



Topologically controlled lossy compression

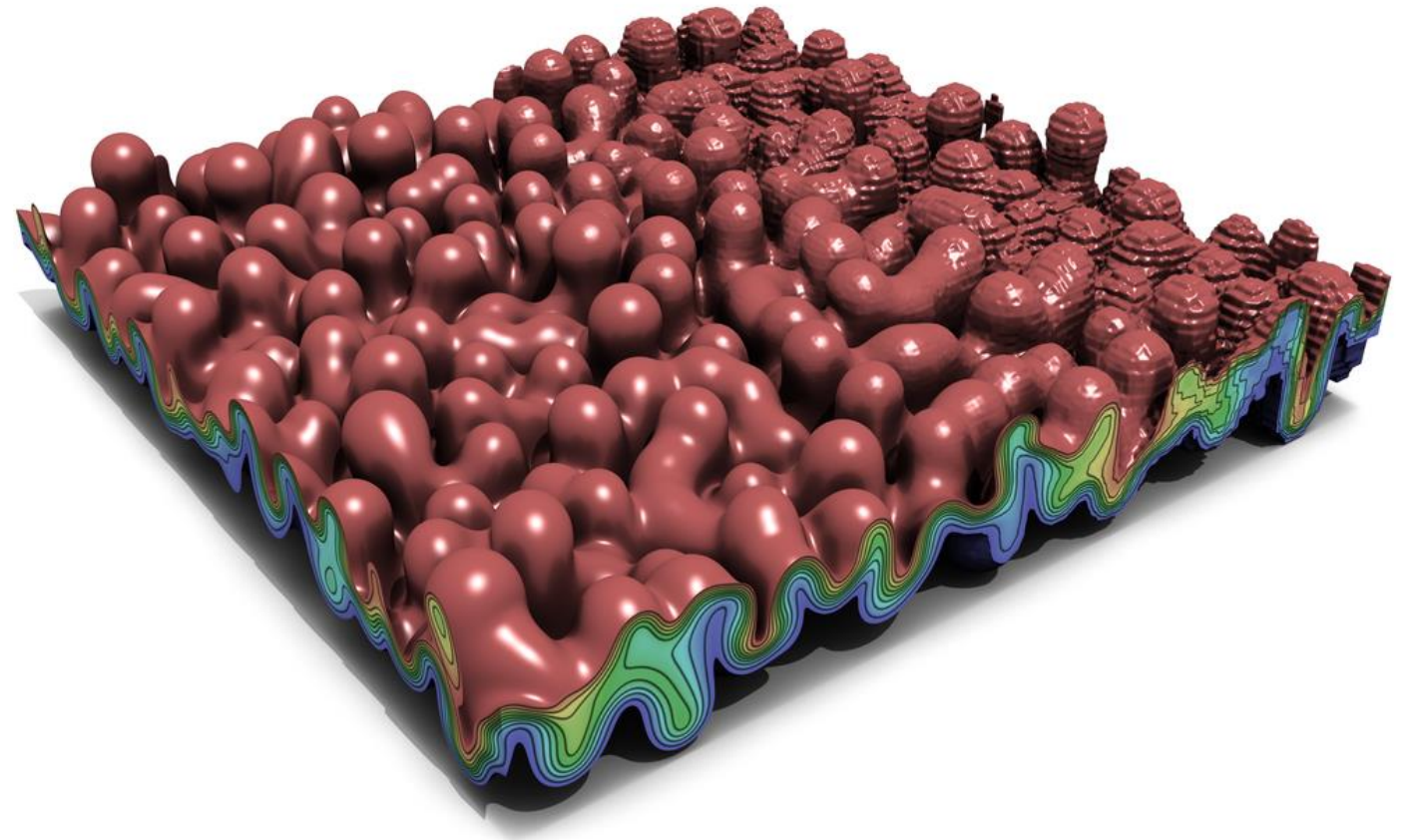
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Sorbonne University, TOTAL S.A.

