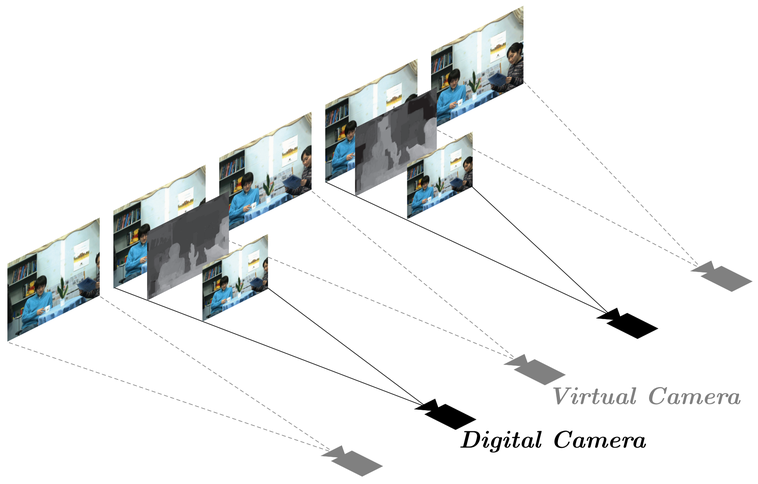
Depth Pixel Clustering for Consistency Testing of Multiview Depth

Pravin Kumar Rana and Markus Flierl

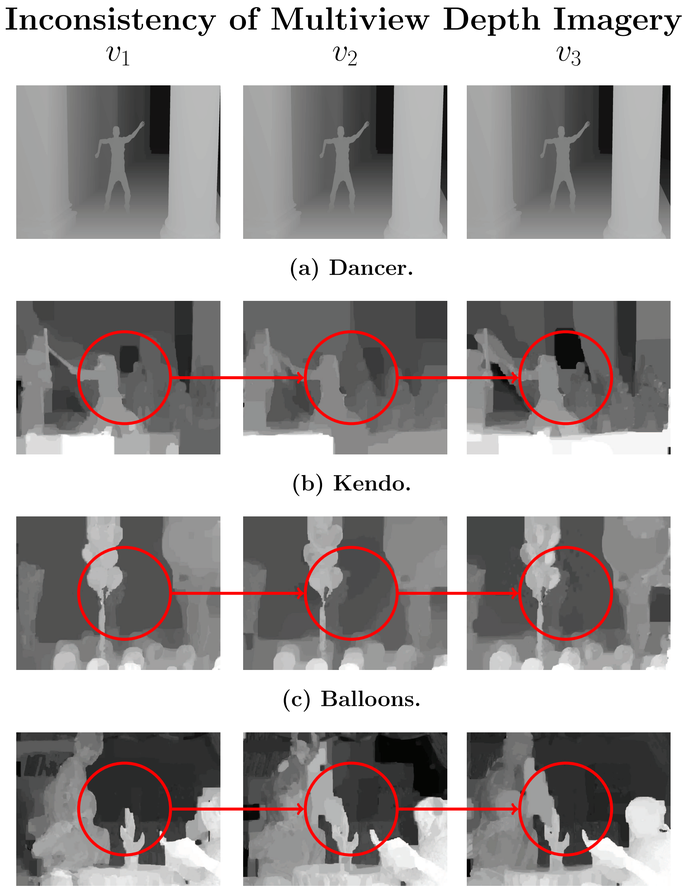
ACCESS Linnaeus Center, School of Electrical Engineering, KTH Royal Institute of Technology, Stockholm, Sweden

1 Motivation

Free-Viewpoint Television



Inconsistency of Multiview Depth Imagery



(a) Dancer.

