TOPOLOGICAL 1D LANDSCAPE PROFILE

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PROJECT DESCRIPTION

AIM : To visualize and analyse high dimensional scientific data using topological 1D landscape profile.

INPUT : Augmented join tree

OUTPUT : 1D landscape profile

REFERENCE PAPER : Patrick Oesterling, Christian Heine, Gunther H. Weber, Gerik Scheuermann, “Visualizing nD point clouds as topological landscape profiles to guide local data analysis”, 2013

1D Landscape profile

Fig. Topological landscape profile of the image segmentation dataset.
Source: referenced paper

MOTIVATION

- Common data analysis techniques: parallel coordinate plots (PCP), scatter plots, principal component analysis
  - Suffer from occlusion when size of dataset exceeds that of screen.
  - Projective approaches cannot ensure distance preservation for high dimensional data.

- 1D Landscape profile
  - Easy to understand topological structure and variance.
  - Ensures occlusion-free display of a dataset’s structure.
  - Allow further analysis by selecting sub-structure.

WORK COMPLETED

- Input generation
- Landscape profile construction
- Ordering of hills
- Analysis of landscape profile
- Comparison with 2D landscape profile

METHOD FOR GENERATING LANDSCAPE

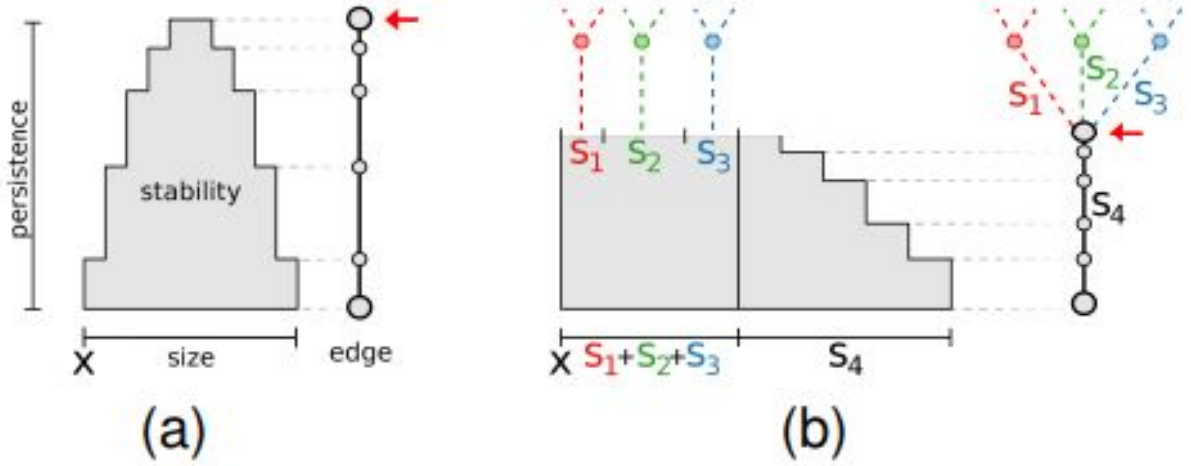
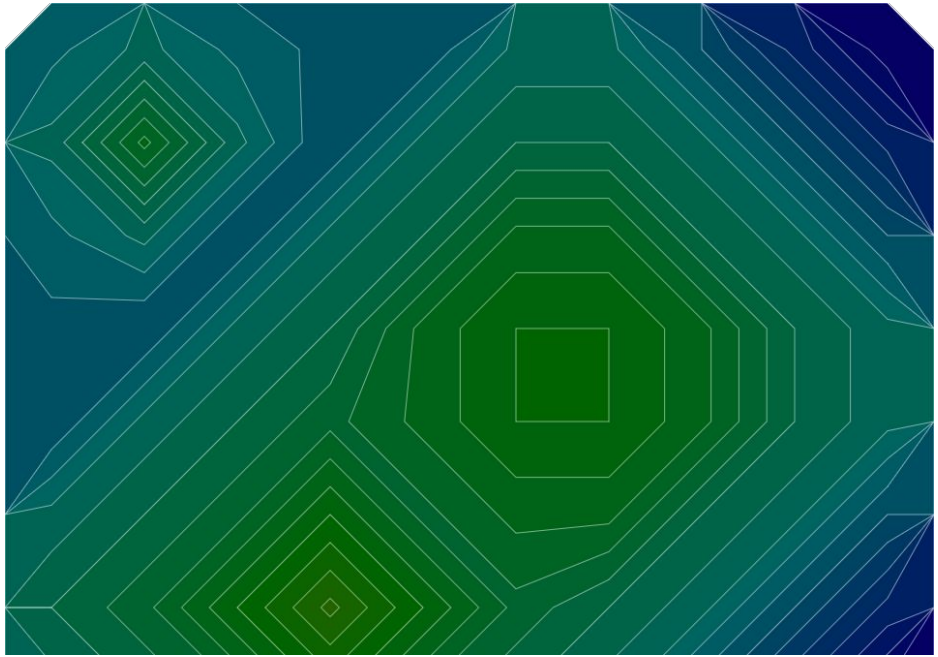
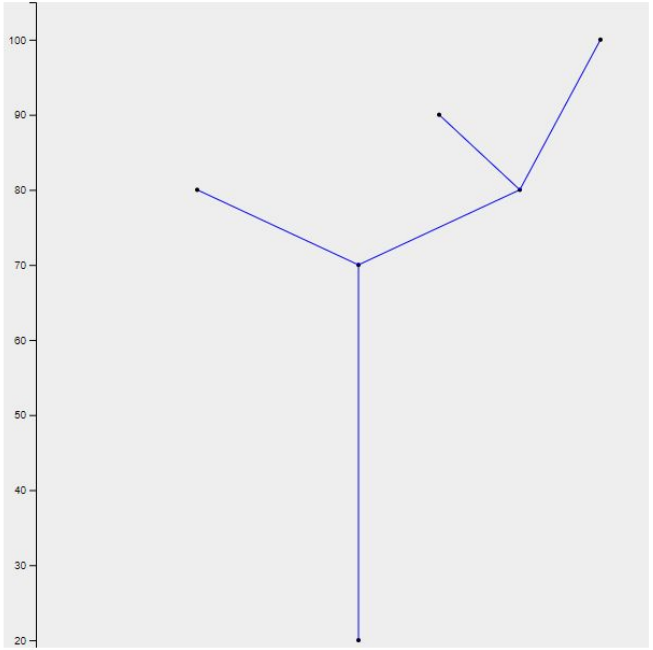


