m58776
Refinement of Trisoup variable node size extension for improving subjective quality

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Overview

■ Problem statement

- Variable node size extension of Trisoup is studied in EE13.50.
- In the conventional proposal, decoding process for each node size is independent.
- It may be cause of visual “gaps” on node boundaries.

■ Proposed method

- Reconstruction process is done by fixed (min) node size, even if decoding of vertex positions is done by variable node size.

	Decoding of vertex positions	Reconstruction
TMC13-14.0	Fixed node size	Fixed node size
Conventional [1][2]	Variable node size	Variable node size
Proposal	Variable node size	Fixed (Min) node size

■ Experimental results

- Objective quality: vs Fixed (TMC13-v14) : -7.4%/1.3% (D1/D2 BD-rate)
  vs Conv. Variable : 0.2%/0.6% (D1/D2 BD-rate)
- Subjective quality: It is confirmed that “gaps” are disappeared.

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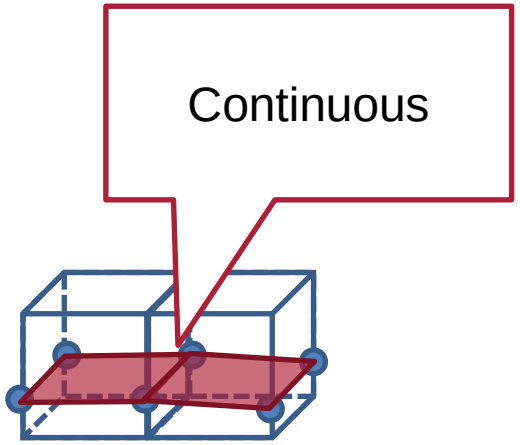
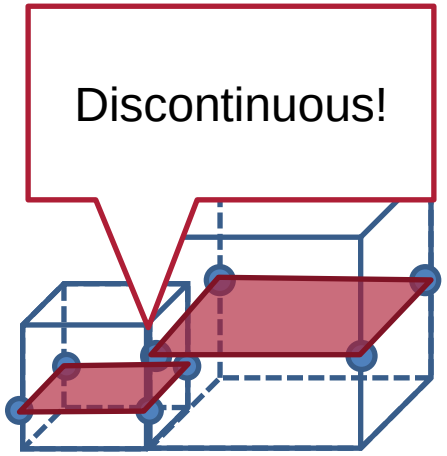
Problem Statement

- Variable node size extension of Trisoup is studied in EE13.50.
- In the conventional proposal, decoding process for each node size is independent.
- It was pointed out that it might be cause of visual “gaps” on node boundaries.
  - Single node size Trisoup shares vertex on each edge to ensure continuity.
  - We confirmed that “gaps” exist on reconstructed point cloud.
- A solution to solve “gaps” on variable node size Trisoup is proposed in this contribution.



Single node size



Conv. variable node size

Visual “gaps” by conv. variable node size

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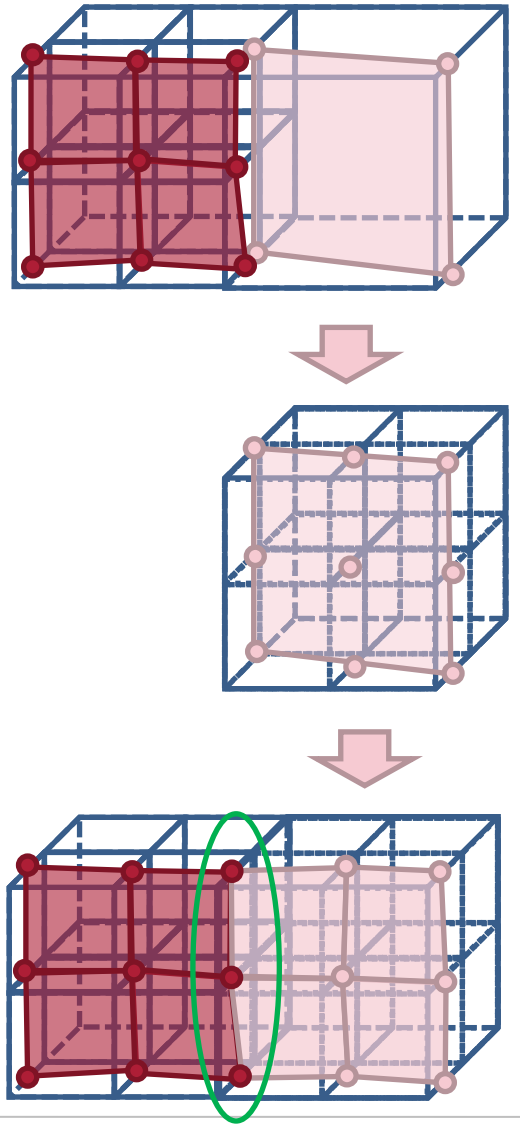
Basic Idea of The Proposed Method

■ Causes of discontinuity

1. Independent decoding for each node size
2. Difference of vertex granularity

■ Proposed solution

- Interpolate vertices on the min node size edges.
- Merge vertices to one vertex on a edge to ensure continuity.



