Structured-Depth Image Based Rendering
&
Depth Enhancement Tool

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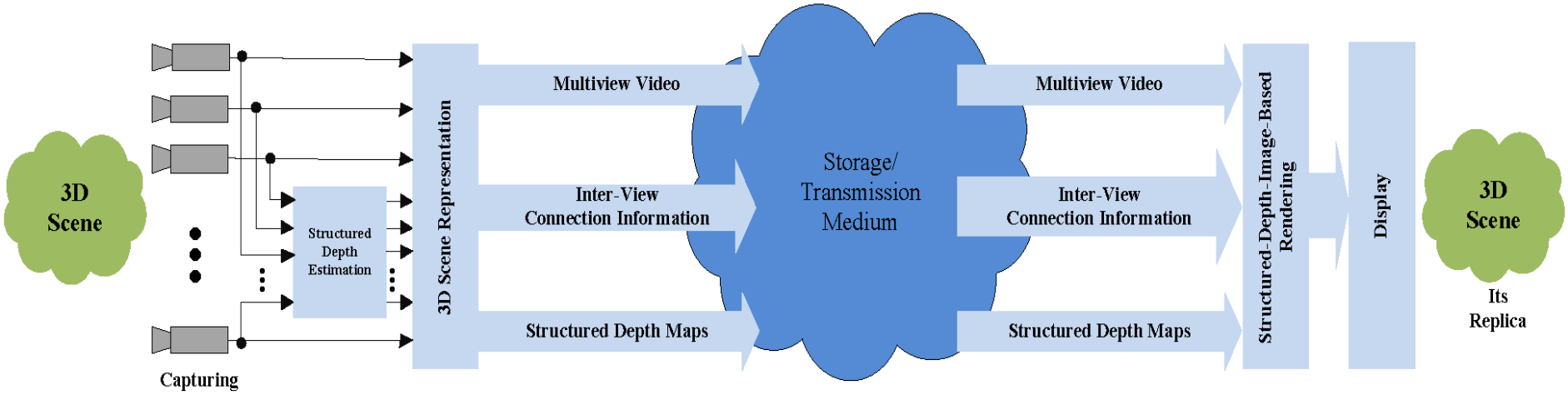
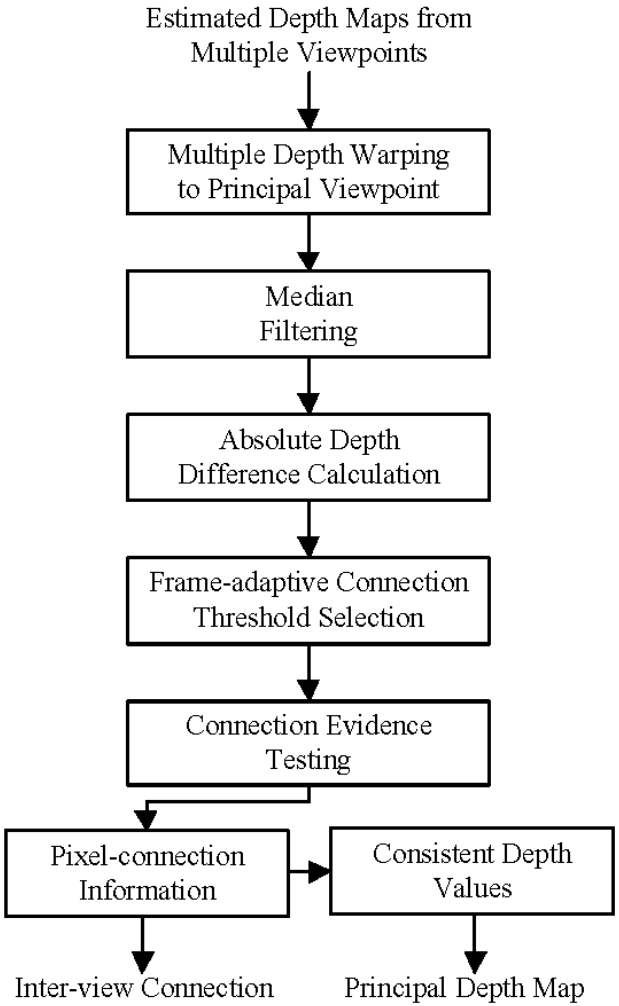
Outline

- Structured-Depth Image Based Rendering
- Depth Enhancement Tool: Updates
- Depth Pixel Cluster Based Thresholding