Agenda

- Context
- Compression algorithm
- Topological compression: 2D image
- Topological compression: medical data

Context

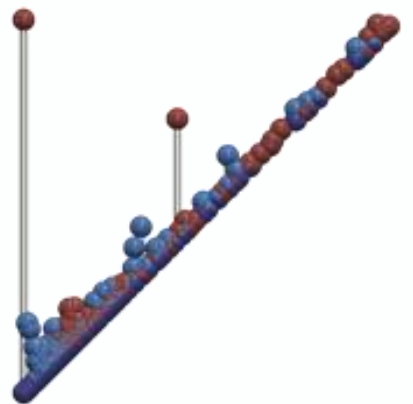
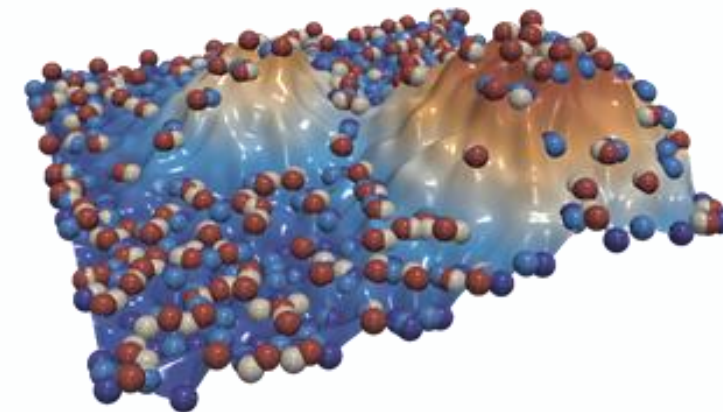
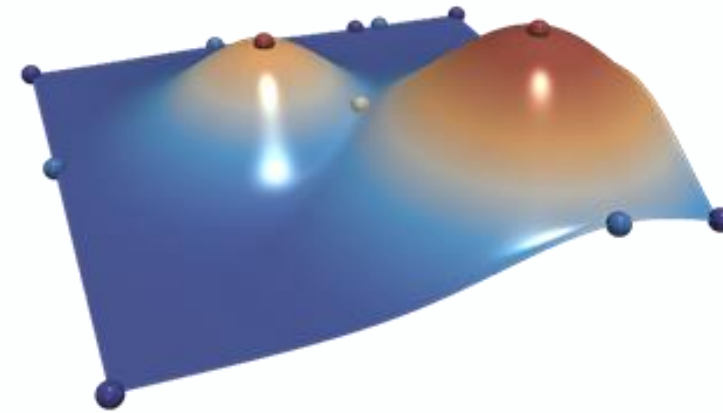
- Data compression
- Problems
 - Lossless: low compression factors
 - Lossy: topological error



Rayleigh-Taylor instability compressed with ZFP [1].
Compression factor from 1 (left) to 64 (right)

Context

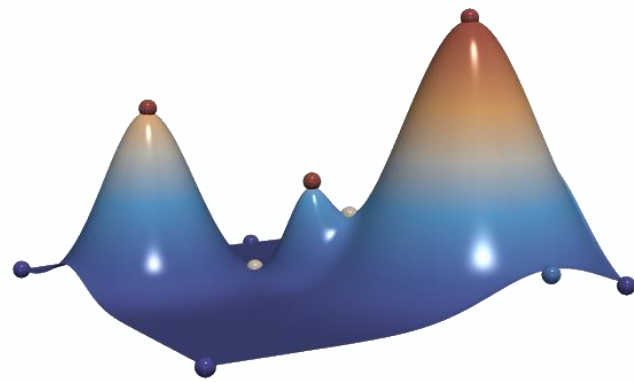
- Data compression
- Topological lossy compression
 - Based on *persistence diagrams*
 - Control of the topological loss



