Depth Enhancement Tool
&
Rendering with Connection Information

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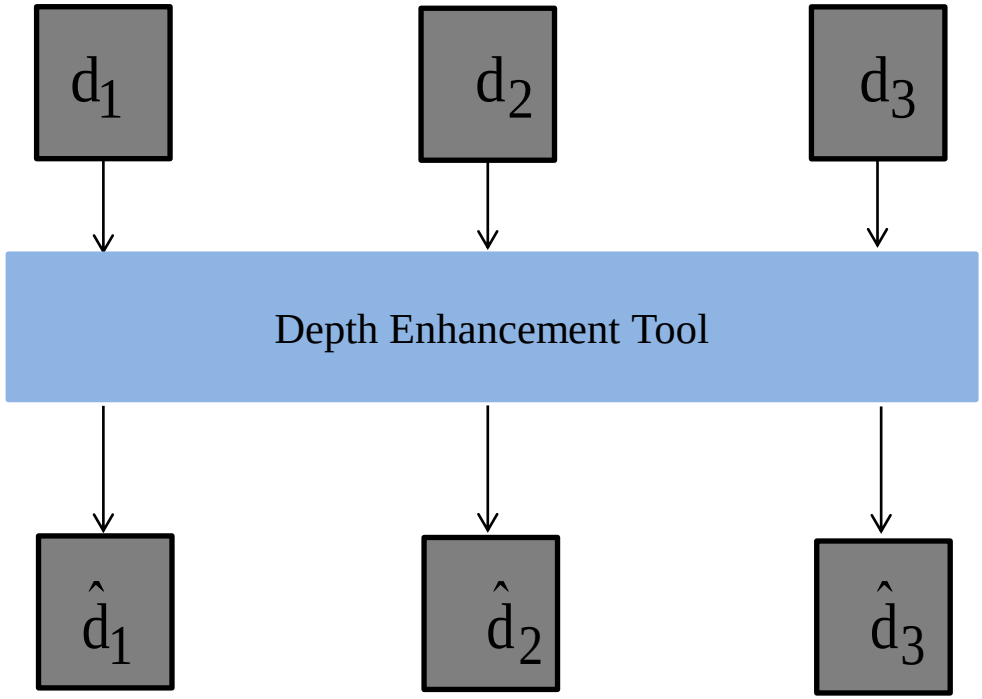
Outline

- Results
  - Depth Enhancement Tool
  - View Synthesis with Connection information
  - Rendering with Structured-Depth

Depth Enhancement Tool

Depth Enhancement Tool

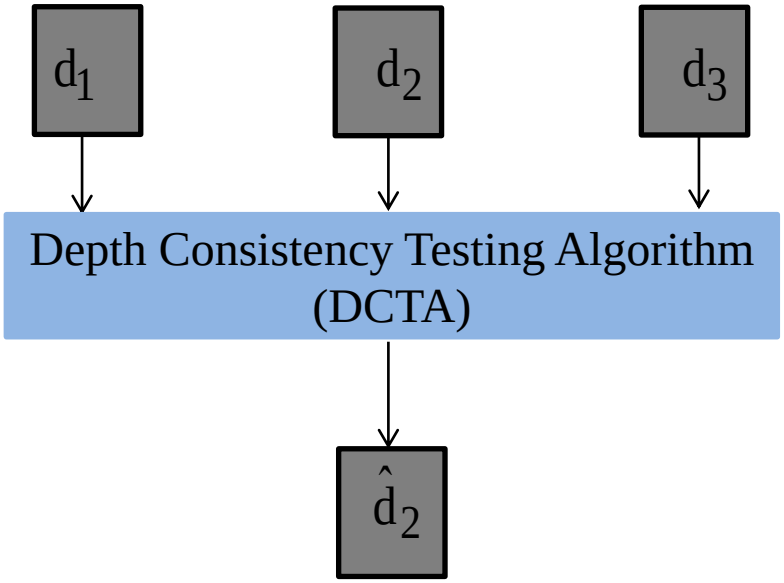
MPEG Depth Maps (MPEG/D)



Enhanced Depth Maps (ED)