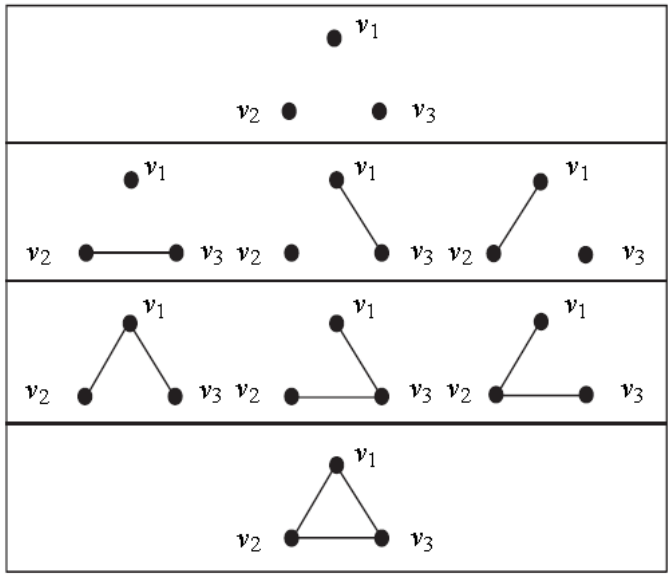
Structured-Depth Image Based Rendering (SDIBR)