Smooth and noisy 2D functions
with associated persistence diagrams

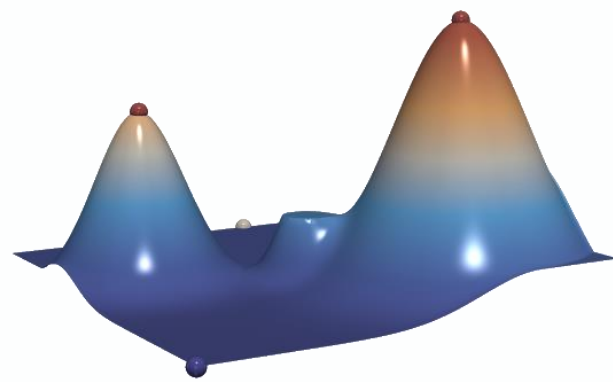
Compression algorithm

Compression

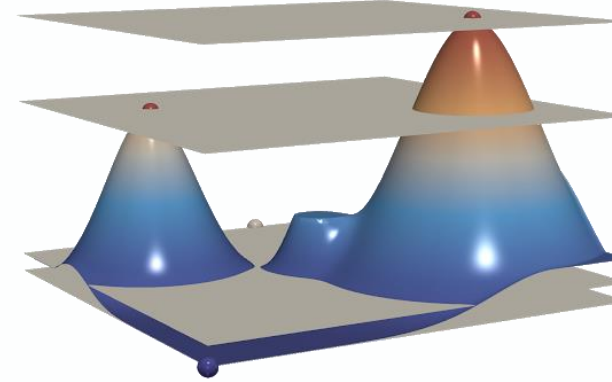


Inputs:

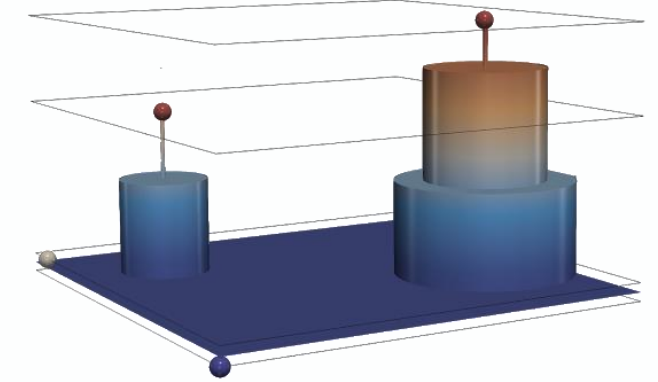
- 2D/3D field
- Threshold ε



1. Topological ε -simplification



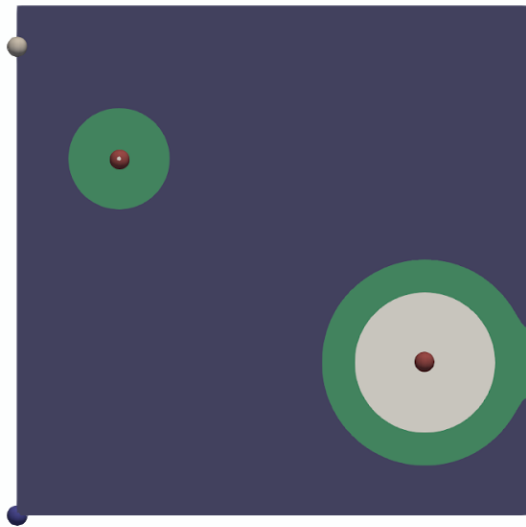
2. Domain quantization



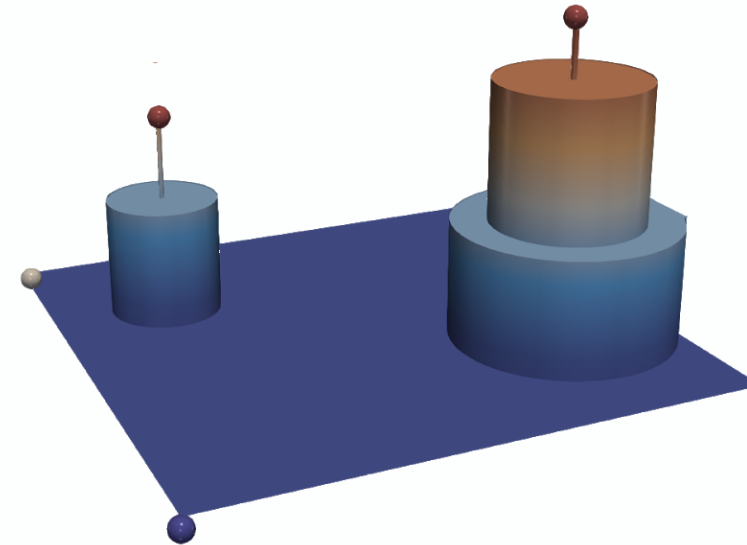
3. Topological identifier and value assignment