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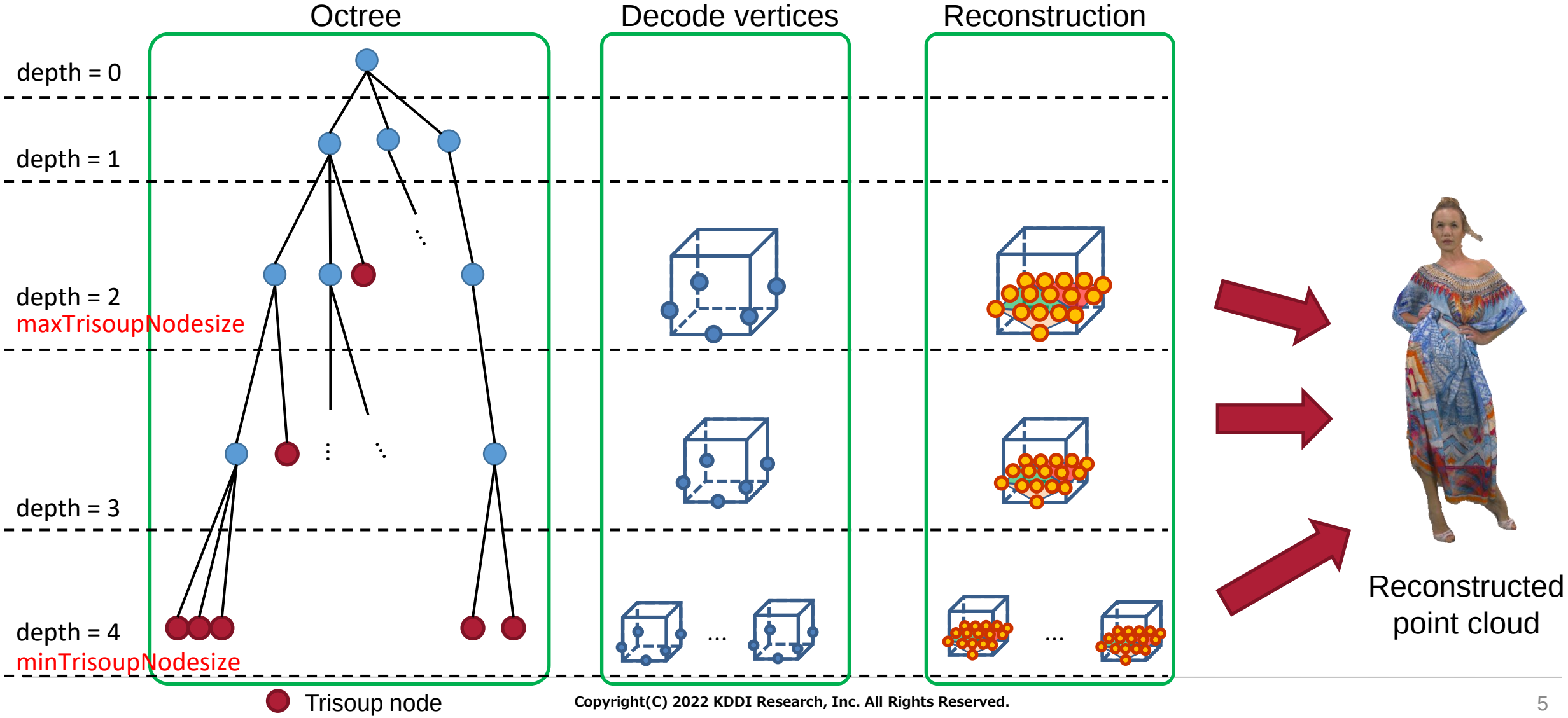
Conventional proposal of variable node size Trisoup