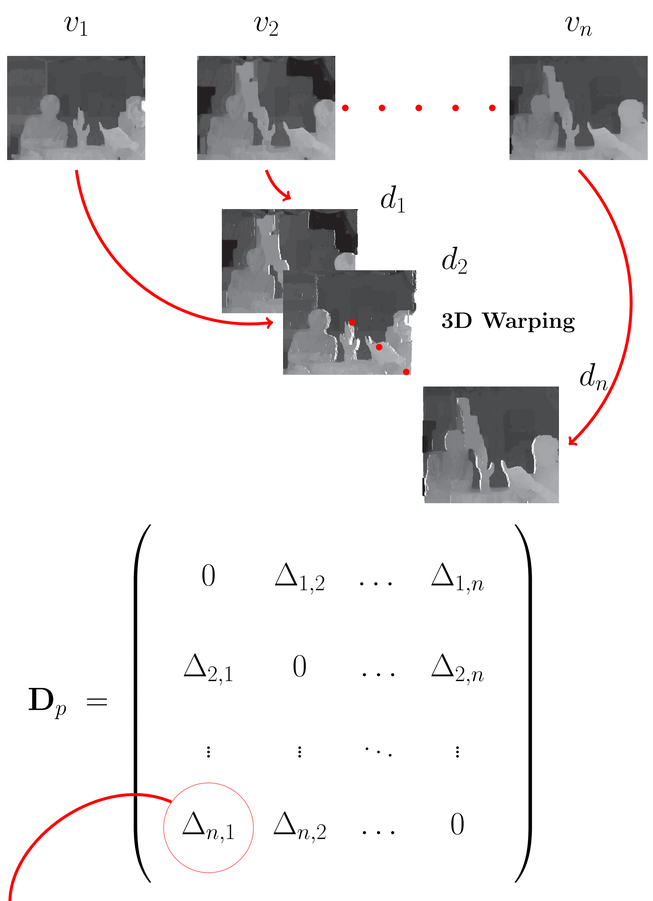
(b) Kendo.

(c) Balloons.

(d) Newspaper.