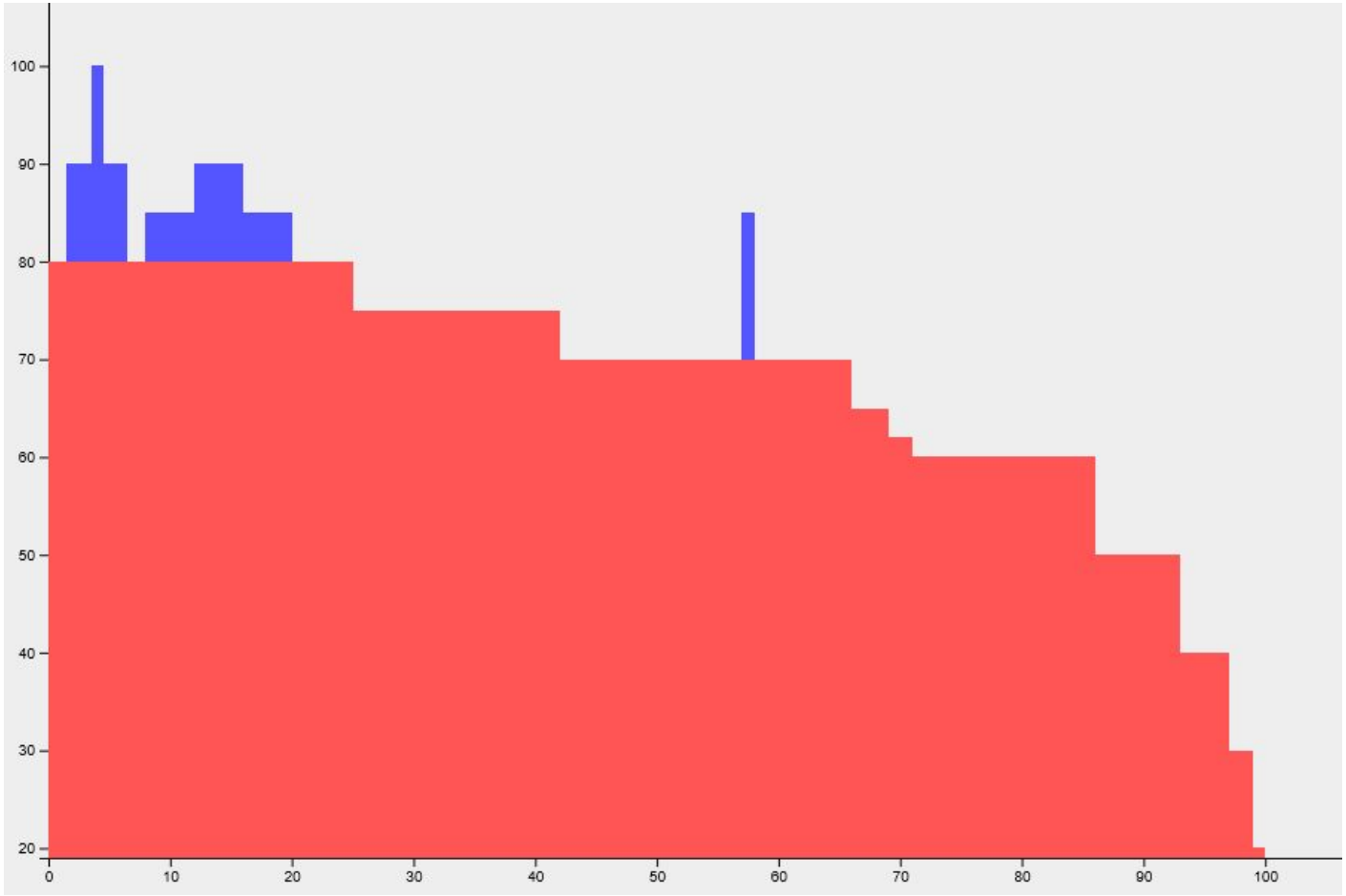
Fig. Landscape profile construction process