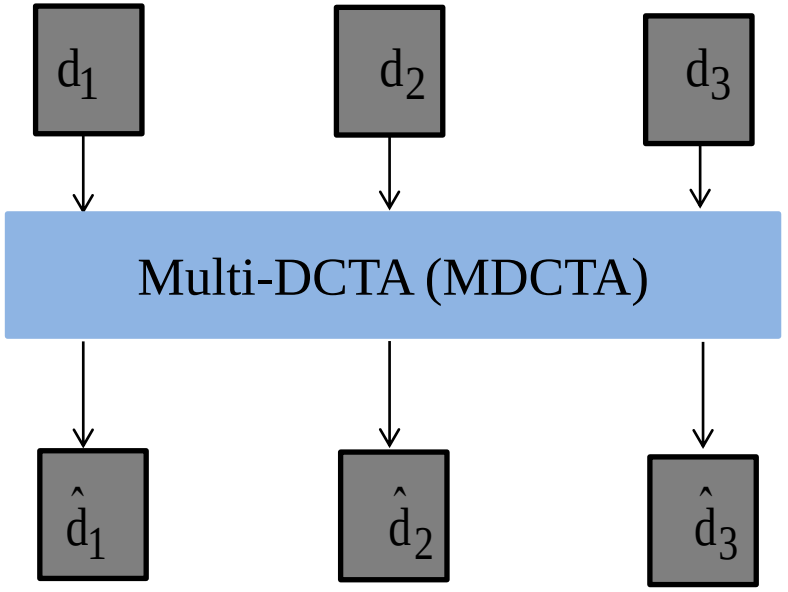
Depth Enhancement Tool

Depth Consistency Testing



Testing pixels in 2

Depth Enhancement Tool

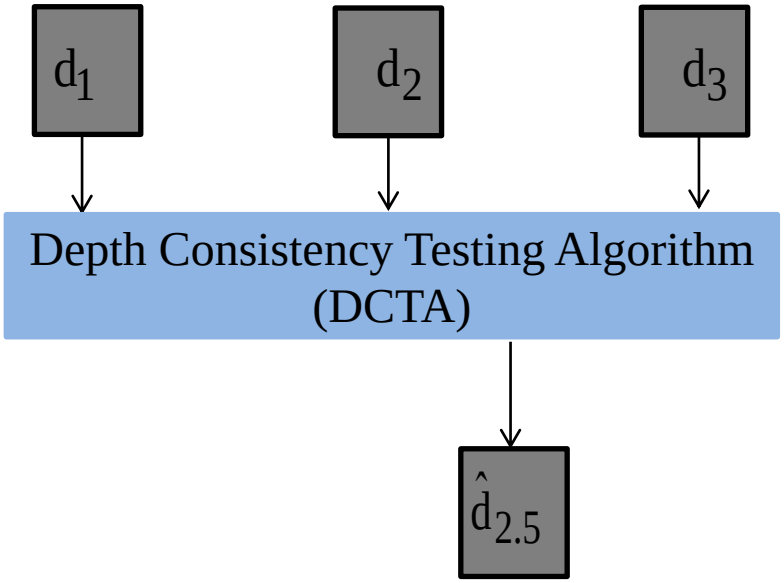


Testing pixels in 1, 2, and 3

MDCTA/ED

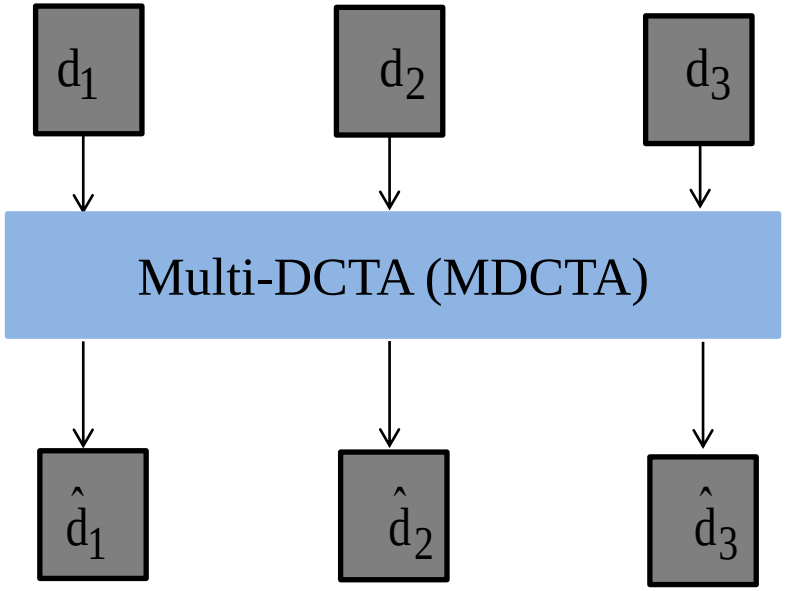
Depth Enhancement Tool

Depth Consistency Testing



Testing pixels in 2

Depth Enhancement Tool

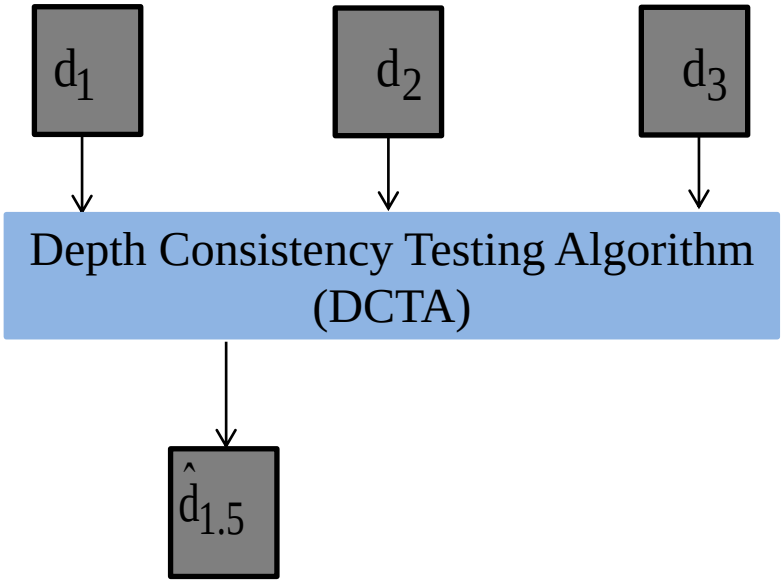


Testing pixels in 1, 2, and 3

MDCTA/ED

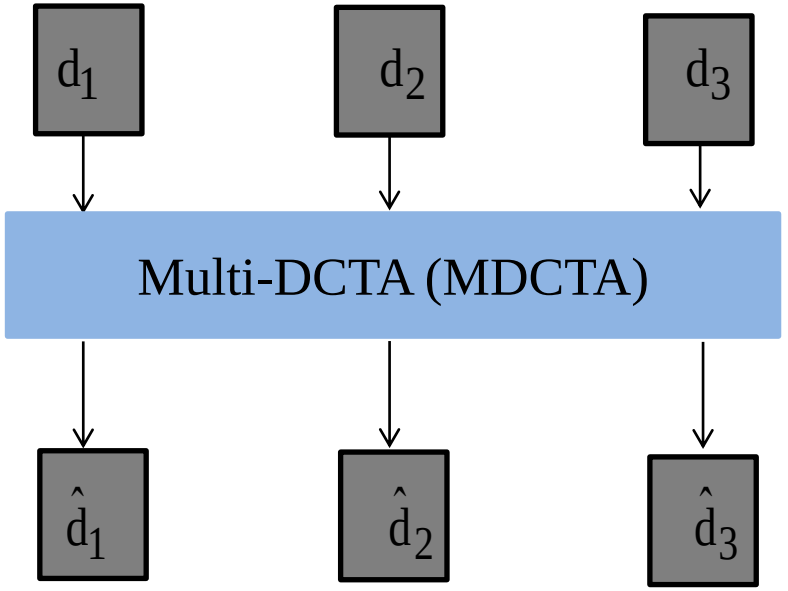
Depth Enhancement Tool

Depth Consistency Testing



Testing pixels in 2

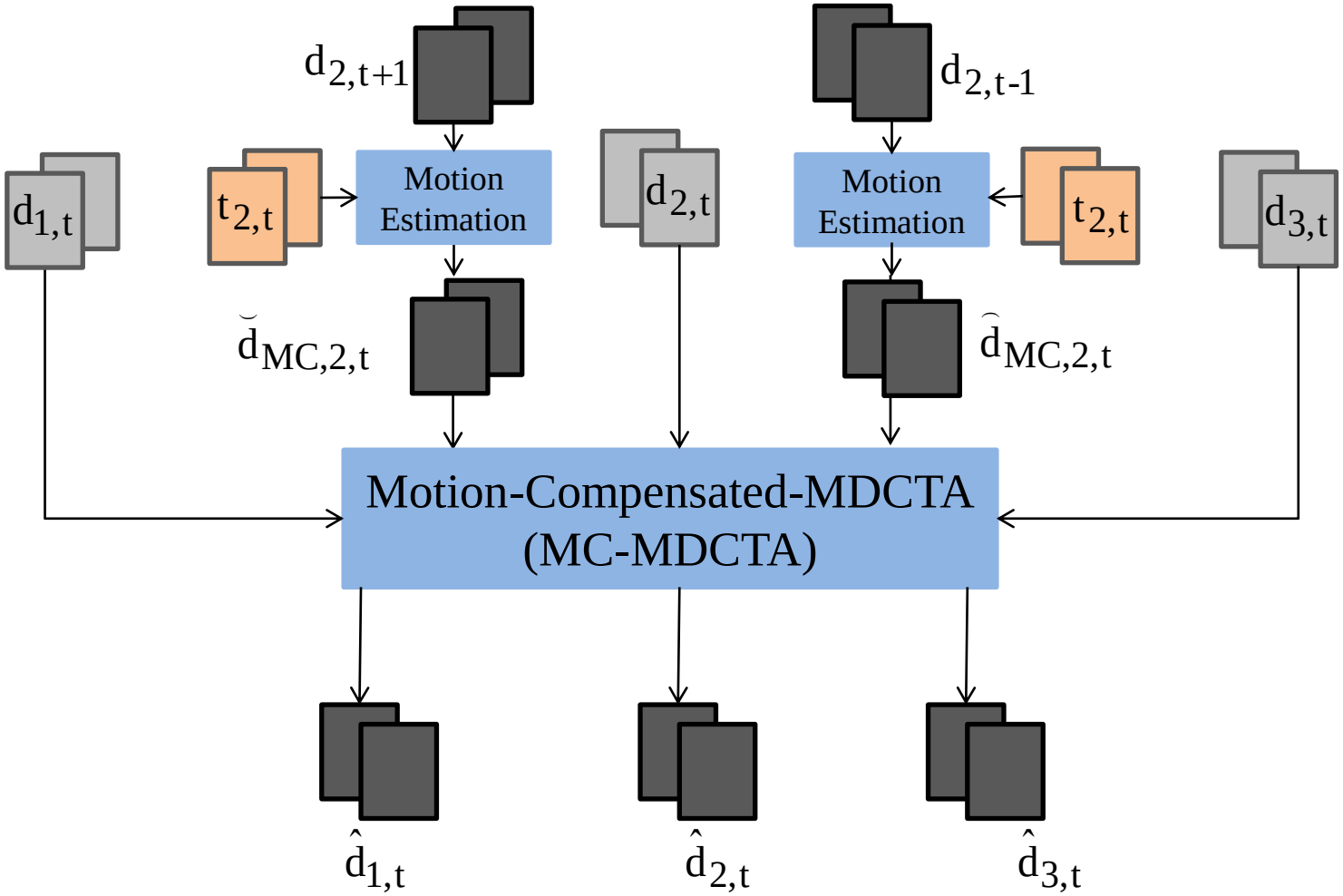
Depth Enhancement Tool



Testing pixels in 1, 2, and 3

MDCTA/ED

Depth Enhancement Tool



MC-MDCTA/ED

VSRS 3.5 Configuration file

The best VSRS parameters setting[1]:

- 1D Synthesis mode
- Boundary Noise Removal off
- View Blending off, not used in the 1D mode
- Half-pel precision
- Any setting for the Filter parameter

[1] Study of VSRS input parameters, Martin Pettersson, Ericsson, 2011-02-28

Results

MPEG/D → MDCTA/ED → VSRS 3.5

Sequence ID	Test Sequence	Spatial Resolution	No. Frames	Virtual View	MPEG/D→ VSRS 3.5 [dB]	MDCTA/ED → VSRS 3.5 [dB]
S01	Poznan Hall 2	1920x1088	200	6.5	SE	SE(1)
S02	Poznan Street	1920x1088	250	3.5	SE	SE
S03	Undo Dancer	1920x1080	250	03	38.50	38.11(2)
S04	GT Fly	1920x1080	250	04	x	x
S03	Kendo	1024x768	300	04	37.66	37.30(2)
S06	Balloons	1024x768	300	04	36.60	36.60
S07	Lovebird1	1024x768	240	07	28.68	28.72
S07*	Lovebird1	1024x768	240	07	30.37	30.00
S08	Newspaper	1024x768	300	05	32.35	32.40(2)

- **Old mpeg depth maps**
- **(1) Good subjective result**
- **(2) Subjective improvement**

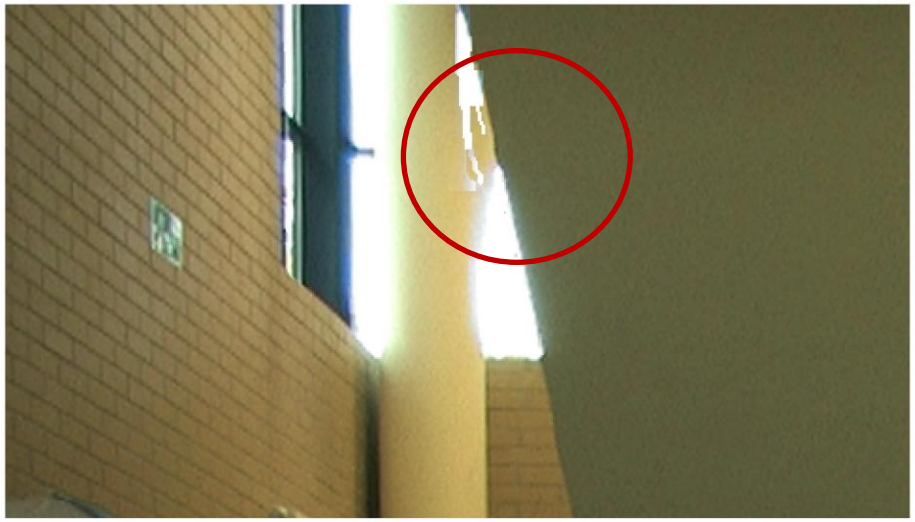
Results

MPEG/D → MC-MDCTA/ED → VSRS 3.5

Sequence ID	Test Sequence	Spatial Resolution	No. Frames	Virtual View	MPEG/D →VSRS 3.5 [dB]	MDCTA/ED →VSRS 3.5 [dB]	MC-MDCTA /ED→ VSRS 3.5 [dB]
S01	Poznan Hall 2	1920x1088	200	6.5	SE	SE(1)	-
S02	Poznan Street	1920x1088	250	3.5	SE	SE	-
S03	Undo Dancer	1920x1080	250	03	38.50	38.11(2)	38.05
S04	GT Fly	1920x1080	250	04	x	x	x
S03	Kendo	1024x768	300	04	37.66	37.30(2)	37.65
S06	Balloons	1024x768	300	04	36.60	36.60	36.74
S07	Lovebird1	1024x768	240	07	28.68	28.72	28.72
S07*	Lovebird1	1024x768	240	07	30.37	30.00	30.30
S08	Newspaper	1024x768	300	05	32.35	32.40(2)	32.56