4. Lossless compression of topological identifiers

Decompression



id1	→	0.45
id2	→	0.04
id3	→	0.76



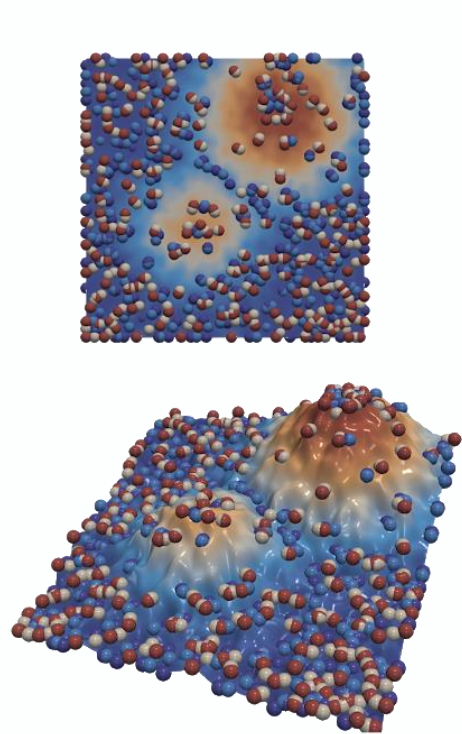
1. Lossless decomposition
of identifiers

2. Value assignment

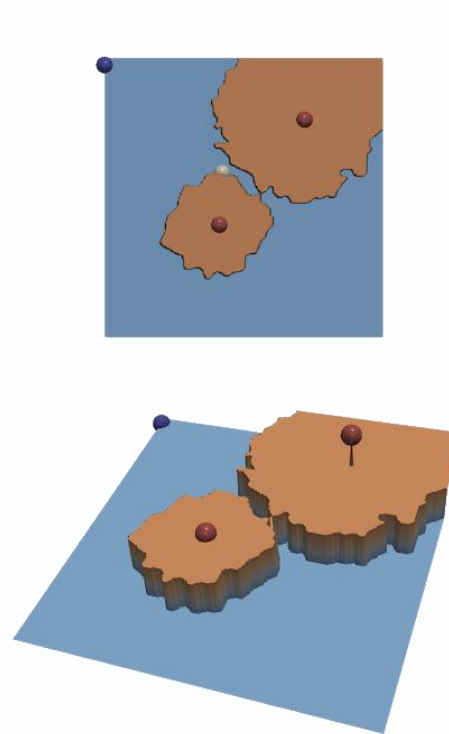
3. Topological (ϵ -)correction
(for extensions)