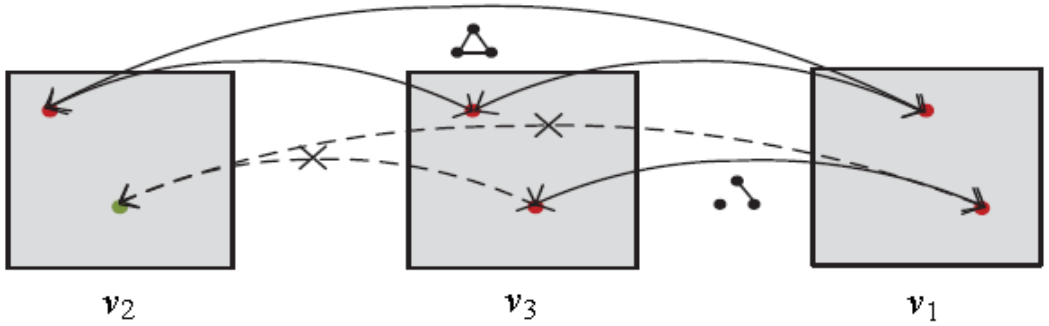


Connection & Principal Depth Map Extraction

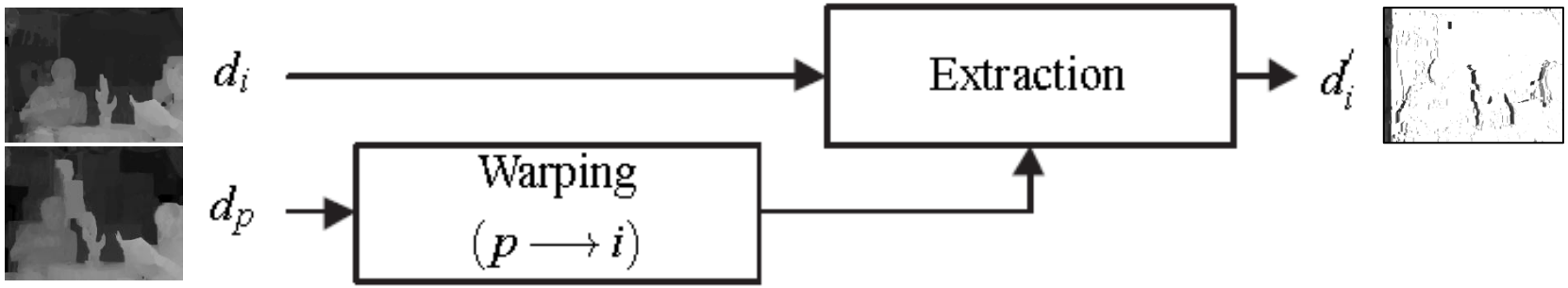


Inter-View Connection Information



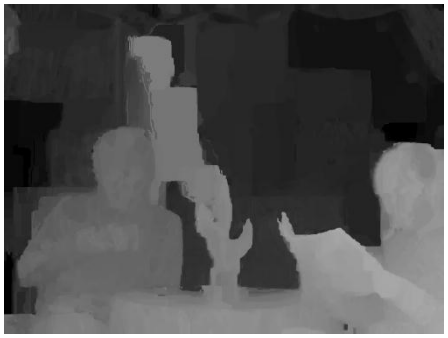


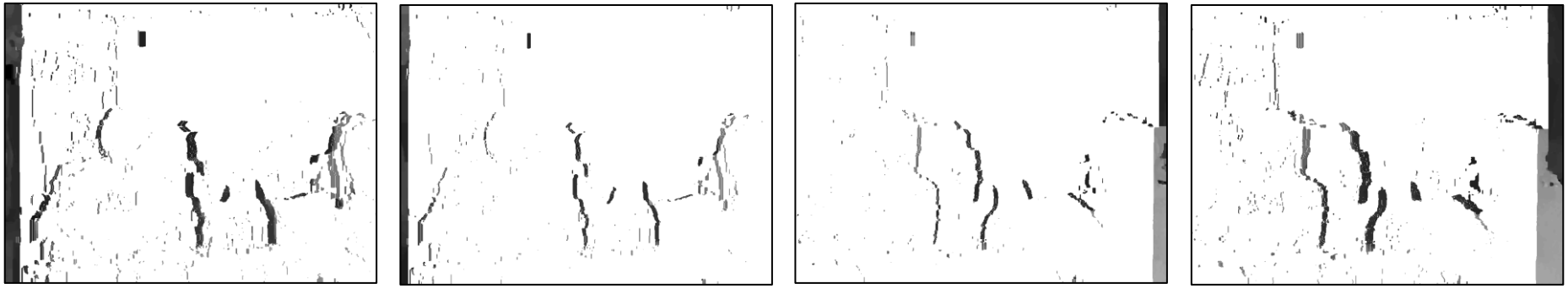
Extraction of Auxiliary Depth Information



Structured Depth Maps

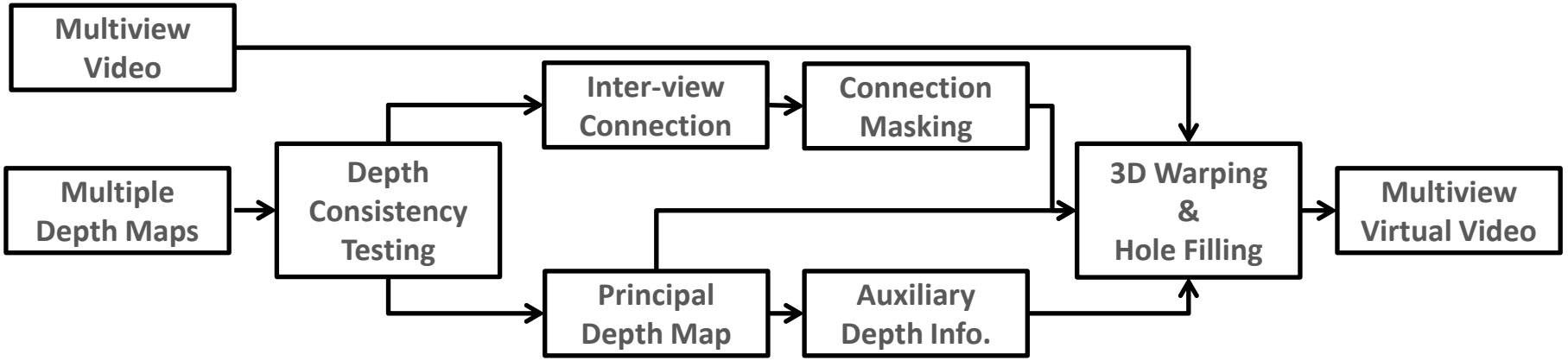
Principal Depth Map





Auxiliary Depth Information

SDIBR Experiments



Experimental Results

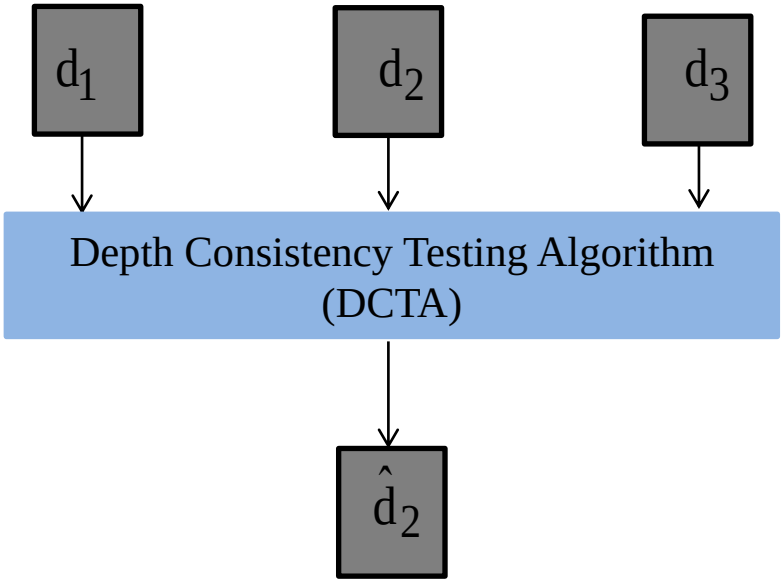
Quality of Rendered Virtual Views

MPEG Test Data	Virtual View	Proposed Method [dB] (a)	VSRS 3.5 [dB] (b)	△Y-PSNR [dB] (a-b)
Pantomime ($p = 39$)	38	38.03	36.81	1.22
	40	39.96	36.62	3.34
Dog ($p = 39$)	38	35.20	34.05	1.15
	40	33.10	28.24	4.86
Lovebird1 ($p = 04$)	05	32.80	31.94	0.86
	07	30.50	30.32	0.18
Newspaper ($p = 03$)	02	31.29	30.73	0.56
	04	30.72	29.52	1.20
Mobile ($p = 05$)	04	42.60	41.36	1.24
	06	41.97	39.94	2.03