- **Old mpeg depth maps**
- **(1) Good subjective result**
- **(2) Subjective improvement**

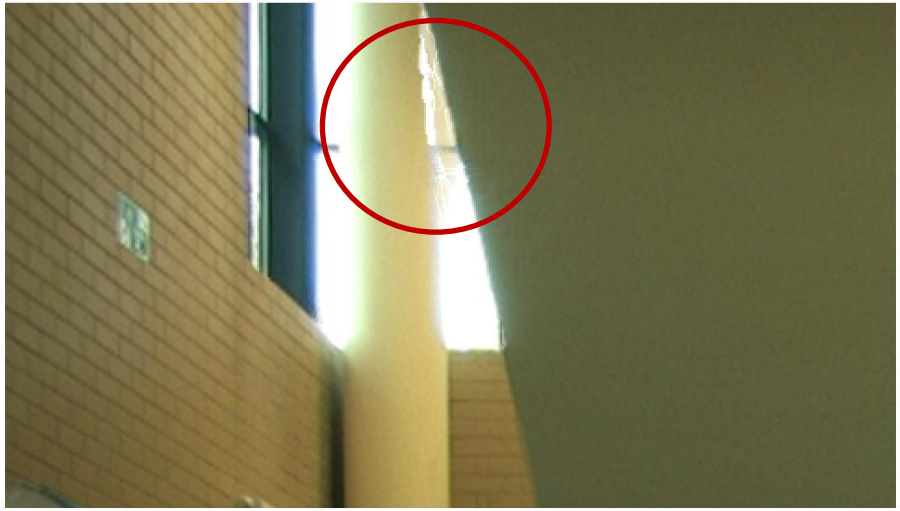
Subjective Results



Poznan Hall2
Frame 157

MPEG/D → VSRS 3.5

MPEG/D → MDCTA/ED → VSRS 3.5



Subjective Results

Poznan Hall2
Frame 121

MPEG/D → VSRS 3.5

MPEG/D → MDCTA/ED → VSRS 3.5

Subjective Results

Undo Dancer 3
Frame 30

Original

MPEG/D → VSRS 3.5

MPEG/D → MDCTA/ED → VSRS 3.5

Subjective Results

Original

Kendo 4
Frame 202

MPEG/D → VSRS 3.5

MPEG/D → MDCTA/ED → VSRS 3.5

Subjective Results

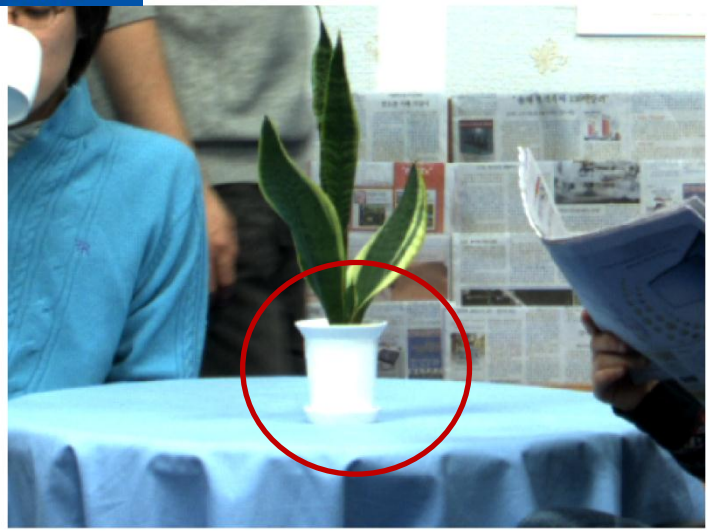
Original

Kendo 4
Frame 204

MPEG/D → VSRS 3.5

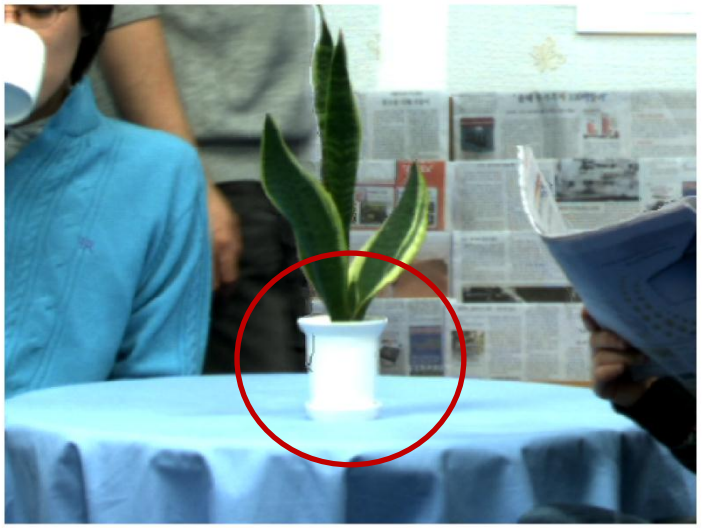
MPEG/D → MDCTA/ED → VSRS 3.5

Subjective Results

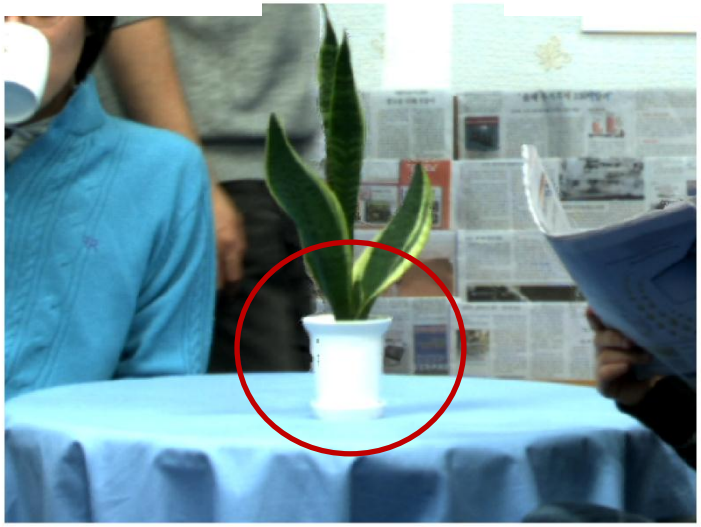


Original

Newspaper 5
Frame 85



MPEG/D → VSRS 3.5



MPEG/D → MDCTA/ED → VSRS 3.5

Subjective Results

Original

Newspaper 5
Frame 217

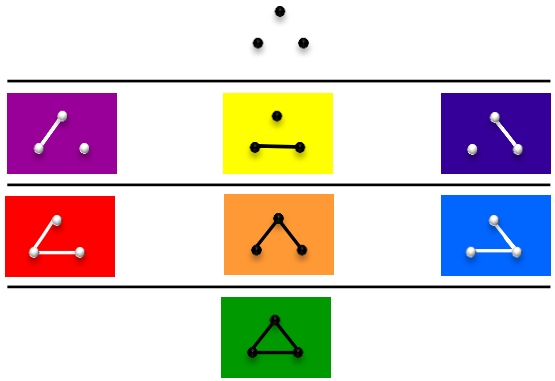
MPEG/D → VSRS 3.5

MPEG/D → MDCTA/ED → VSRS 3.5

View Synthesis with Connection Information

Inter-View Connection Information

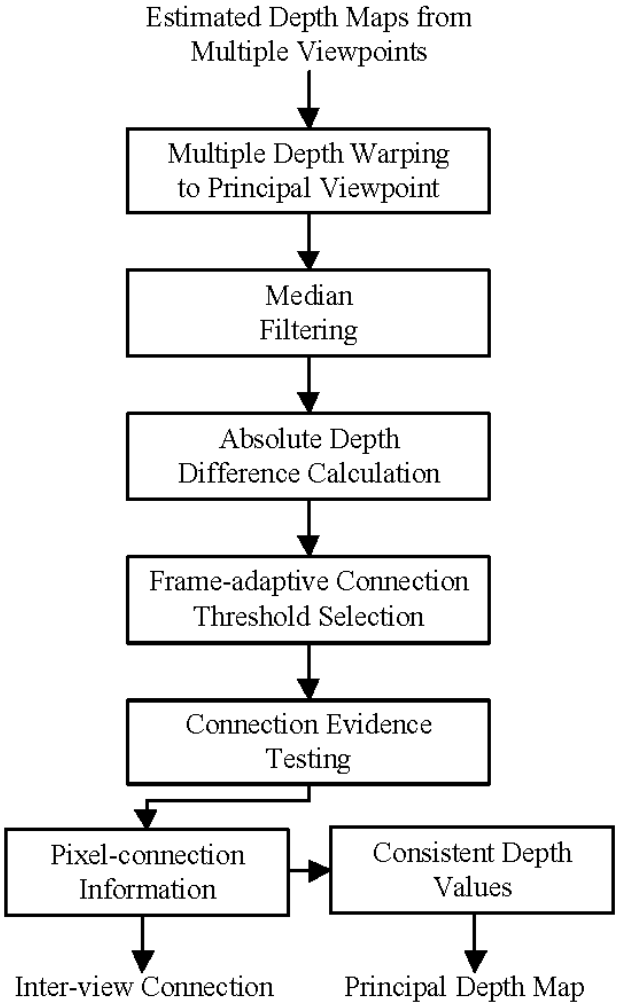
Possible cases of inter-view connectivity for $n = 3$:



Use of Connection Information:

- *To obtain consistent depth values*
- *To combine texture pixels from multiple viewpoint reliably*

Depth Consistency Testing



Virtual View Rendering

User

$view_{n+2}$

$view_{n+1}$

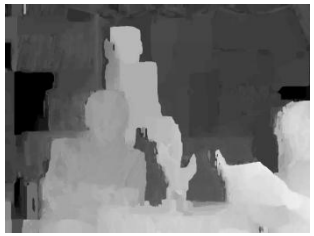
$view_n$

$view_{n-1}$

Free Viewpoint TV

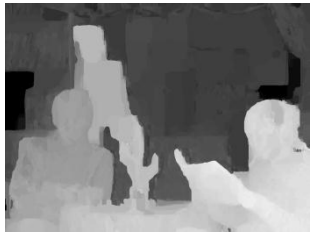
Virtual View Synthesis (VSRS+)

$view_{n+2}$



$view_{n+1} = p$

$view_{n-1}$



Enhanced depth maps

VSRS+

$view_{n+2}$

$view_{n+1} = p$

$view_{n-1}$

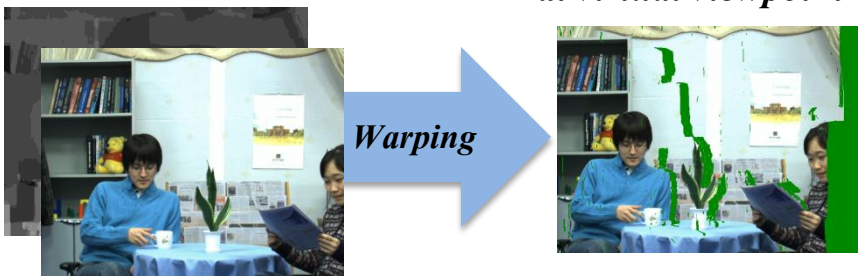
Multiview Texture

VSRS+

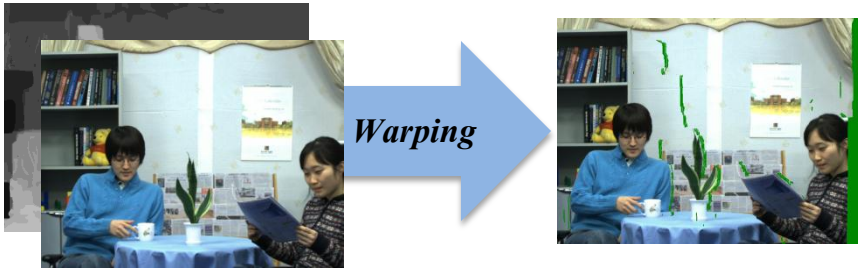
Warped views

at virtual viewpoint n

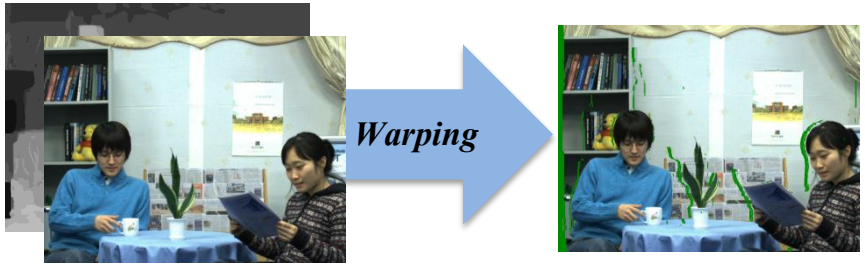
$view_{n+2}$



$view_{n+1} = p$



$view_{n-1}$



VSRS+

$view_{n+2}$

Warping

Warped views at virtual viewpoint n

$view_{n+1} = p$

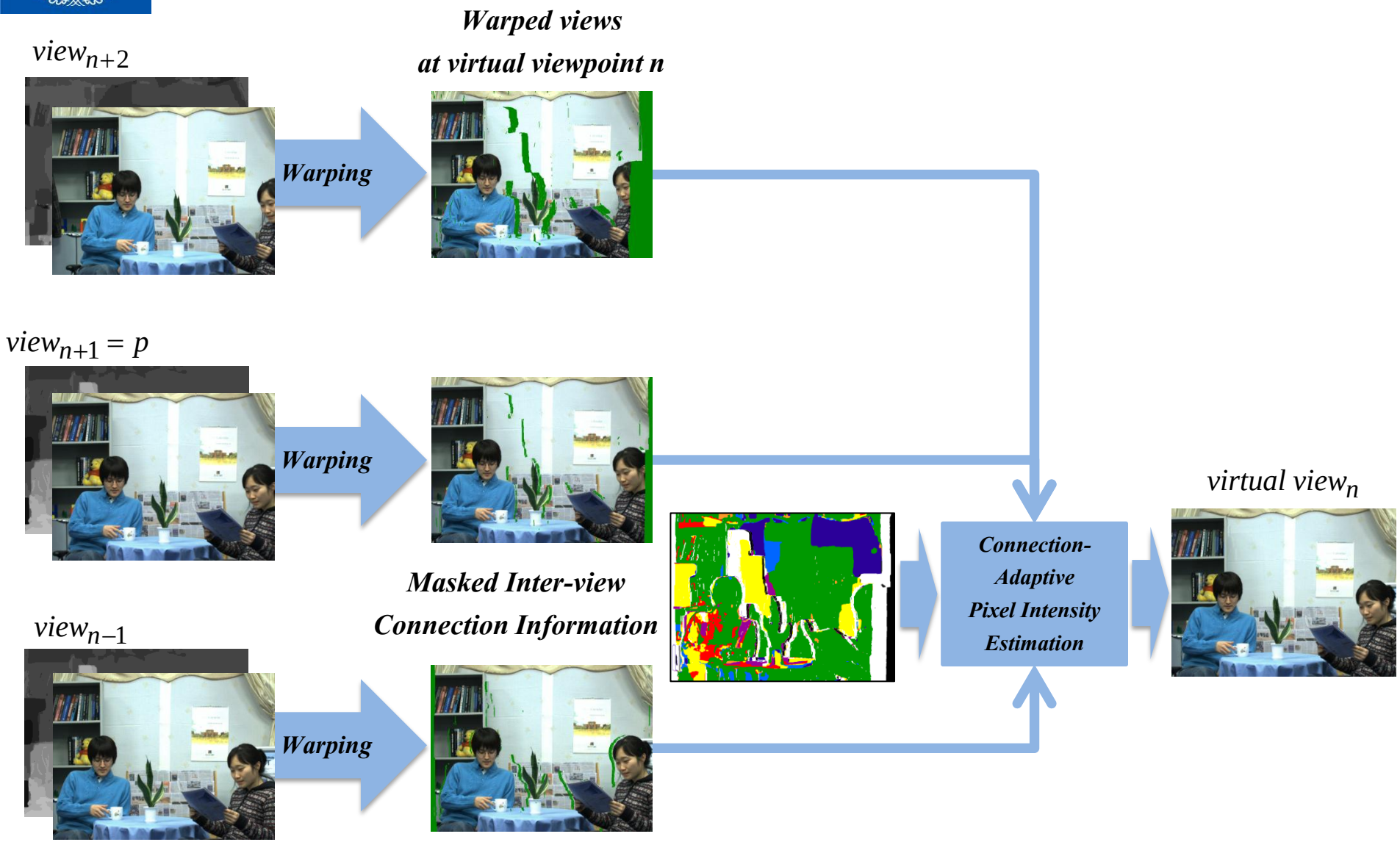
Warping

Masked Inter-view Connection Information

$view_{n-1}$

Warping

VSRS+


Warped views
at virtual viewpoint n
$view_{n+2}$
Warping
$view_{n+1} = p$
Warping
Masked Inter-view
Connection Information
$view_{n-1}$
Warping
Connection-
Adaptive
Pixel Intensity
Estimation
virtual $view_n$

Results

MPEG/D→ MDCTA/ED → VSRS+

Sequence ID	Test Sequence	Spatial Resolution	No. Frames	Virtual View	MPEG/D→ VSRS 3.5 [dB]	MDCTA/ED→VSRS+	
						Adaptive Connection	Fixed Connection
S01	Poznan Hall 2	1920x1088	200	6.5	SE	SE	SE
S02	Poznan Street	1920x1088	250	3.5	SE	SE	SE
S03	Undo Dancer	1920x1080	250	03	38.50	38.84	38.84
S04	GT Fly	1920x1080	250	04	SE	x	x
S03	Kendo	1024x768	300	04	37.66	37.96	38.10
S06	Balloons	1024x768	300	04	36.63	36.88	36.89
S07	Lovebird1	1024x768	240	07	28.68	29.37	29.85
S07*	Lovebird1	1024x768	240	07	30.37	30.50	30.81
S08	Newspaper	1024x768	300	05	32.35	34.10	34.43

Results

MPEG/D→ VSRS+

Sequence ID	Test Sequence	Spatial Resolution	No. Frames	Virtual View	MPEG/D→ VSRS 3.5 [dB]	MDCTA/ED→VSRS+		MPEG/D→ VSRS+
						Adaptive Connection	Fixed Connection	Adaptive Connection
S01	Poznan Hall 2	1920x1088	200	6.5	SE	SE	SE	SE
S02	Poznan Street	1920x1088	250	3.5	SE	SE	SE	SE
S03	Undo Dancer	1920x1080	250	03	38.50	38.84	38.84	39.46
S04	GT Fly	1920x1080	250	04	SE	x	x	x
S03	Kendo	1024x768	300	04	37.66	37.96	38.10	38.13
S06	Balloons	1024x768	300	04	36.63	36.88	36.89	37.00
S07	Lovebird1	1024x768	240	07	28.68	29.37	29.85	29.60
S07*	Lovebird1	1024x768	240	07	30.37	30.50	30.81	30.70
S08	Newspaper	1024x768	300	05	32.35	34.10	34.43	33.50