Extensions

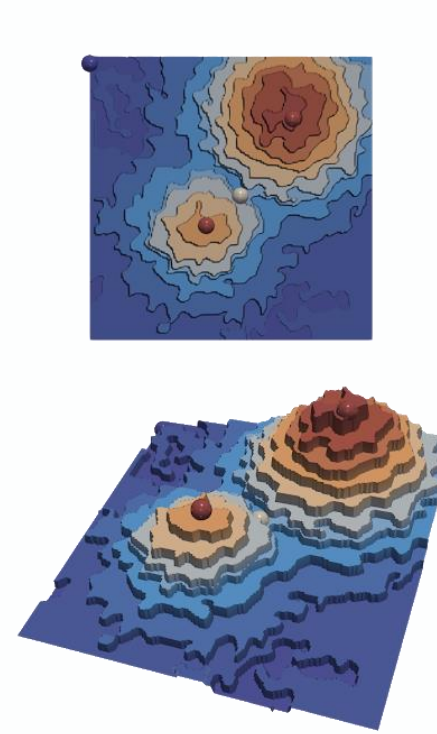
Original (2D) data



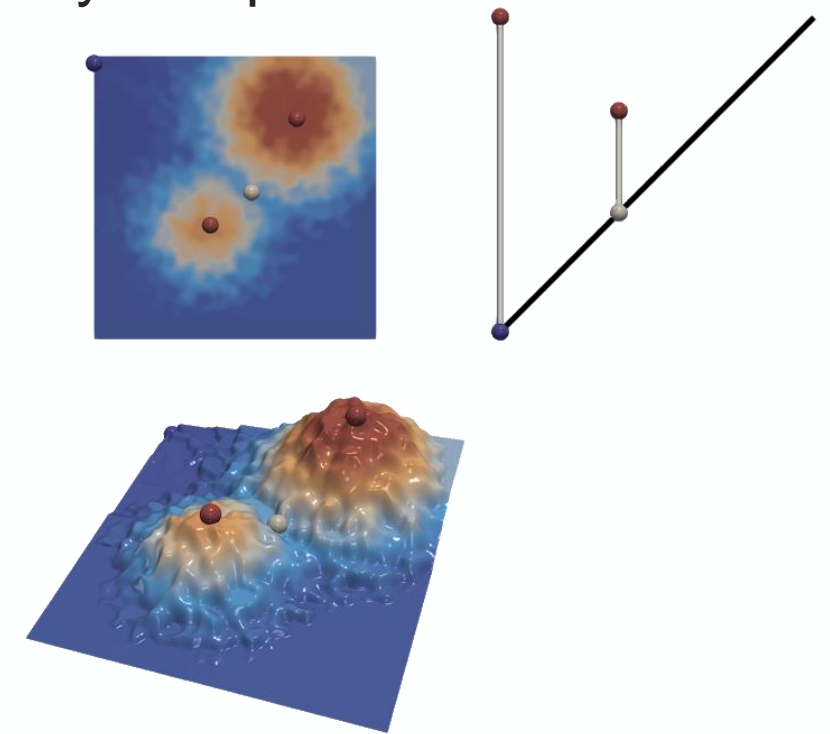
Basic approach



Subdivision



Coupled with a lossy compressor

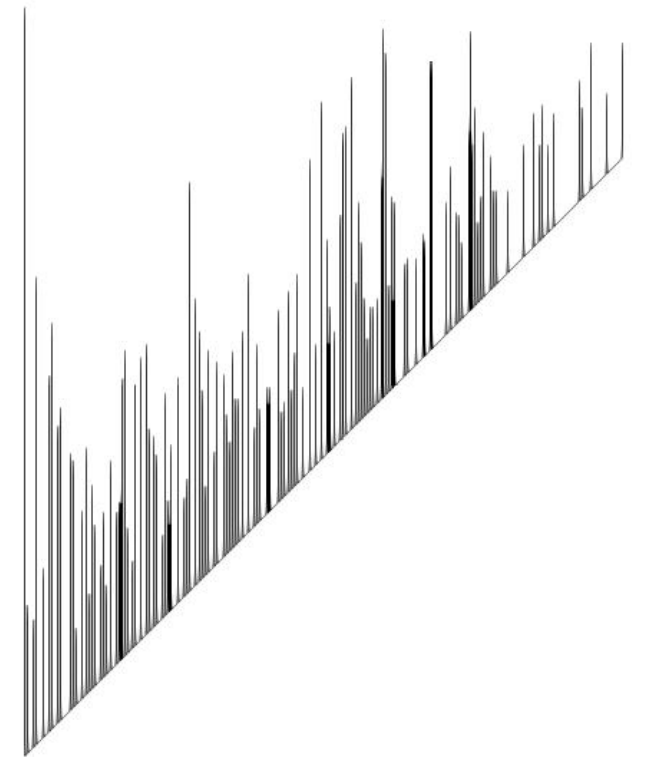




Topological compression

2D image compression

- Original



2D image compression

- Compression

Configure Writer (TTKTopologicalCompressionWriter)