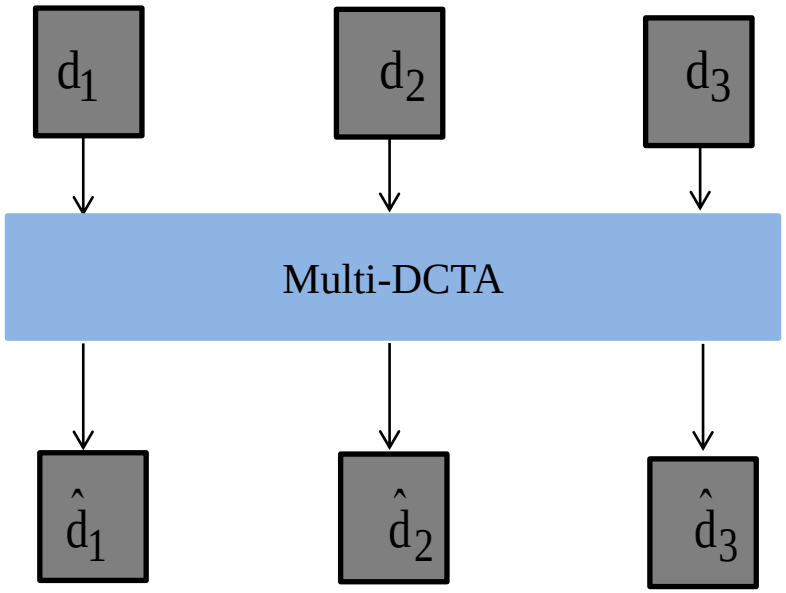
Conclusions

- It exploits the inter-view connectivity information among multiview video and takes advantage of a consistent depth map.
- It addresses the problems of inter-view depth inconsistencies and varying illumination conditions.
- It permit an appealing 3D scene representation on the encoder side by avoiding depth consistency testing for each interpolated pixel on the decoder side.
- It improves the subjective visual quality as well as the objective quality of rendered views