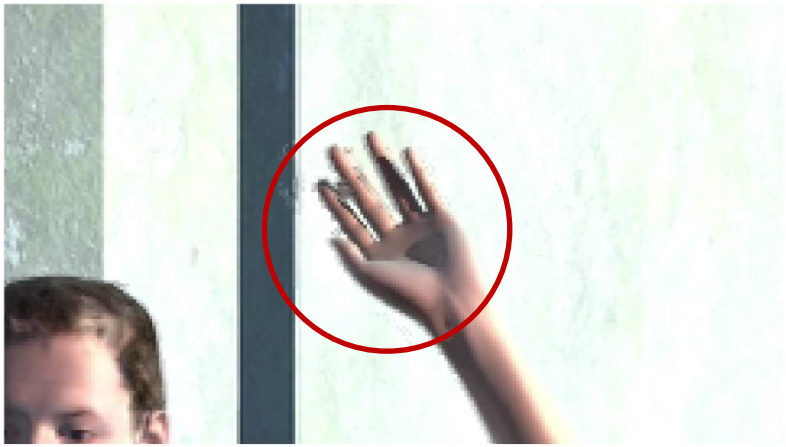
Subjective Results

Original

Undo Dancer 3
Frame 30

MPEG/D → VSRS 3.5

MPEG/D → MDCTA/ED → VSRS+

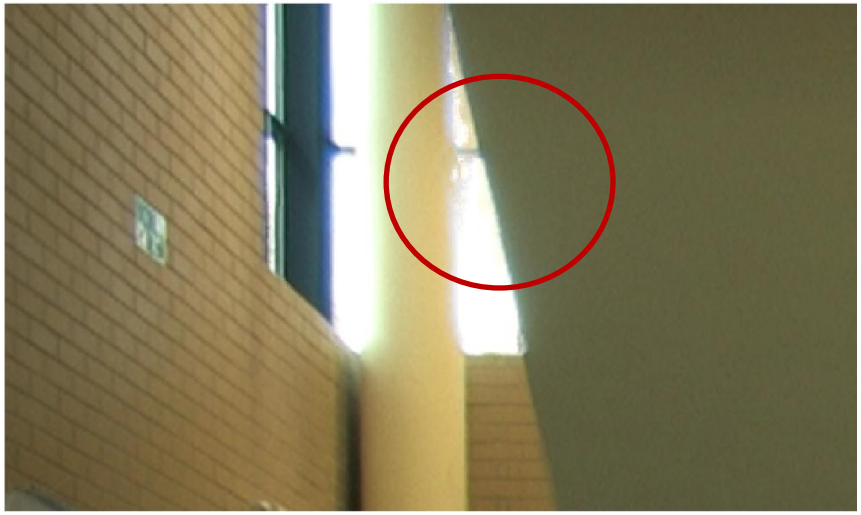


MPEG/D → VSRS+

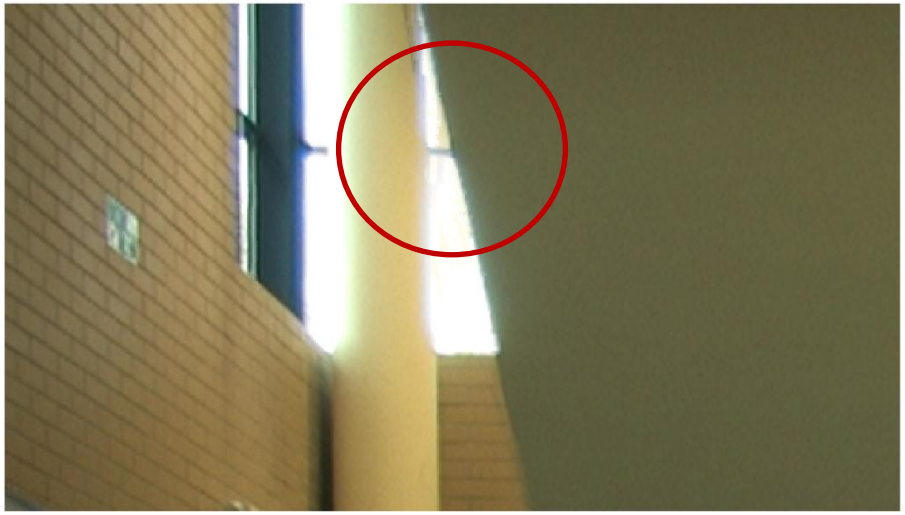
Subjective Results

MPEG/D → VSRS 3.5

Poznan Hall2
Frame 159



MPEG/D → MDCTA/ED → VSRS+



MPEG/D → VSRS+

Subjective Results

MPEG/D → VSRS 3.5

Poznan Street
Frame 121

MPEG/D → MDCTA/ED → VSRS+

MPEG/D → VSRS+

Subjective Results

MPEG/D → VSRS 3.5

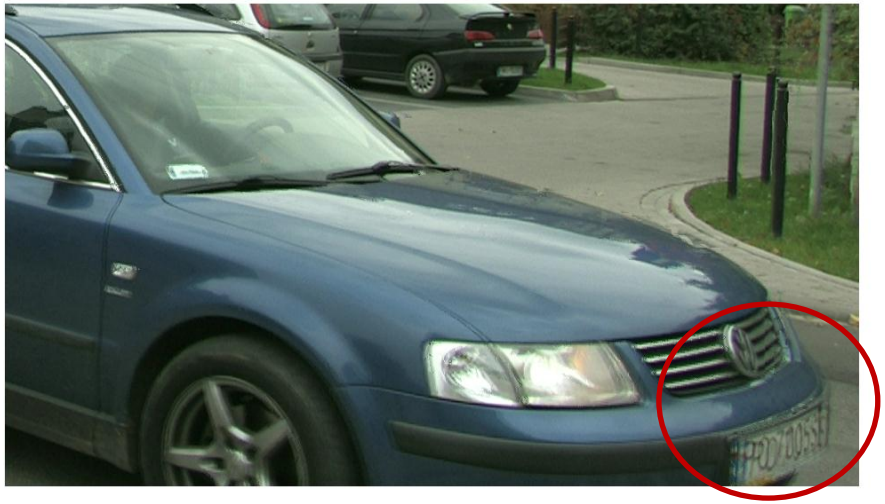
Poznan Hall2
Frame 122

MPEG/D → MDCTA/ED → VSRS+

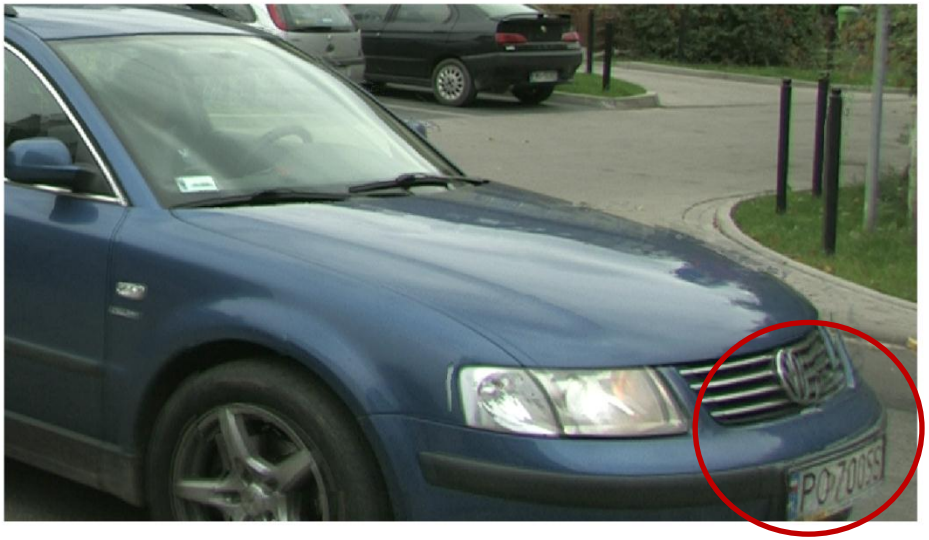
MPEG/D → VSRS+

Subjective Results

MPEG/D → VSRS 3.5



Poznan Street
Frame 250



MPEG/D → MDCTA/ED → VSRS+

MPEG/D→ VSRS+

Subjective Results

Original

Kendo 4
Frame 202

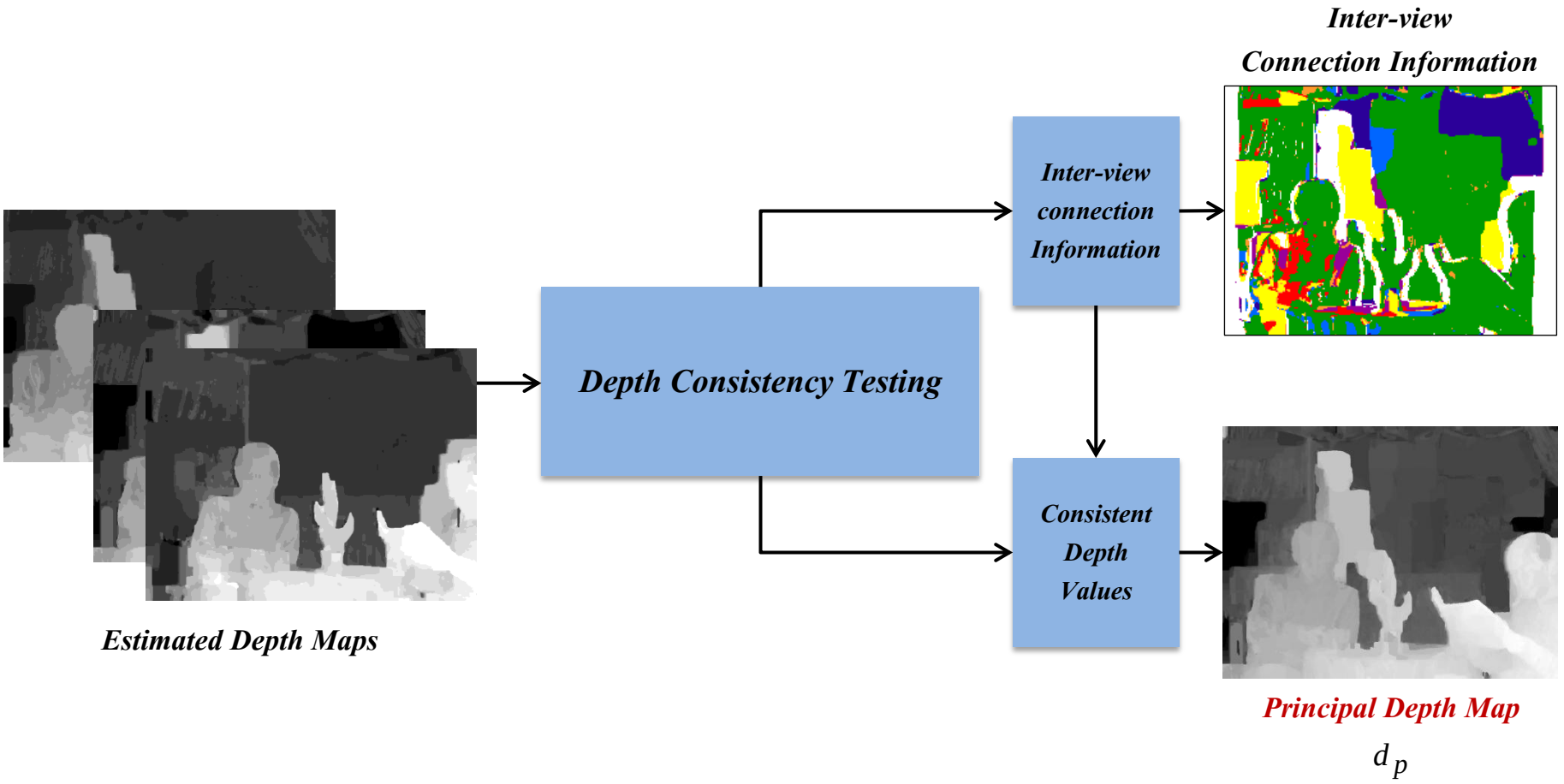
MPEG/D → VSRS 3.5

MPEG/D → MDCTA/ED → VSRS+

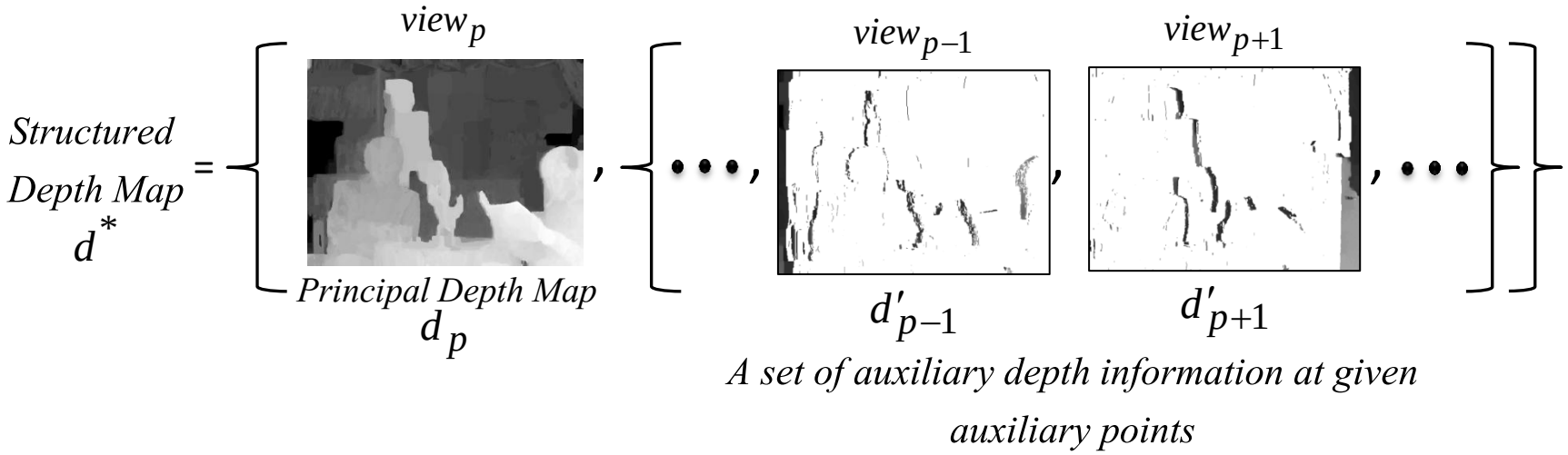
MPEG/D → VSRS+

Rendering with Structured-Depth