Input

Scalar Field: Result

Output

File Name: /home/ttk/share/compressed.ttk

Topology aware compression

Compression type: Driven by persistence diagram

Topological loss (persistence): 10

☐ Enable maximum pointwise error control

Maximum pointwise error: 10

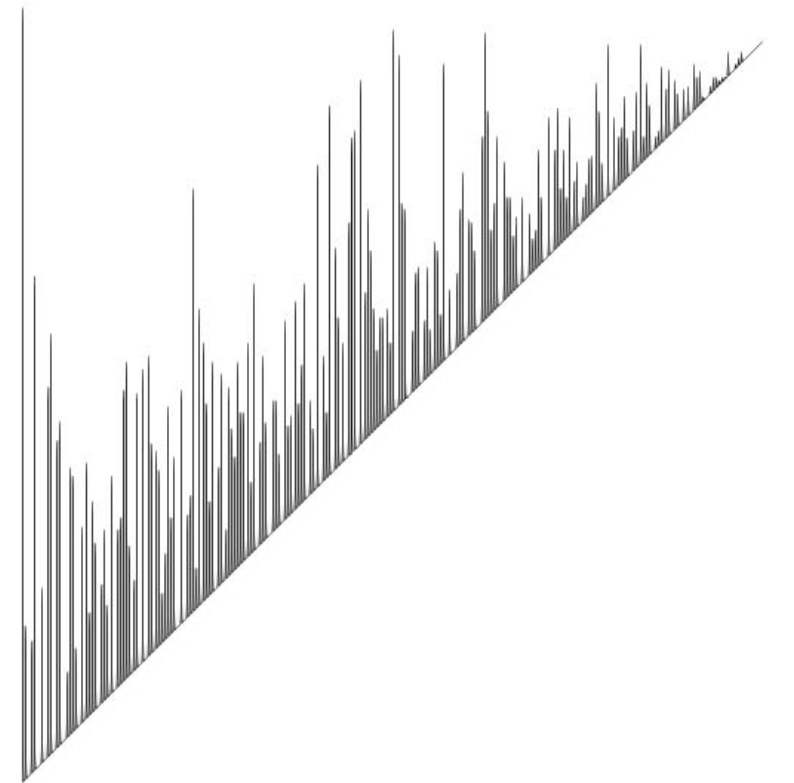
ZFP bit budget (extra): 0

☐ Use ZFP compressor only (no topological compression)

Cancel OK

2D image compression

- Compressed



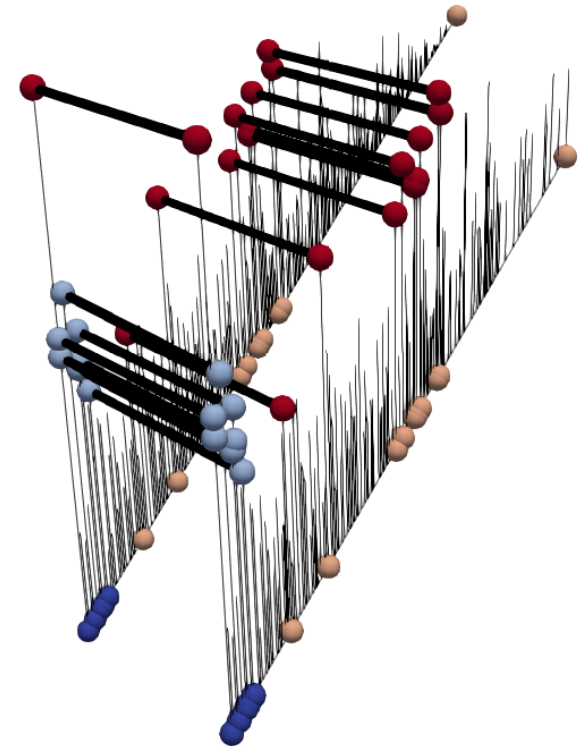
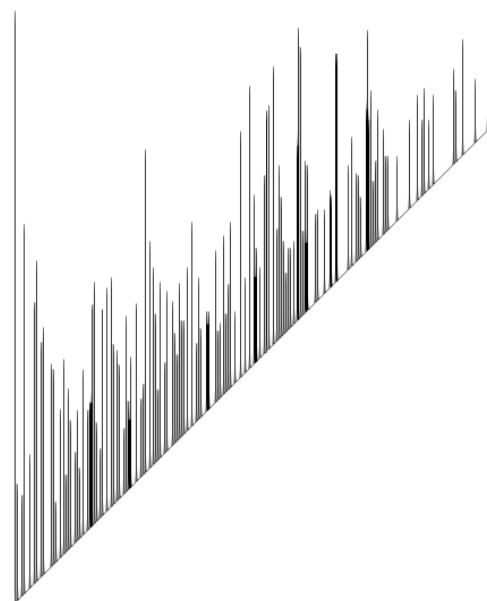
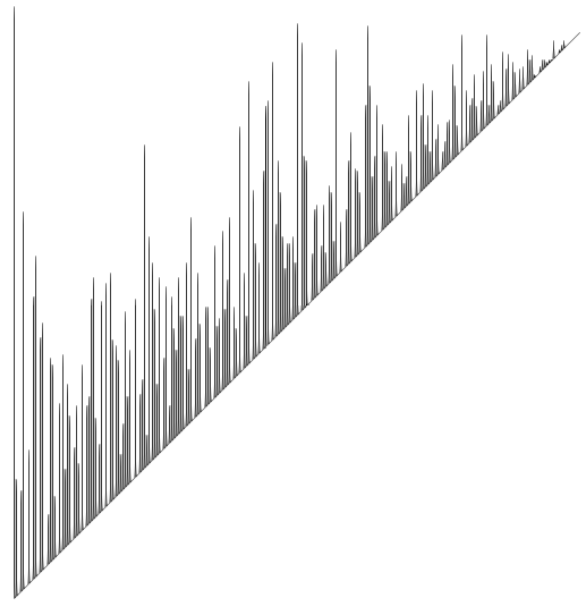
2D image compression

