Object-based Layered Depth Images for improved virtual view synthesis in rate-constrained context

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Context of multi-view videos

Functionalities:

3DTV: Depth feeling by stereo-vision simulation.

FVV: Live viewpoint selection.

Require a virtual view synthesis method.

Fig: 3D rendering
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Outline

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Depth Image-Based Rendering (DIBR)

Warping algorithm

**Input**: View and associated depth map

**Output**: New viewpoint (texture & depth)

Disocclusions

Obstructed scene information from reference viewpoint

They appear along depth discontinuities

Solution: Add additional informations (LDI)

Fig: Disocclusion
Layered Depth Image (LDI) [SGHS98]
A set of layers, containing depth pixels from a single viewpoint

From a reference viewpoint

1\textsuperscript{st} layer $\Rightarrow$ Reference view
Visible texture and depth
2\textsuperscript{nd} layer $\Rightarrow$ Residual data
Hidden texture and depth
Layered Depth Image (LDI) \[SGHS98\]

A set of layers, containing depth pixels from a single viewpoint

From a reference viewpoint

1\textsuperscript{st} layer ⇒ Reference view
Visible texture and depth

2\textsuperscript{nd} layer ⇒ Residual data
Hidden texture and depth

1\textsuperscript{st} layer
Layered Depth Image (LDI) [SGHS98]

A set of layers, containing depth pixels from a single viewpoint

From a reference viewpoint

1\textsuperscript{st} layer $\Rightarrow$ Reference view
Visible texture and depth
2\textsuperscript{nd} layer $\Rightarrow$ Residual data
Hidden texture and depth
Limitations

- Redundant boundaries in both layers
- Moving elements in both layers
- Layers contain large depth discontinuities (Discontinuities are hard to compress)
Outline

1. Introduction
2. Object-based classification
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Object-based LDI representation
This representation organizes pixels into layers to enhance depth continuity

![Classical LDI depth layers](image1)

![Object-based LDI depth layers](image2)

Method based on a growing-region algorithm
Region $R$ initialized with pixels where $Z_{FG}$ and $Z_{BG}$ are already defined.
For each pixel $q$ outside $R$:
- Extrapolate $Z_{FG}$ and $Z_{BG}$.
- Classify $q$. 
Object-based LDI representation

This representation organizes pixels into layers to enhance depth continuity

1st layer

2nd layer

Fig: Classical LDI depth layers

Fig: Object-based LDI depth layers

Method based on a growing-region algorithm

Region $R$ initialized with pixels where $Z_{FG}$ and $Z_{BG}$ are already defined.

For each pixel $q$ outside $R$:
- Extrapolate $Z_{FG}$ and $Z_{BG}$.
- Classify $q$. 
Classification: Initializing

Foreground

Unclassified

Background
Classification: Results

Foreground

Unclassified

Background
Background inpainting [CPT03]

Advantages
- Remove unnecessary boundaries
- Inpainting processed once, before encoding stage
- No need of inpainting method at rendering stage

Fig: Background inpainting

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Rendering results

Classical LDI rendering  Virtual view inpainting  O-LDI rendering
Fast mesh-based rendering

Continuous layers can be rendered as meshes.
Foreground mesh is partially transparent.

Fig: Meshes rendering
Fig: Object-based LDI
MVD compression (MVC)

Input views

$V_1, V_3, V_5, V_7$

Compressed views

$V'_1, V'_3, V'_5, V'_7$

Rendering

VSRS

Final view

$V''_6$

LDI compression (MVC)

Input LDI

$LDI_4$

Compression

$LDI'_4$

Compressed LDI

DIBR

Rendering

$V_6$

Final view
Rate-distortion curve

![Rate-distortion curve graph](image_url)

- **Object-based LDI**
- **Classical LDI**
- **MPEG (MVC/VSRS)**

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Conclusions on Object-Based LDI

Advantages
- Remove unnecessary boundaries ⇒ Improve compression
- Static background along time
- Compatible with fast mesh-based rendering
- Depth continuity improves rendering quality

Limit
- No backward compatibility with 2D decoding scheme

Questions?
Object removal by exemplar-based inpainting.

[JMG09] Vincent Jantet, Luce Morin, and Christine Guillemot.
Incremental-ldi for multi-view coding.

Layered depth images.