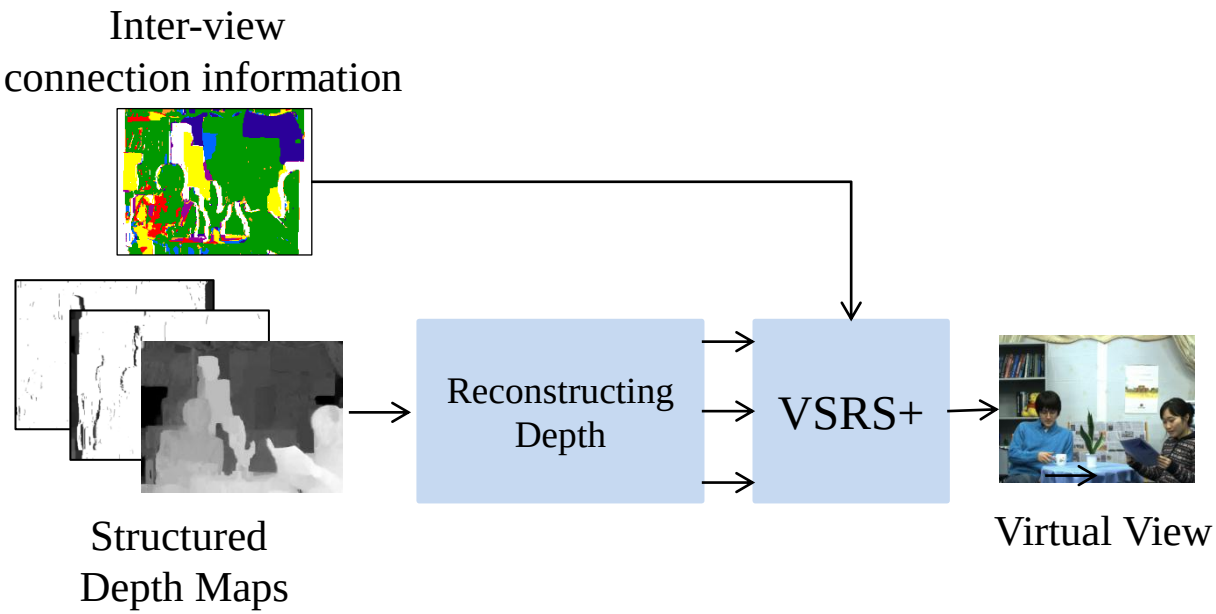
Principal Depth Map



Structured Depth Maps

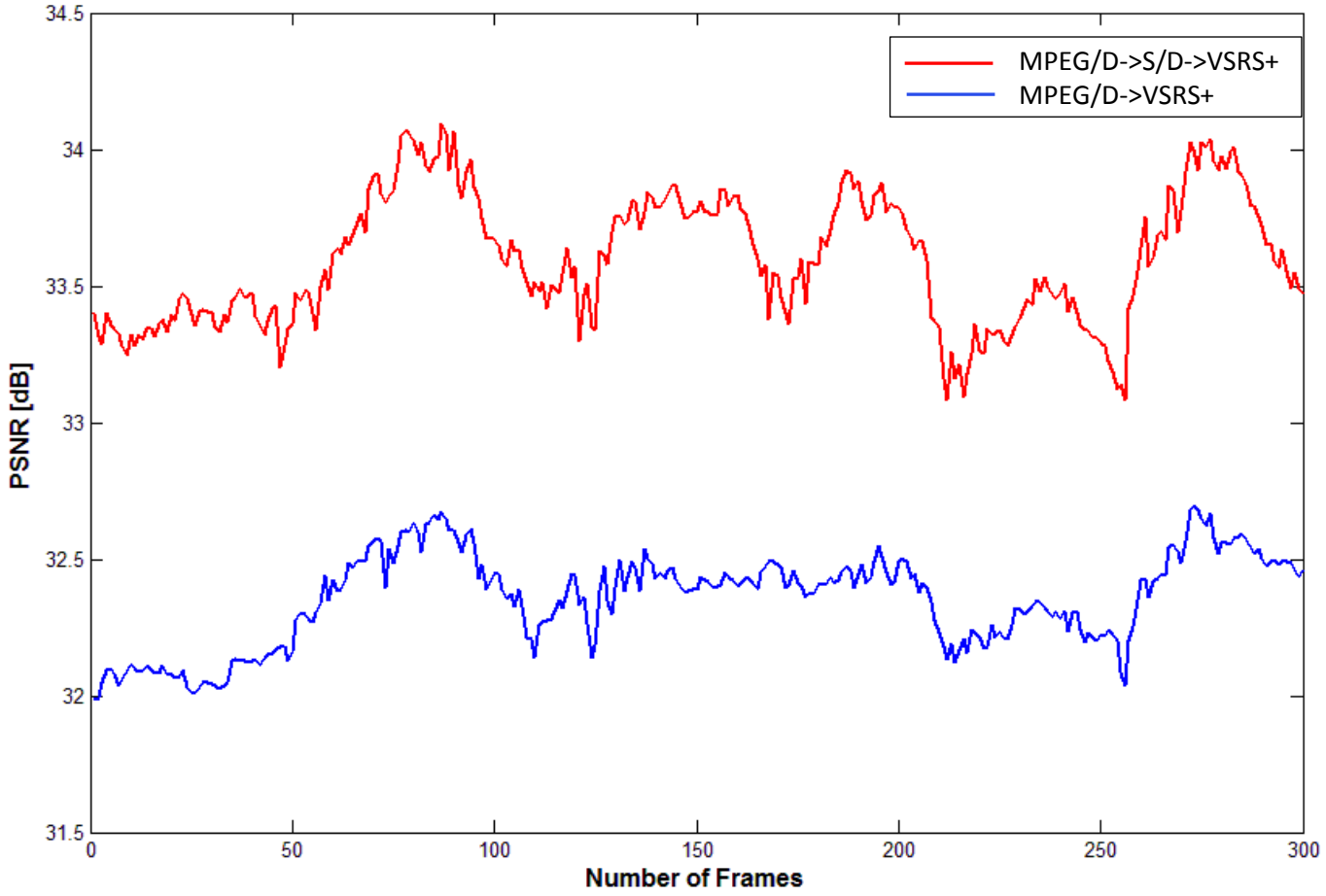


Rendering with Structured Depth Maps



Results

MPEG/D→S/D→VSRS+



Newspaper 5

Results

MPEG/D→ S/D → VSRS+

Sequence ID	Test Sequence	Spatial Resolution	No. Frames	Virtual View	MPEG/D→ VSRS 3.5 [dB]	MDCTA/ED→VSRS+		MPEG/D→ VSRS+	MPEG/D→S/D→VSRS+	
						Adaptive Connection	Fixed Connection	Adaptive Connection	Adaptive Connection	Fixed Connection
S01	Poznan Hall 2	1920x1088	200	6.5	SE	SE	SE	SE	SE	SE
S02	Poznan Street	1920x1088	250	3.5	SE	SE	SE	SE	SE	SE
S03	Undo Dancer	1920x1080	250	03	38.50	38.84	38.84	39.46	38.86	38.86
S04	GT Fly	1920x1080	250	04	SE	x	x	x	x	x
S03	Kendo	1024x768	300	04	37.66	37.96	38.10	38.13	37.79	37.82
S06	Balloons	1024x768	300	04	36.63			37.00	36.60	36.56
S07	Lovebird1	1024x768	240	07	28.68			29.60	29.50	30.00
S07*	Lovebird1	1024x768	240	07	30.37			30.70	30.32	30.34
S08	Newspaper	1024x768	300	05	32.35			33.50	33.60	33.90