■ **Both decoding vertices and reconstruction are independent for each level.**



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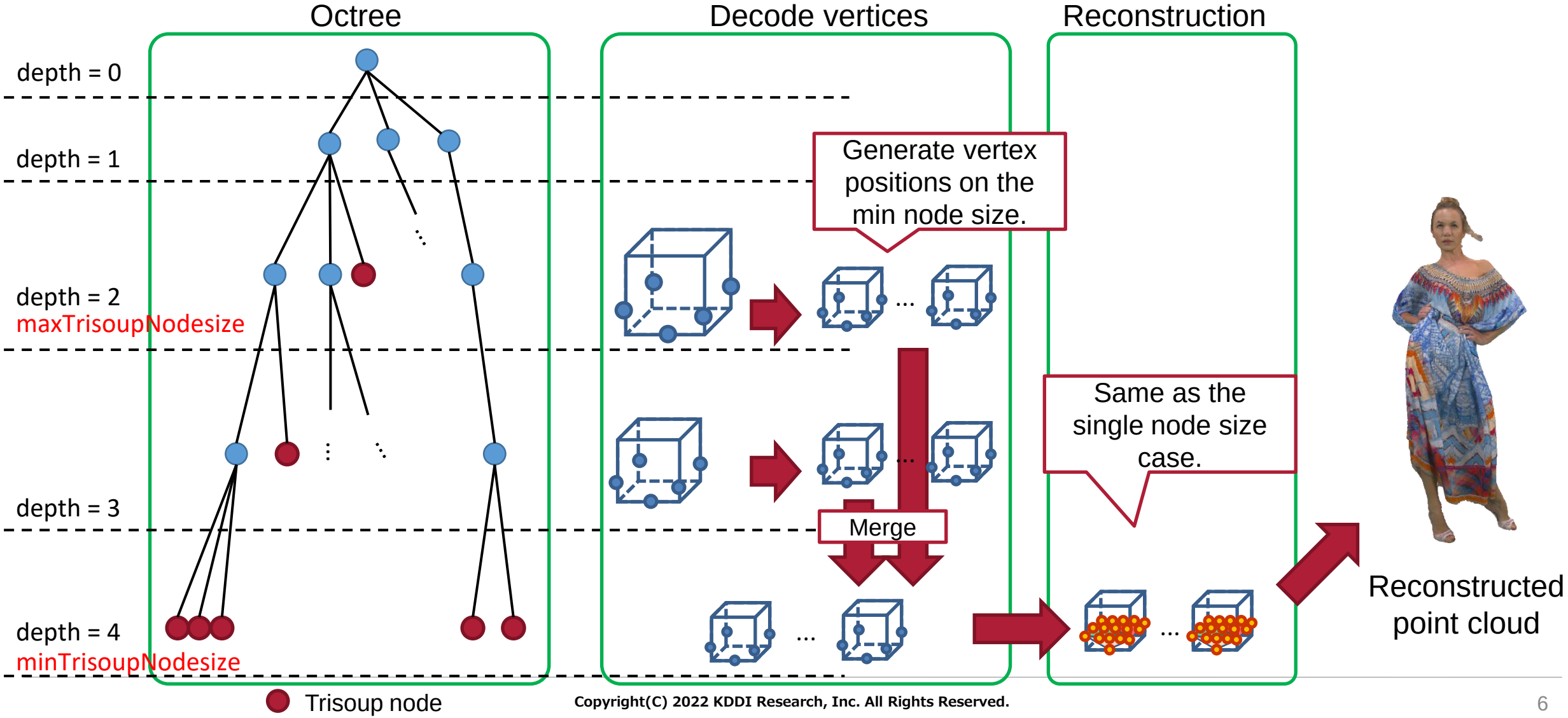
Proposed solution

■ **Reconstruction process is done by fixed (min) node size.**



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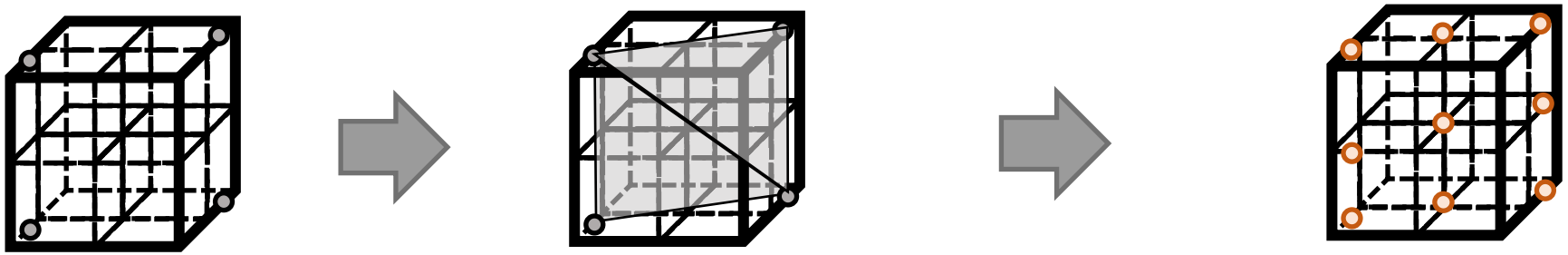
How to merge vertices from different levels?