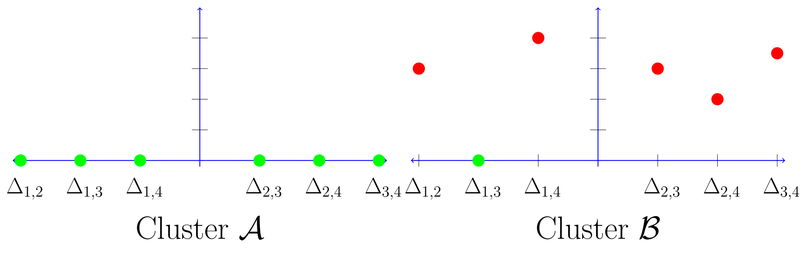
2 Approach: Depth Consistency Testing

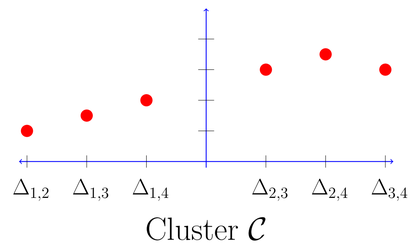
Multiview Depth Imagery



2.1 Depth Pixel Clustering

– Exploit local statistical properties for testing

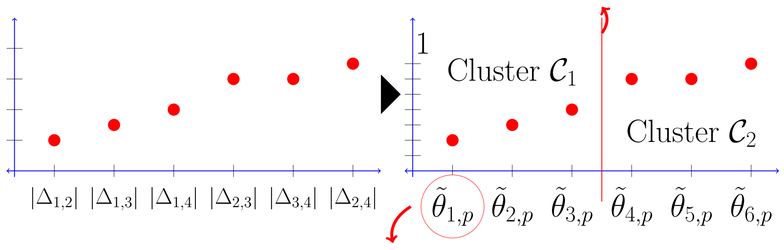




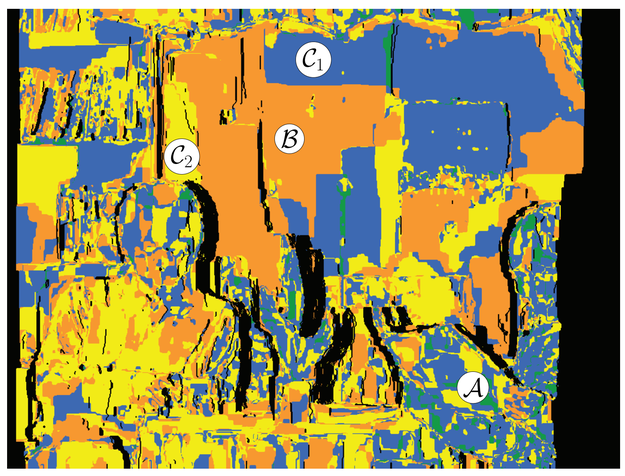
Sub-clustering of $\mathcal{C}$

– Statistical properties of $\mathcal{C}$ determine sub-clustering criteria

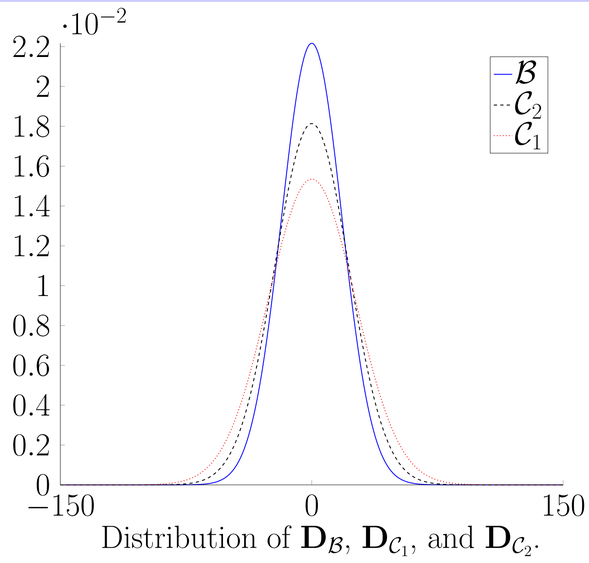
Relative inter-view connection threshold



$\frac{|\Delta_{1,2}|}{|\Delta_{2,4}|} \longrightarrow$ *Relative inter-view connection evidence*



2.2 Connection Threshold & Information



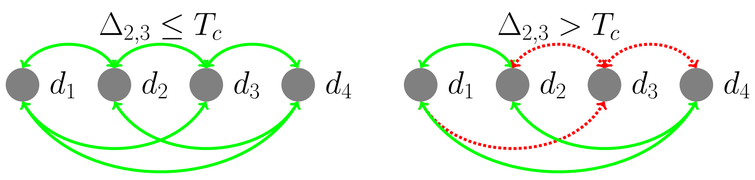
Distribution of $\mathbf{D}_{\mathcal{B}}$, $\mathbf{D}_{\mathcal{C}_1}$, and $\mathbf{D}_{\mathcal{C}_2}$.

Cluster-Adaptive Connection Threshold:

$T_c = \frac{\sigma_{\mathcal{C}}}{2}$ — *Standard deviation of* $\boldsymbol{D}_{\mathcal{C}} = \{\boldsymbol{D}_p | p \in \mathcal{C}\}$

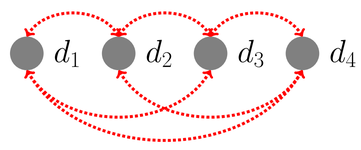
Example: Inter-View Connectivity (n = 4)

General-Hypothesis



(Consistent depth pixels) ($(d_1, d_2, d_4) \rightarrow$ consistent depth pixels)

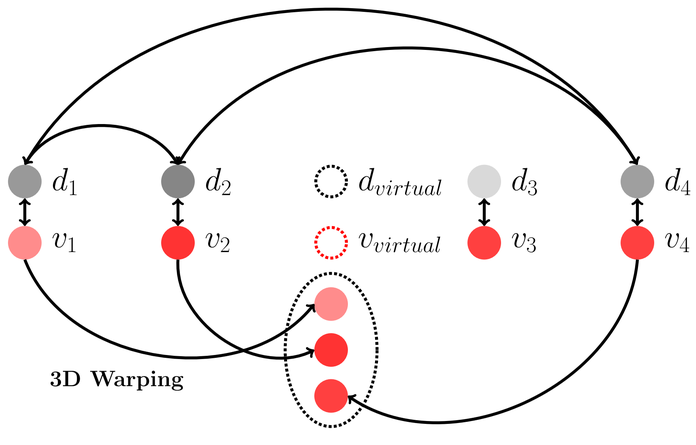
Null-Hypothesis

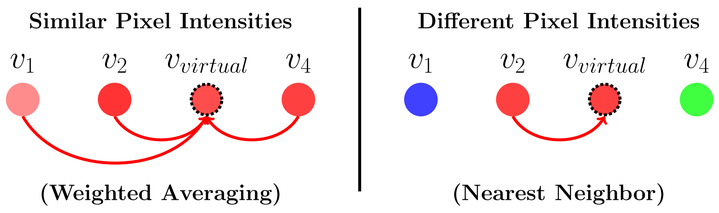


(Inconsistent depth pixels)