Subjective Results

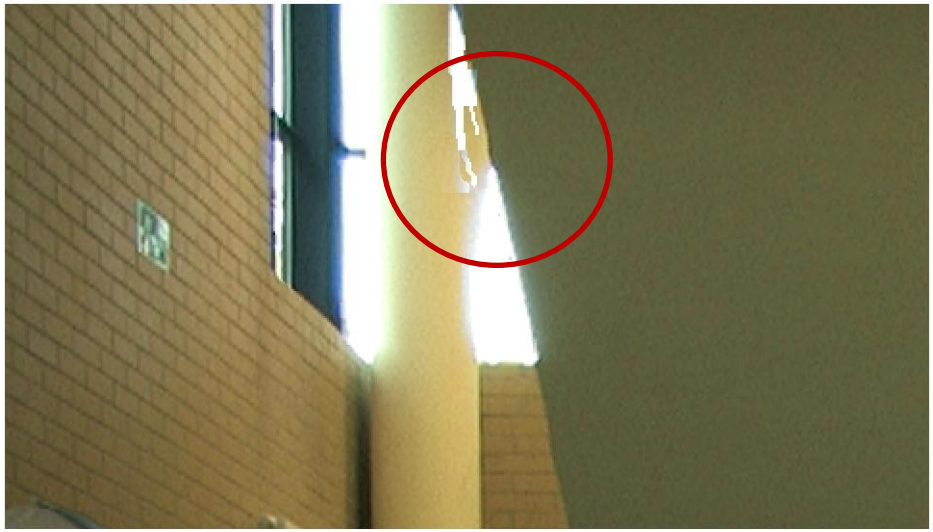
MPEG/D →S/D → VSRS+: Fixed

Adaptive VSRS+
vs.
Fixed VSRS+

MPEG/D → S/D → VSRS+:Adaptive

Newspaper 5
Frame 105

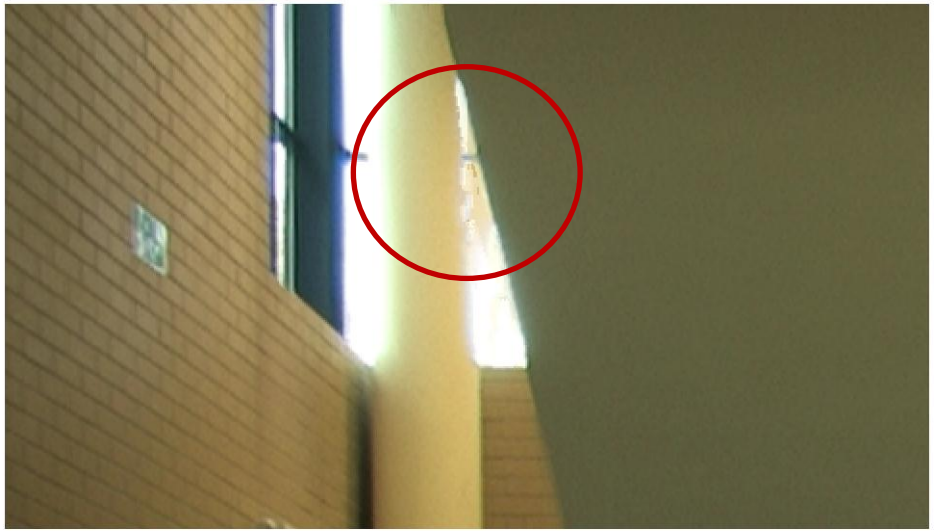
Subjective Results



Poznan Hall2
Frame 151

MPEG/D → VSRS 3.5

MPEG/D → S/D → VSRS+



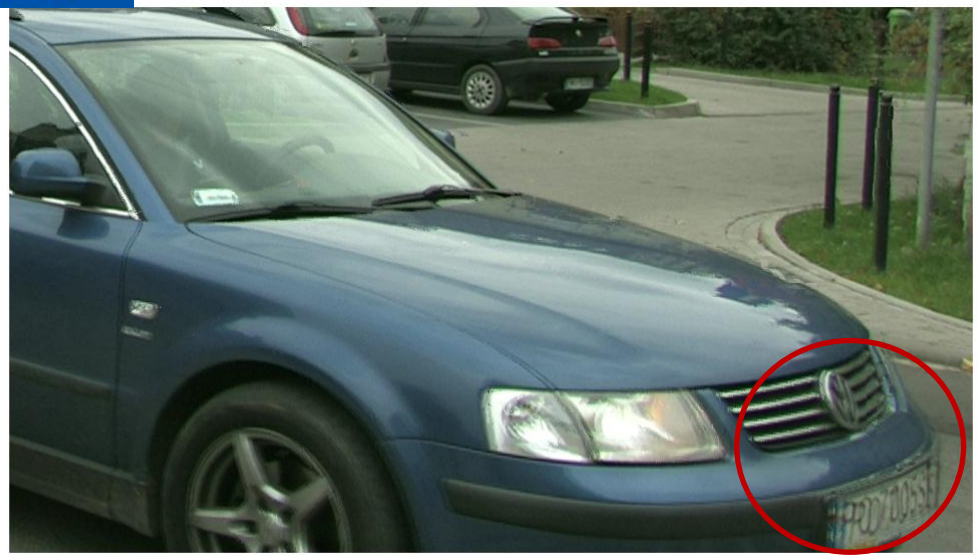
Subjective Results

Poznan Hall2
Frame 121

MPEG/D → VSRS 3.5

MPEG/D → S/D → VSRS+

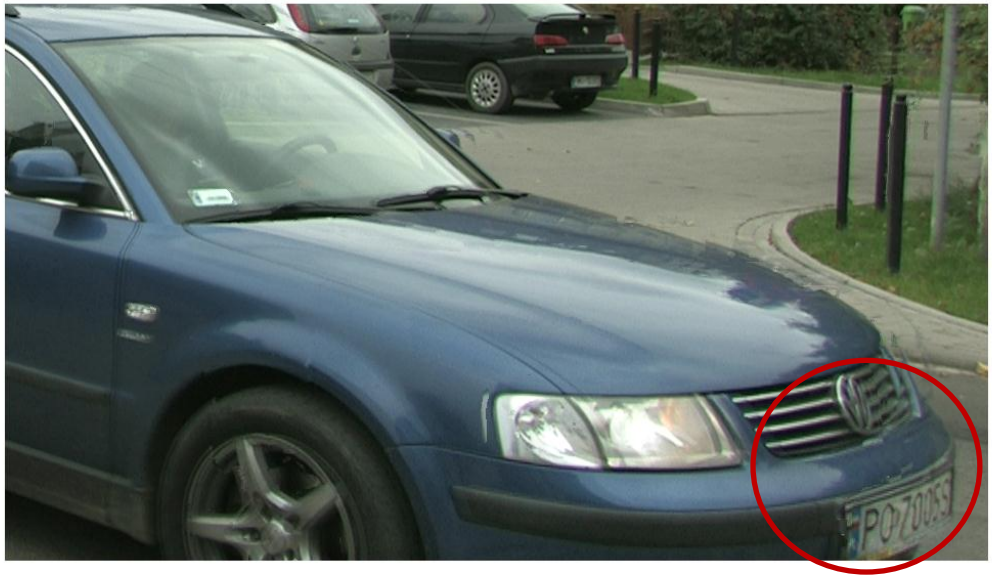
Subjective Results



Poznan Street
Frame 250

MPEG/D → S/D → VSRS+

MPEG/D → VSRS 3.5



Subjective Results

Undo Dancer 3
Frame 30

Original

MPEG/D → VSRS 3.5

MPEG/D → S/D → VSRS 3.5

Subjective Results

Original

Kendo 4