1. Generate vertices on the min node size from vertices on larger node size.



Decode vertex positions.

Make triangle meshes
(as same as the normal Trisoup)

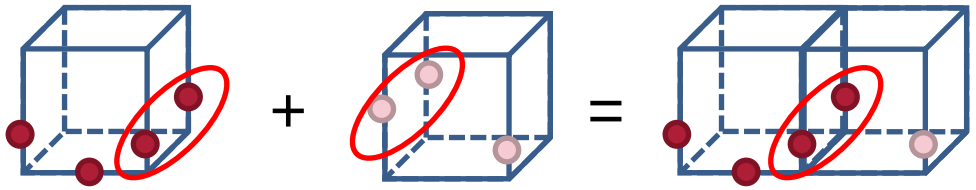
Generate vertices on intersection of meshes
and edges (similar with normal Trisoup)

Vertices are merged (by average) if two or more vertices on an edge in the min node size.

2. Merge vertices on the min node size

- **If two or more vertices on an edge, a vertex decoded by the smallest node size is retained.**
  Because vertex position by smaller node may be more accurate.

- **Surface continuity can be preserved even if vertex positions decoded by variable node size!**



Vertices from node size N

Vertices from node size N+m

Merged vertices

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Experiments (same as the EE13.50 report)

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Conditions

- Anchor : TMC13-v14.0
- Test : TMC13-v14.0 + Proposed method
- Trisoup – RAHT (Only C2 condition, Cat1 Sequences)

Node size settings

- In the test method, node size can be chosen among CTC and CTC+1.

Method	Node size log2			
	r01	r02	r03	r04
Anchor (CTC)	5	4	3	2
Test (node size = CTC & CTC+1)	6, 5	5, 4	4, 3	3, 2

Cost function (Cost function of Test 3 is used in this contribution)

- D1 MSE: Symmetrical,
- D2 MSE: Asymmetrical (only use original normal data)
- In test 2.2, D2 MSE is multiplied by four
  - D1 MSE is roughly four times larger than D2 in CTC.
- λ is heuristically set as {372.0, 26.0, 1.8, 0.12} for {r01, r02, r03, r04}.

Test	Cost function
1	$D1$
2.1	$D1 + D2$
2.2	$D1 + 4 * D2$
3	$D1 + 4 * D2 + \lambda R$

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Experimental results (Objective Quality)

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■ Objective quality

- **vs Fixed (TMC13-v14) : -7.4%/1.3% (D1/D2 BD-rate)**
- **vs Conv. Variable : 0.2%/0.6% (D1/D2 BD-rate)**
  - For Solid and Dense, D1/D2 BD-rates are improved.
  - For Sparse, almost all of losses come from ulb_unicorn_vox13.
  - For Scant, losses come from ulb_unicorn_vox20.

TMC13-v14.0 (Fixed) vs. Proposal (Variable)

C2_ai	lossy geometry, lossy attributes [all intra] Geom. BD-TotGeomRate [%] D1	D2
Solid average	−1.1%	1.4%
Dense average	−8.2%	−0.1%
Sparse average	−6.6%	5.5%
Scant average	−10.7%	−0.1%
Overall average	−7.4%	1.3%
Avg. Enc Time [%]	215%	
Avg. Dec Time [%]	121%	

m55773 (Variable) Test 3 vs. Proposal (Variable)

C2_ai	lossy geometry, lossy attributes [all intra] Geom. BD-TotGeomRate [%] D1	D2
Solid average	−0.9%	−1.6%
Dense average	−0.7%	−0.8%
Sparse average	2.4%	4.1%
Scant average	0.3%	0.9%
Overall average	0.2%	0.6%
Avg. Enc Time [%]	110%	
Avg. Dec Time [%]	125%	