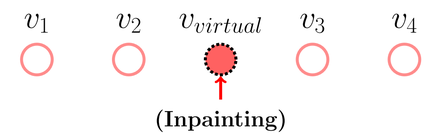
3 Virtual View Synthesis

General-Hypothesis





Null-Hypothesis



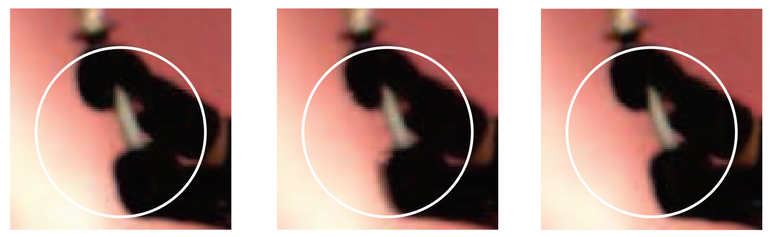
4 Experimental Results

Objective Quality of Synthesized Virtual Views (PSNR)					
Test Material (Virtual View)	QP	MPEG VSRS 3.5 [dB]	DCT+View Synthesis [dB] No Cluster	Cluster	Sub-Cluster
Dancer (3)	0	37.00	38.72	38.72	38.72
	28	35.50	36.85	37.31	37.31
	42	33.02	33.52	34.15	34.15
Kendo (4)	0	37.10	38.05	38.12	38.12
	34	36.60	37.56	37.60	37.60
	40	36.25	37.17	37.21	37.20
Balloons (4)	0	35.46	35.83	35.85	35.91
	34	35.00	35.03	35.12	35.10
	40	34.73	34.76	34.87	34.83
Newspaper (5)	0	32.54	33.32	33.32	33.31
	35	32.37	33.30	33.30	33.31
	40	32.16	33.17	33.17	33.20

Effect of Depth Pixel Clustering

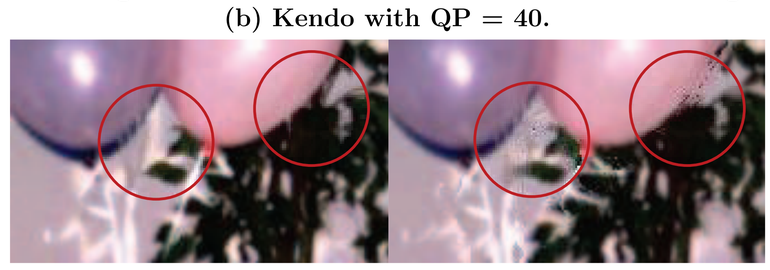
Original. Without clustering. With clustering.

(a) Dancer with QP = 42.



Original. Without clustering. With clustering.

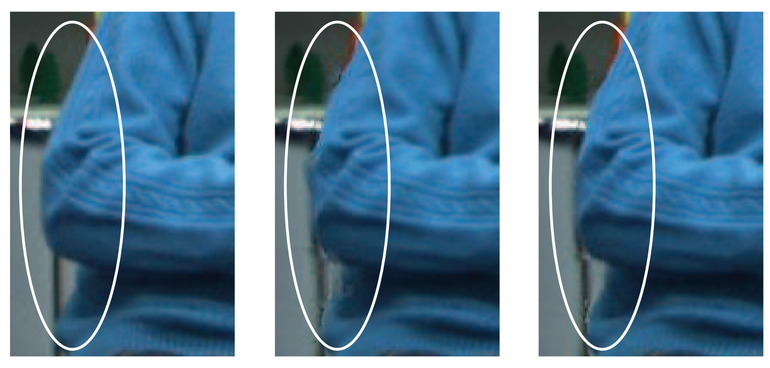
(b) Kendo with QP = 40.



Original. Without clustering.

With clustering.

(c) Balloons with QP = 40.



Original. Without clustering. With clustering.

(d) Newspaper with QP = 40.

5 Conclusions

- Improves inter-view connectivity among multiple depth maps by clustering depth pixels.
- Improves the quality of coded depth maps.
- Improves the visual quality of synthesized virtual views by exploiting the resulting connection information.

♯ This work was supported in part by Ericsson AB.