Frame 202

MPEG/D → VSRS 3.5

MPEG/D → S/D → VSRS 3.5

Subjective Results

Original

Kendo 4
Frame 204

MPEG/D → VSRS 3.5

MPEG/D → S/D → VSRS 3.5

Subjective Results

Original

Kendo 4
Frame 204

MPEG/D → VSRS 3.5

MPEG/D → S/D → VSRS 3.5

Subjective Results

Original

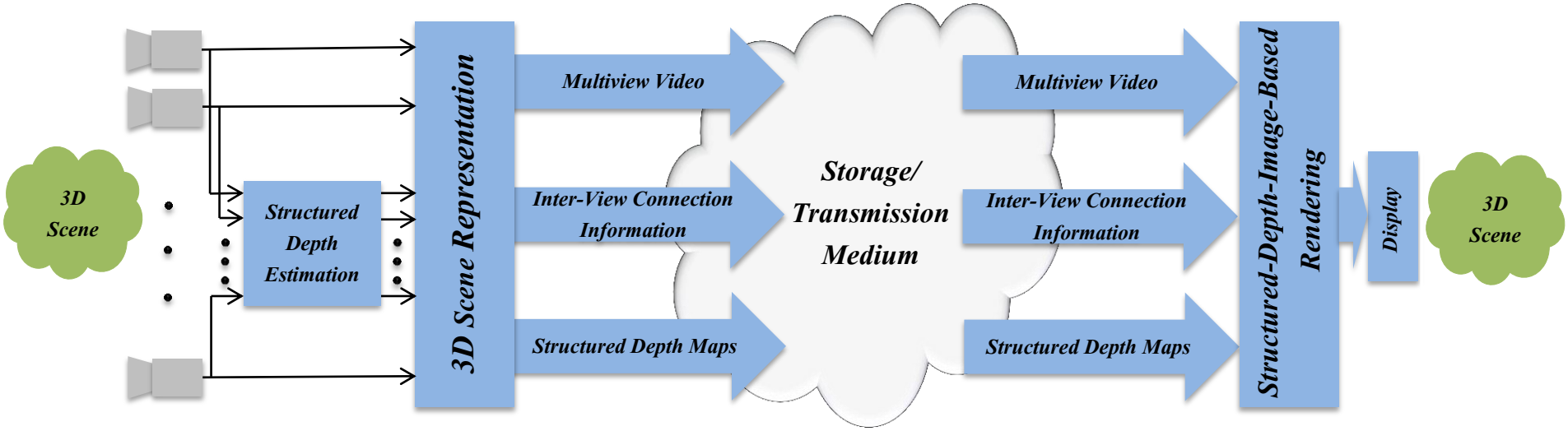
Kendo 4
Frame 204

MPEG/D → VSRS 3.5

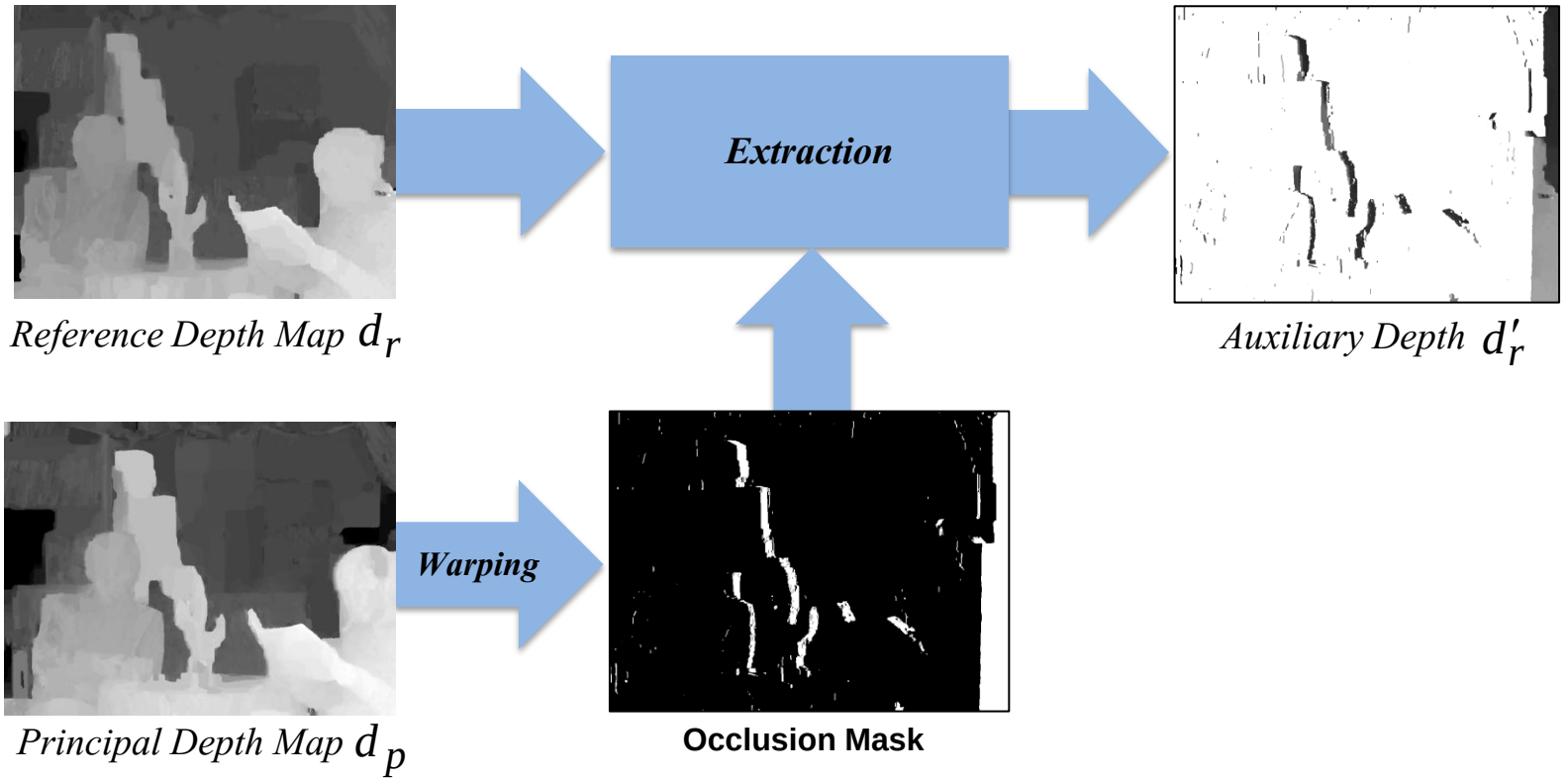
MPEG/D → S/D → VSRS 3.5

Thank You

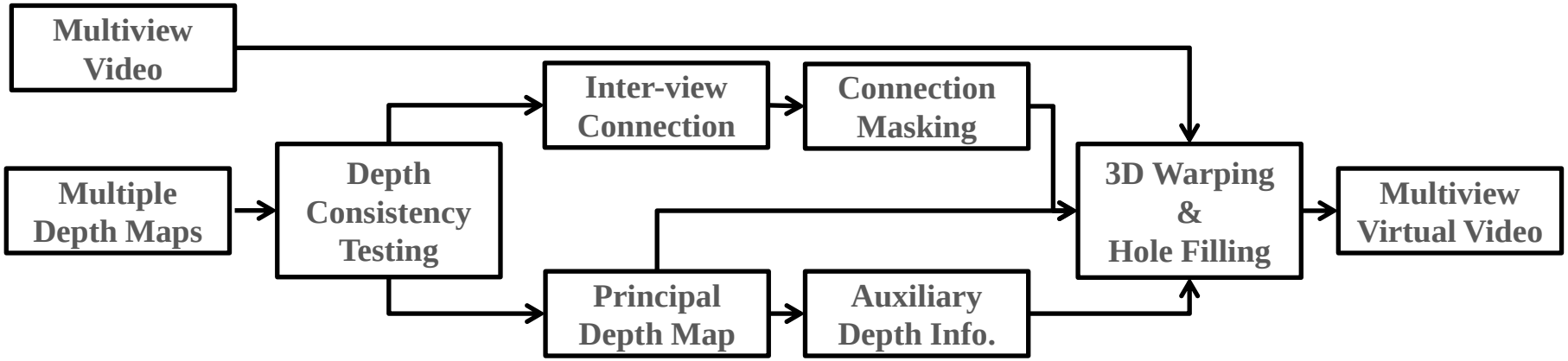
View Synthesis Using Structured Depth Images (VSRS+)



Extraction of Auxiliary Depth



Experiments



Subjective Results

Original

Undo Dancer 3
Frame 30

MPEG/D → VSRS 3.5

MPEG/D → MDCTA/D → VSRS 3.5

MPEG/D → S/D → VSRS+