- Comparison



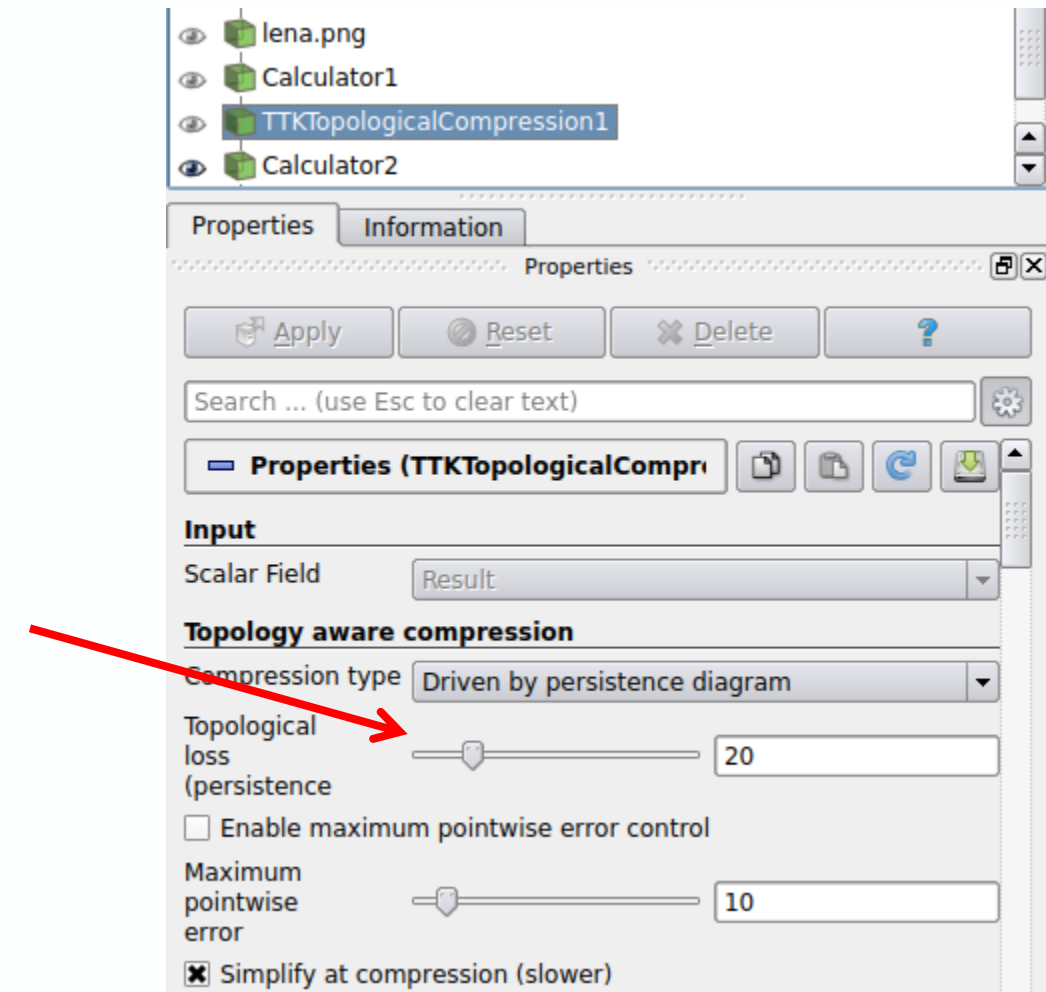
2D image compression

- Comparison: BottleneckDistance



2D image compression

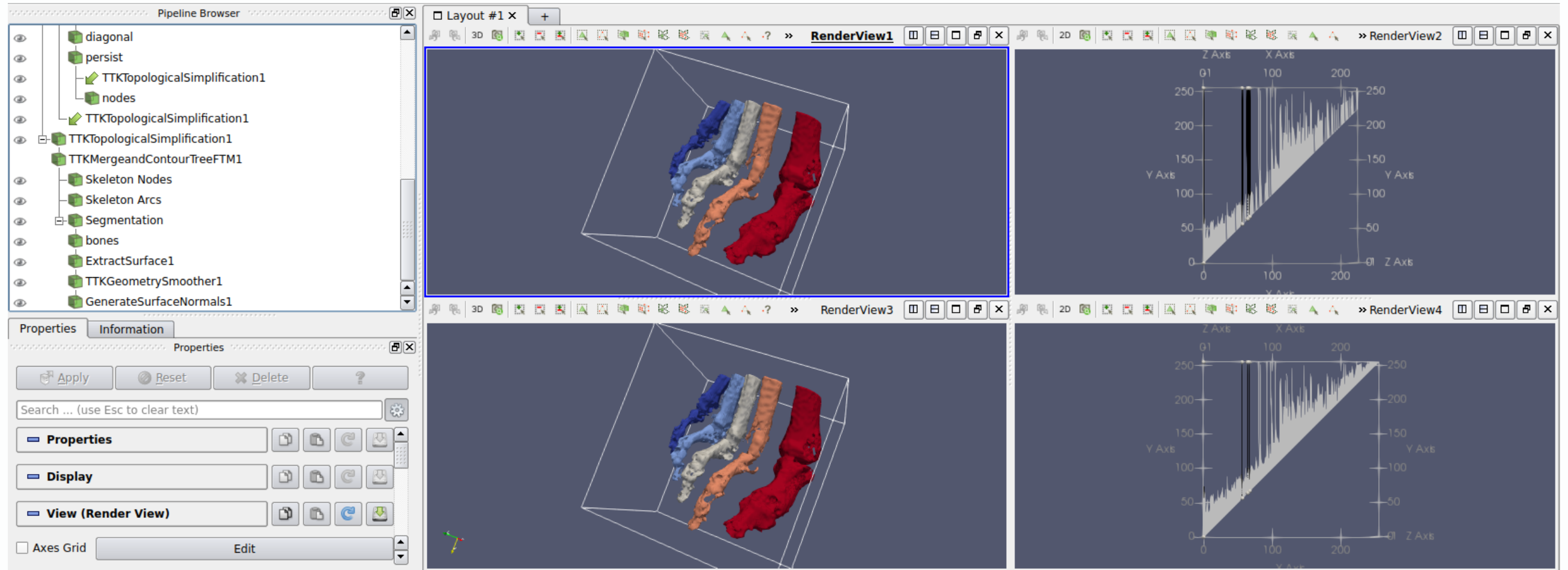
- Compression preview: TopologicalCompression



3D image compression

- Segmentation pipeline
 - Persistence diagram
 - Threshold ($p > 187$, diagonal)
 - Topological simplification
 - FTM Tree

3D image compression



3D image compression

- foot.vti (22MB)
- footc.ttk (81KB, 270x smaller, 68% persistence threshold)

Bonus: persistence-driven tracking

Persistence tracking