Depth Enhancement Tool

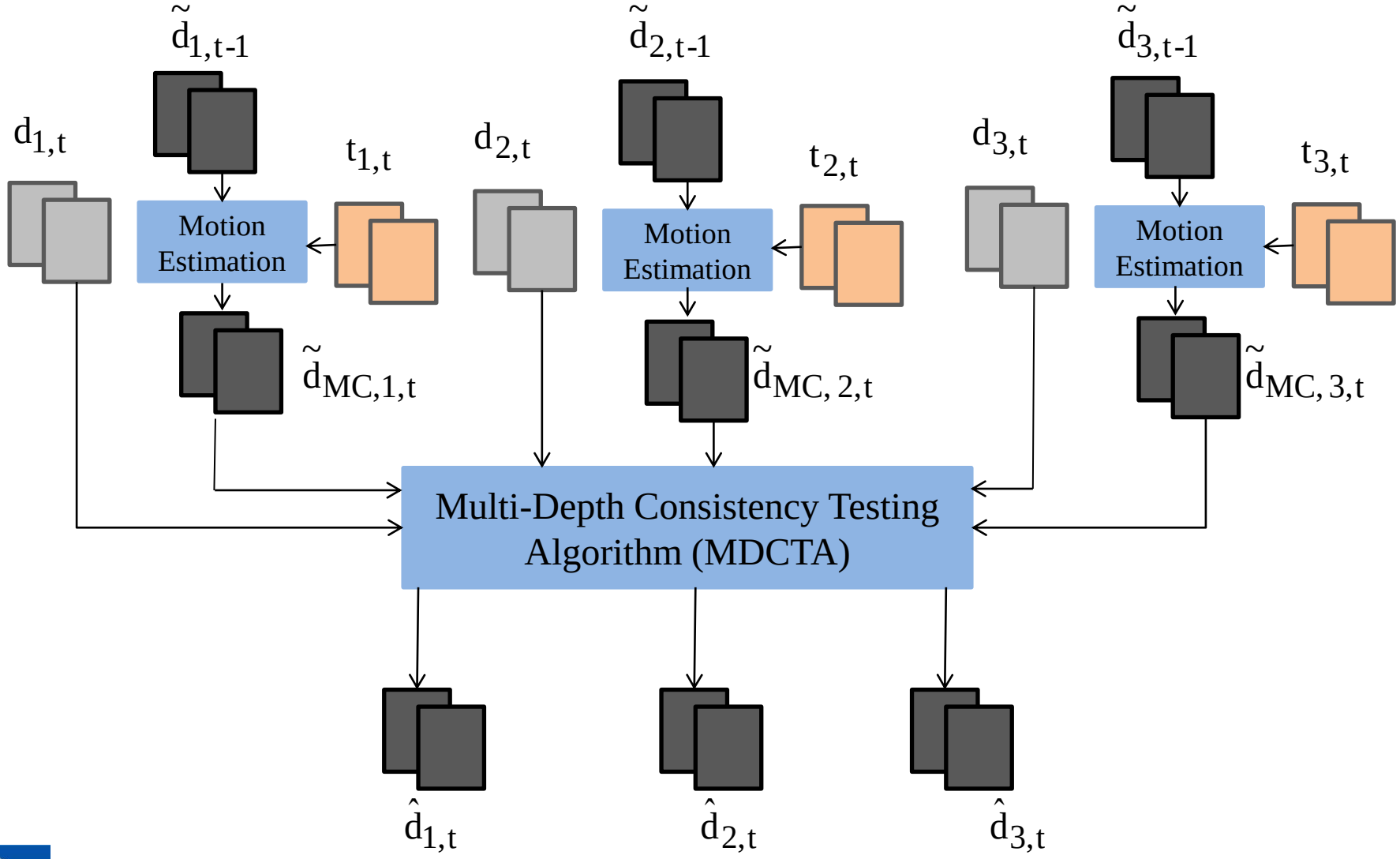


Testing pixels in 2



Testing pixels in 1, 2, and 3

Depth Enhancement Tool



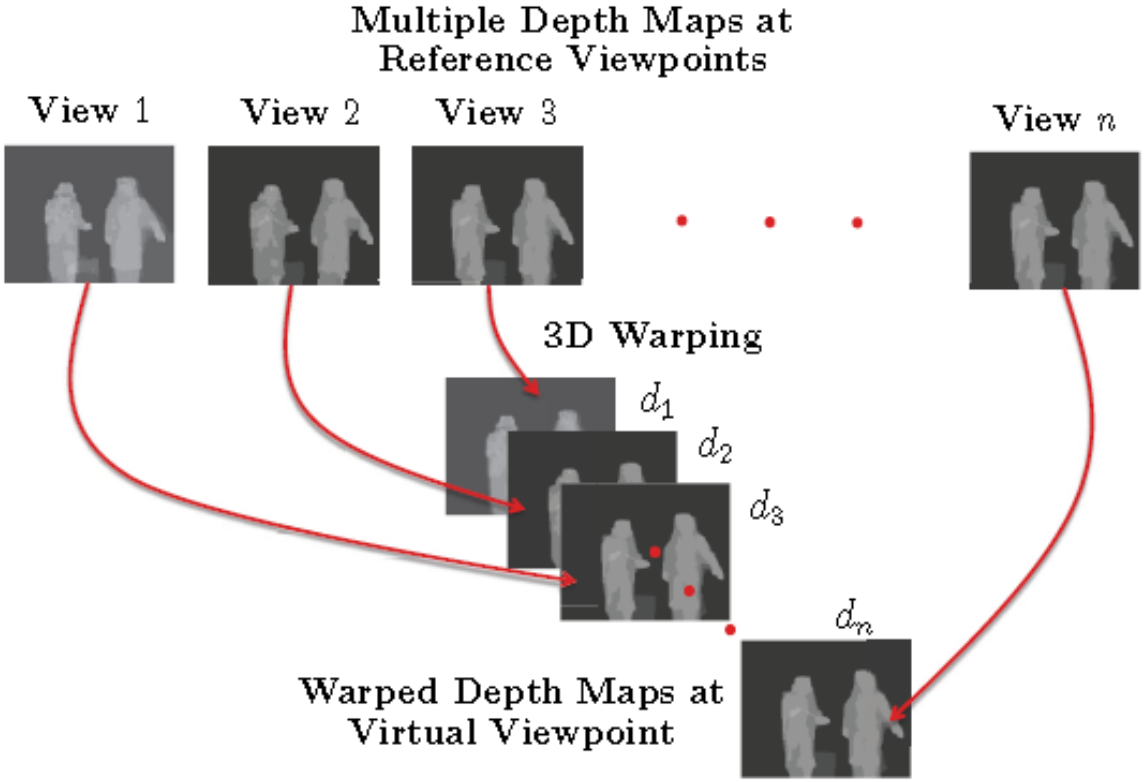
Sub-pel DET Results

Test Sequences	Virtual View	VSRS 3.5 [dB]	
		Integer-pel	Half-pel
Kendo	02	37.52	37.57
Balloons	04	35.44	35.50
Lovebird1	05	33.00	33.03
Newspaper	05	32.00	32.01