Source: Oesterling et. al., “Visualizing nD point clouds as topological landscape profiles to guide local data analysis”

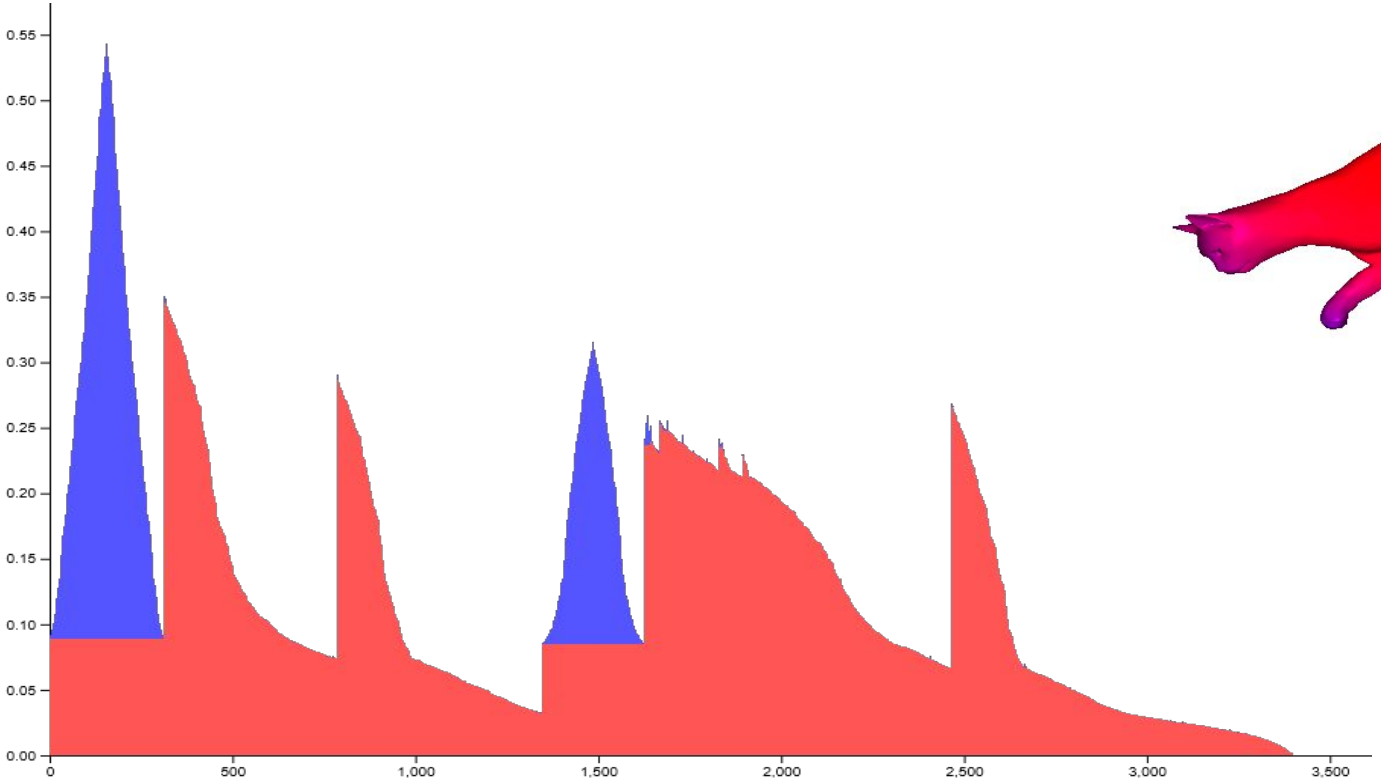
SAMPLE GRID






100
90
80
70
60
50
40
30
20
0
10
20
30
40
50
60
70
80
90
100

CAT MODEL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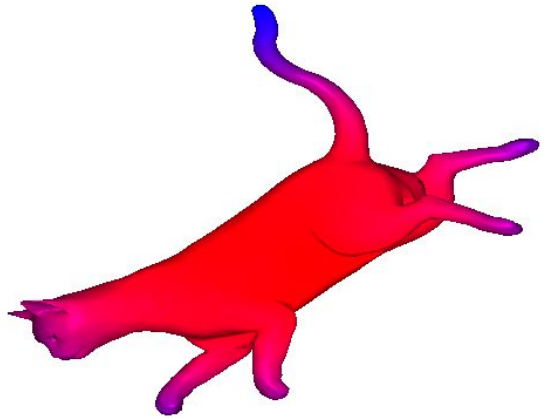
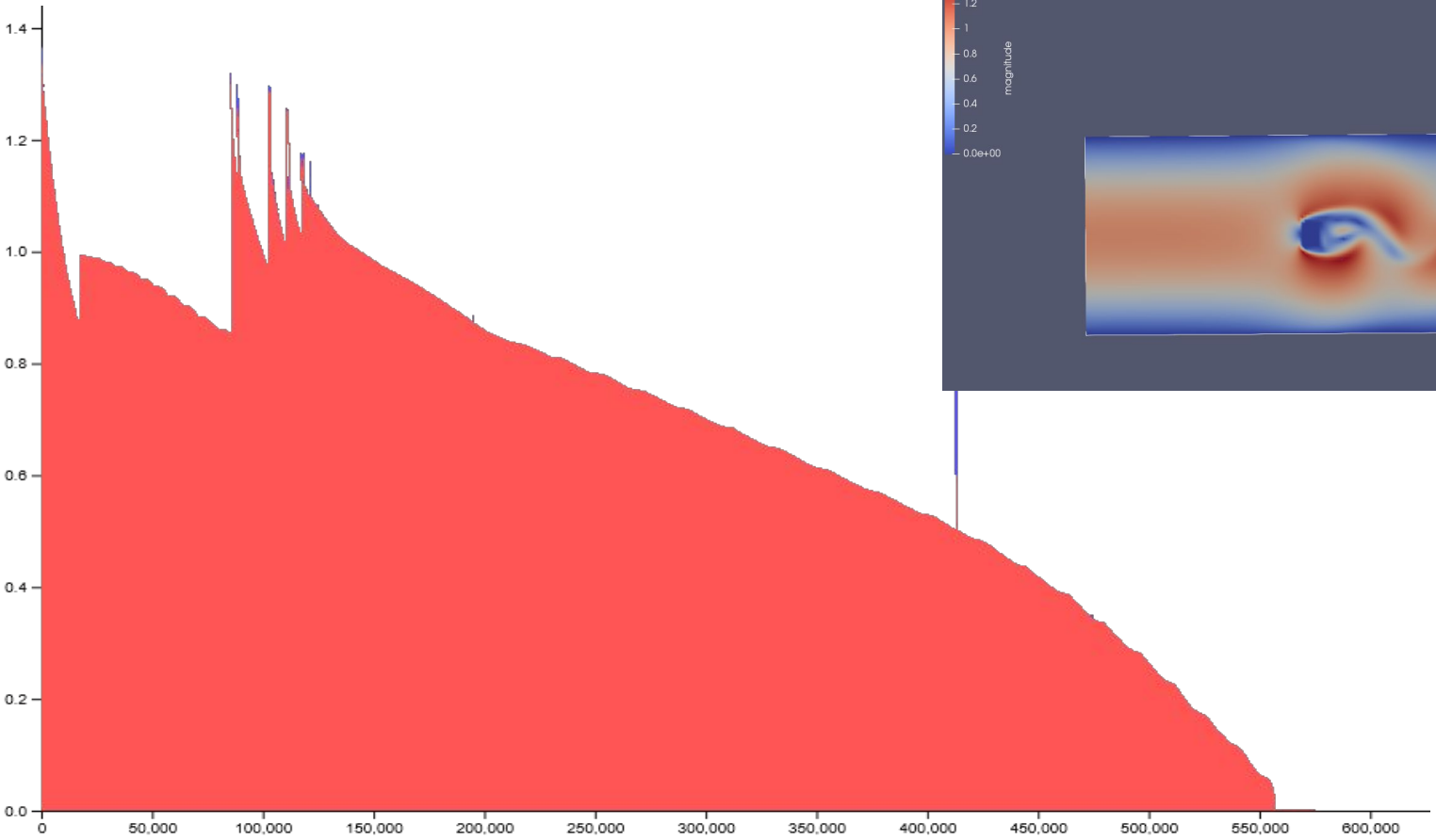
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
500
1,000
1,500
2,000
2,500
3,000
3,500




1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
400,000
450,000
500,000
550,000
600,000

1.4e+00
1.2
1
0.8
0.6
0.4
0.2
0.0e+00
magnitude

CONCLUSION

- Landscape profile illustrates the scalar field information without occlusion. The hills show various iso-contour/surface regions simultaneously which allows analysing whole data at once.
- Landscape profile can only be generated for join/split tree. Join/split tree may not contain the entire information about the data and such data cannot be properly visualised and analysed using 1D landscape profiles.