48)</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>33.86dB</td>
<td>35.75dB</td>
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<tr>
<td>Cave (64)</td>
<td>26.51dB</td>
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<td>-</td>
<td>30.99dB</td>
<td>38.57dB</td>
<td>41.08dB</td>
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<tr>
<td>Alley (64)</td>
<td>36.58dB</td>
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<td>-</td>
<td>43.23dB</td>
<td>43.83dB</td>
<td>44.35dB</td>
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<tr>
<td>Amethyst (72)</td>
<td>-</td>
<td>36.40dB</td>
<td>-</td>
<td>-</td>
<td>42.18dB</td>
<td>42.55dB</td>
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<tr>
<td>Tarot (72)</td>
<td>-</td>
<td>30.19dB</td>
<td>-</td>
<td>-</td>
<td>37.81dB</td>
<td>39.20dB</td>
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<tr>
<td>Amethyst (69)</td>
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<td>-</td>
<td>41.91dB</td>
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<td>42.07dB</td>
<td>42.43dB</td>
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<tr>
<td>Tarot (69)</td>
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<td>-</td>
<td>34.09dB</td>
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<td>37.88dB</td>
<td>39.04dB</td>
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<td>35.96dB</td>
<td>37.54dB</td>
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<tr>
<td>Cave (69)</td>
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<td>-</td>
<td>29.96dB</td>
<td>-</td>
<td>39.14dB</td>
<td>41.41dB</td>
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<tr>
<td>Alley (69)</td>
<td>-</td>
<td>-</td>
<td>41.36dB</td>
<td>-</td>
<td>44.24dB</td>
<td>45.20dB</td>
</tr>
</tbody>
</table>
Lego: Schedl ’17 (64)  Ours (64)  Reference (225)
Cave: Kalantari' 16 (64)  Ours (64)  Reference (225)
Amethyst: Shi ’14 (72)  Ours (72)  Reference (225)
LIMITATIONS / FUTURE WORK

- Time: 40h – 5 days on NVIDIA Tesla V100 GPU
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- Other light-field camera designs
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- Time: 40h – 5 days on NVIDIA Tesla V100 GPU
- Other light-field camera designs
- Other fields (e.g. image-based relighting)
More information: [www.jku.at/cg](http://www.jku.at/cg)
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