Depth Pixel Cluster-Based Thresholding

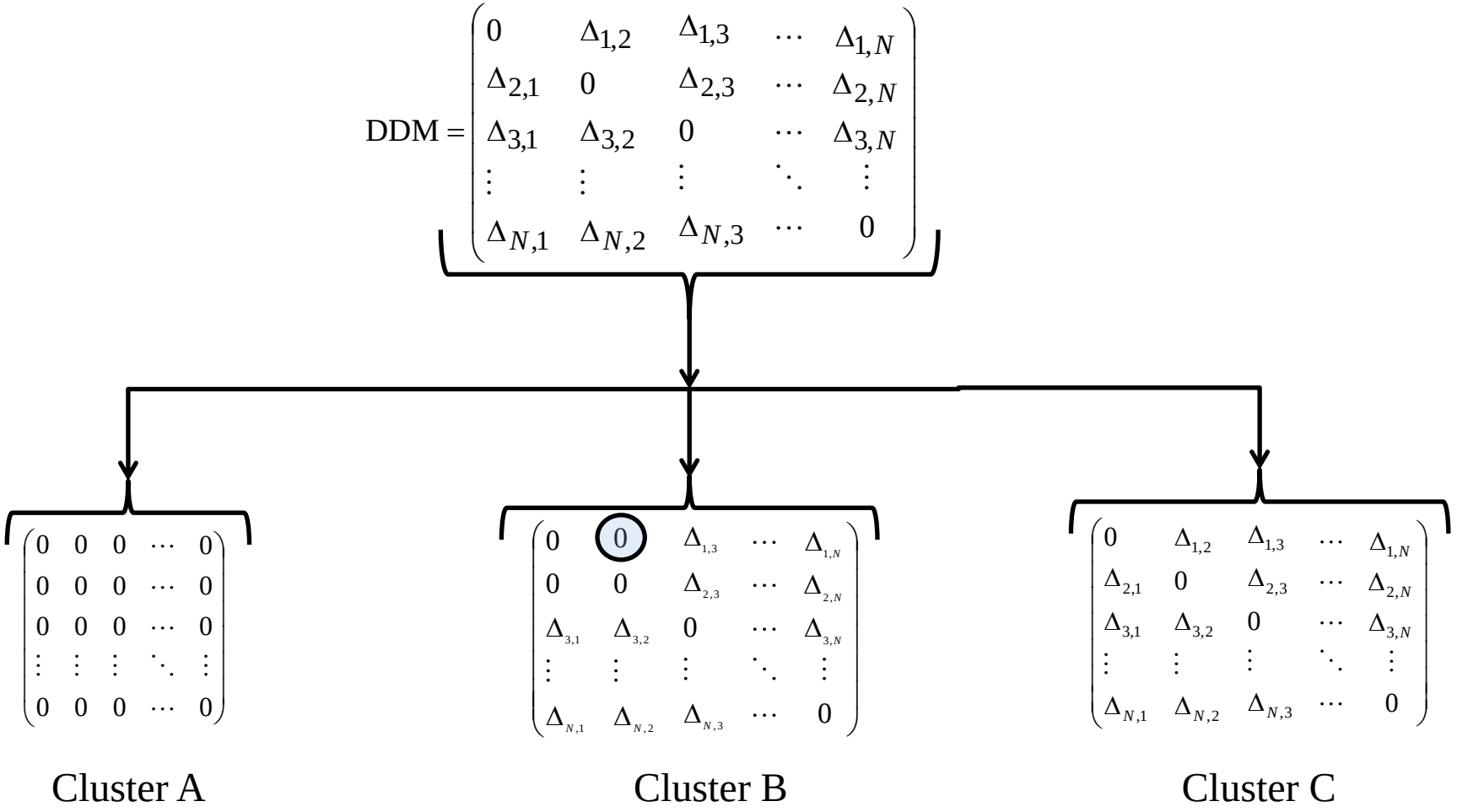
Kendo

Connection Threshold

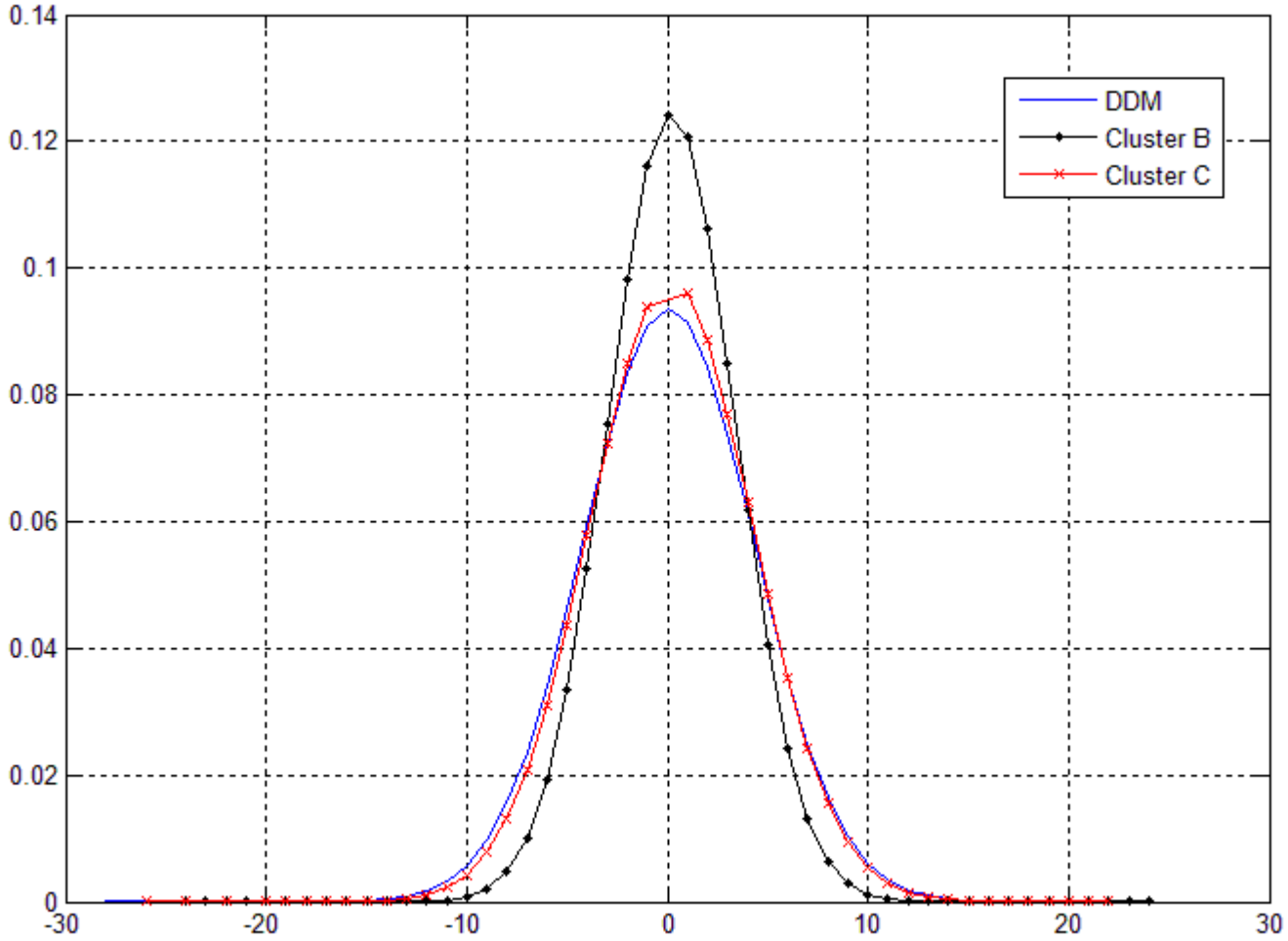


$$\text{Depth Difference Matrix (DDM)} = \begin{pmatrix} 0 & \Delta_{1,2} & \Delta_{1,3} & \cdots & \Delta_{1,N} \\ \Delta_{2,1} & 0 & \Delta_{2,3} & \cdots & \Delta_{2,N} \\ \Delta_{3,1} & \Delta_{3,2} & 0 & \cdots & \Delta_{3,N} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \Delta_{N,1} & \Delta_{N,2} & \Delta_{N,3} & \cdots & 0 \end{pmatrix}, \text{ where, } \Delta_{i,j} = \left(d_i - d_j\right);$$

Cluster Approach Based Connection Thresholding