From ulb_unicorn_vox13

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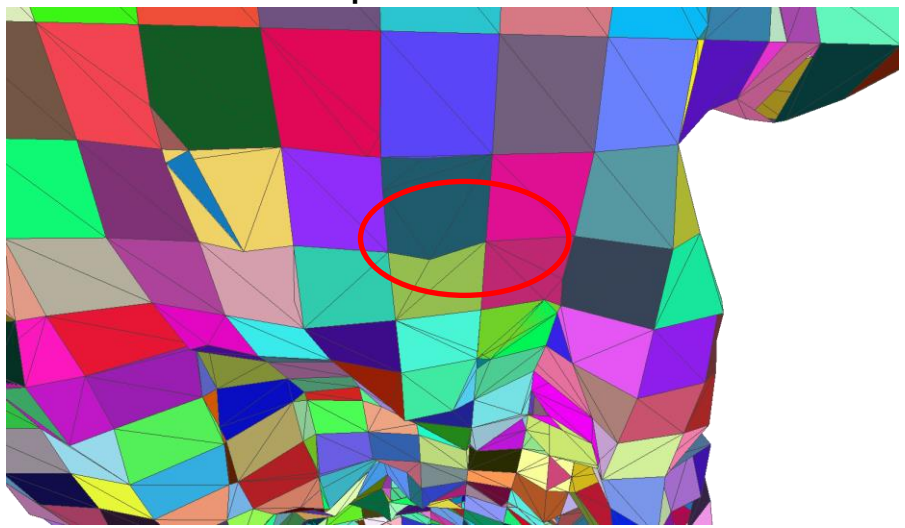
Experimental results (Subjective Quality)

■ **Visual “gaps” are disappeared.**

Conventional variable node size

Proposal



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Experimental results (Subjective Quality)

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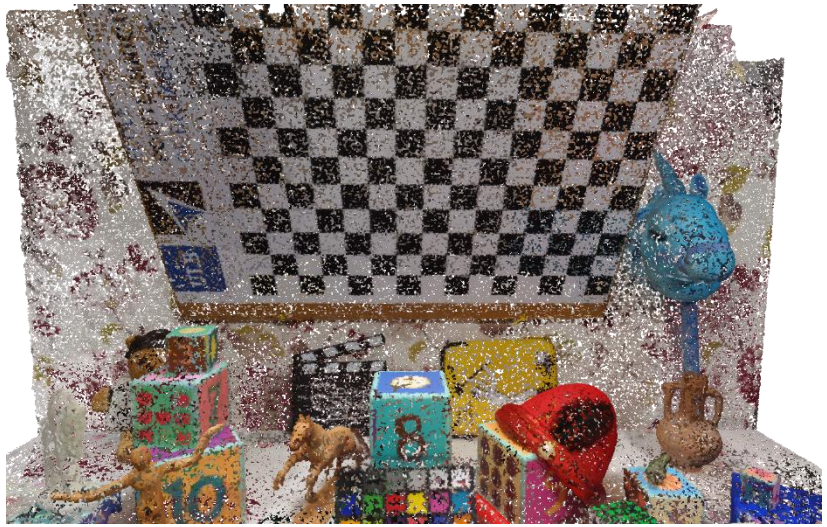
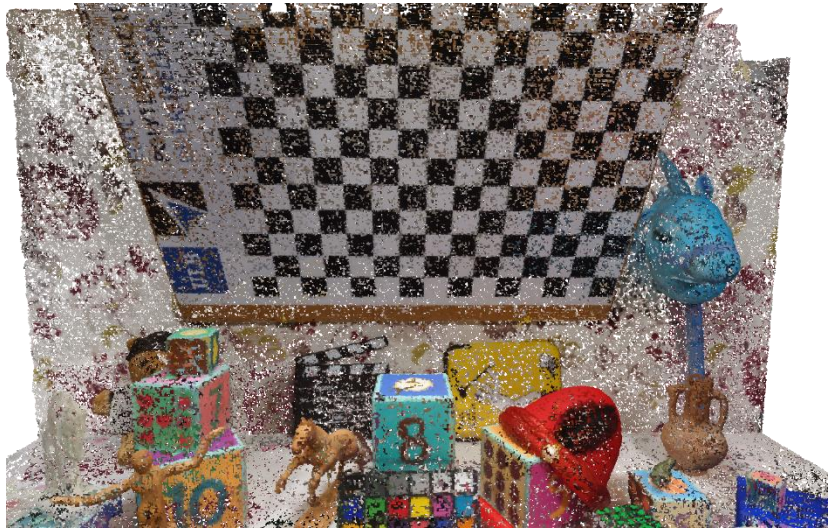
- **ulb_unicorn_vox13**
  - **Subjective quality of proposal is not so different from TMC13-v14.0.**
  - **ulb_unicorn_vox13 is challenging data for Trisoup because original point cloud is sparse.**

Original



TMC13-v14.0
(Fixed node size)



Proposal
(Variable node size)

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Conclusion

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Recommendation

- **Adopt refined variable node size extension of Trisoup to the next version of TMC13.**
  Variable node size extension has been already studied in EE, and subjective quality concern is solved.

Thank Sony for cross-checking.

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