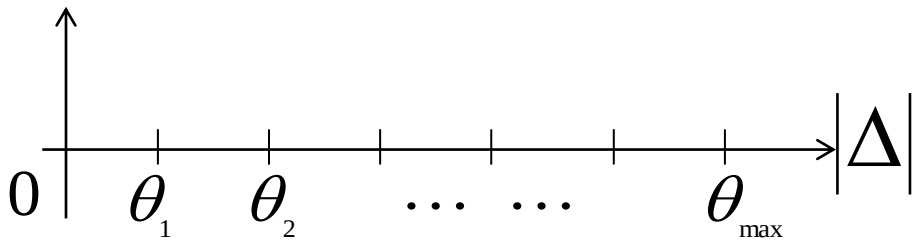
Cluster Distribution



3 Reference-view Scenario

Relative Distance Sub-cluster Classification

$$\text{DDM} = \begin{pmatrix} 0 & \Delta_{1,2} & \Delta_{1,3} & \cdots & \Delta_{1,N} \\ \Delta_{2,1} & 0 & \Delta_{2,3} & \cdots & \Delta_{2,N} \\ \Delta_{3,1} & \Delta_{3,2} & 0 & \cdots & \Delta_{3,N} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \Delta_{N,1} & \Delta_{N,2} & \Delta_{N,3} & \cdots & 0 \end{pmatrix}$$



where,

$$\theta_1 = \min\left\{ \left[\Delta_{i,j}\right] \middle| \left|\Delta_{i,j}\right| > 0;\ \mathrm{j} > i \right\}$$

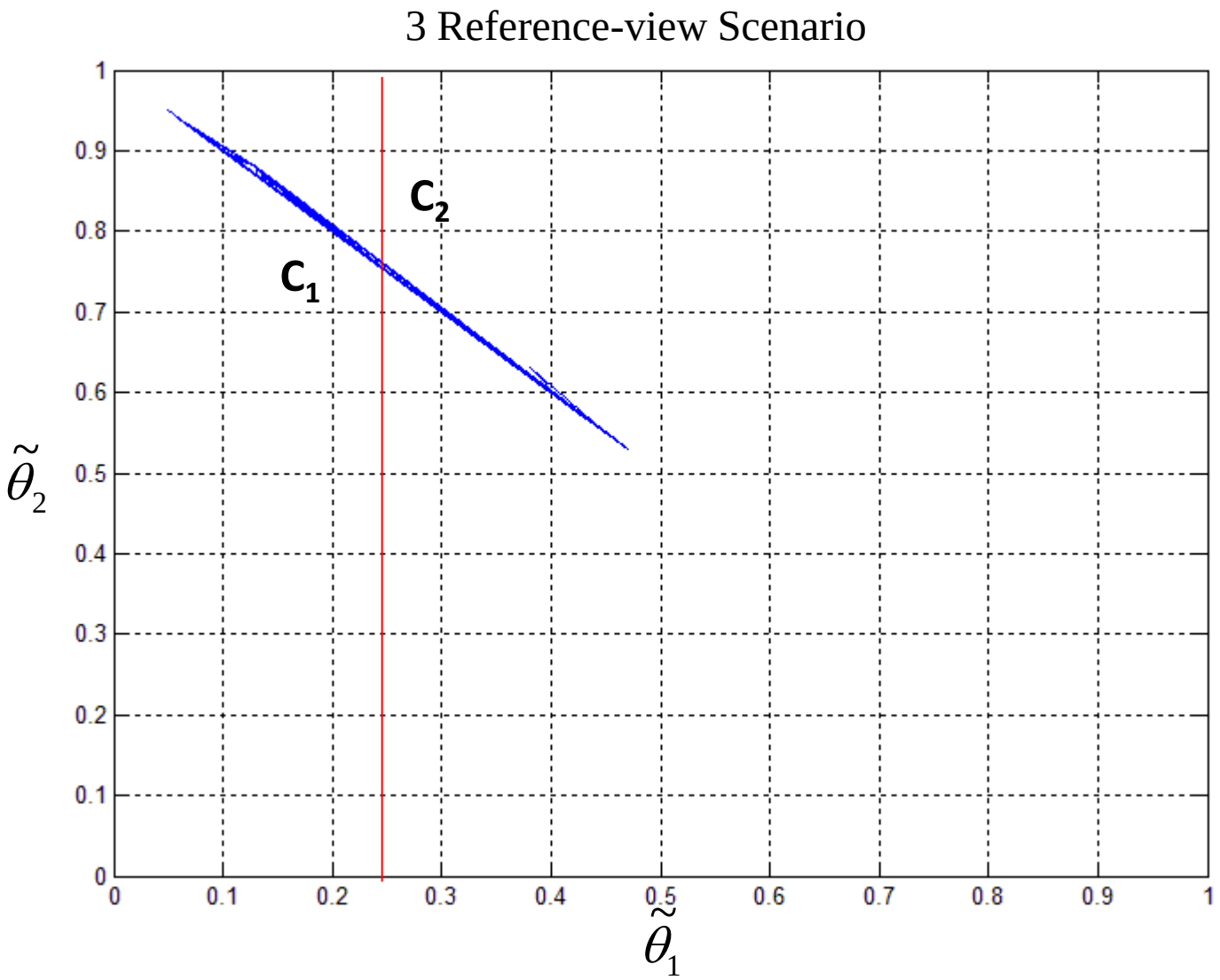
$$\theta_2 = \min\left\{ \left[\Delta_{i,j}\right] \middle| \left|\Delta_{i,j}\right| > \theta_1;\ \mathrm{j} > i \right\}$$

... ...

Define relative distances :

$$\tilde{\theta}_1 = \frac{\theta_1}{\theta_{\max}},\ \tilde{\theta}_2 = \frac{\theta_2}{\theta_{\max}},\ \cdots\ \cdots, 1$$

Relative Distance Sub-cluster Classification



Connection Threshold

Class A Cluster: $T_A = 0.0$

Class B Cluster: $T_B <= 2\sigma_B$

Class C Cluster:

- $if \quad \tilde{\theta}_1 < 0.25 \rightarrow$ Class C_1 Cluster
- $if \quad \tilde{\theta}_1 \geq 0.25 \rightarrow$ Class C_2 Cluster

Class C_i Cluster: $T_{C_i} <= 2\sigma_{C_i}$

Experimental Results

4-view Depth Consistency Testing Supported View Synthesis Algorithm

Test Data (50 frames)	Virtual View	$T<(\mu+\lambda\sigma)$ [dB]	Cluster Based Threshold [dB]
Lovebird1	05	32.0	32.3
	06	29.2	29.3
Newspaper	04	30.0	30.5
	05	32.6	32.8