Multi-Scale Analysis of Point Cloud

Thibault Lejemble[1]   Claudio Mura[2]   Loïc Barthe[1]   Nicolas Mellado[1]

[1]IRIT, CNRS, Université de Toulouse   [2]Department of Informatics, University of Zurich

Introduction

Point-sampled surfaces often exhibit multi-scale properties due to the high variation between their feature size. Traditional multi-scale shape descriptors usually characterize a point and its close neighborhood of varying sizes. We propose to add a spatial regularization to these descriptors and apply the following general approach to two applications.
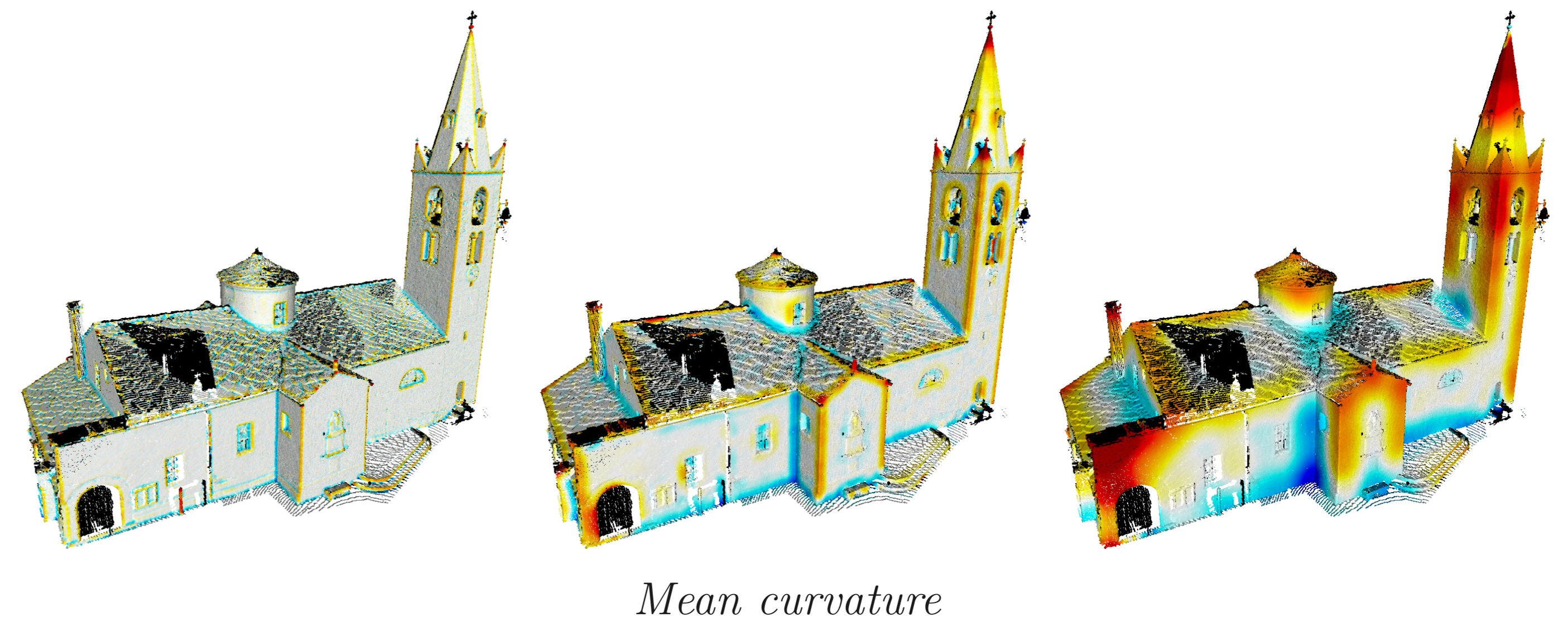
General approach

- Multi-scale shape characterization
- Extraction of stable features across scales
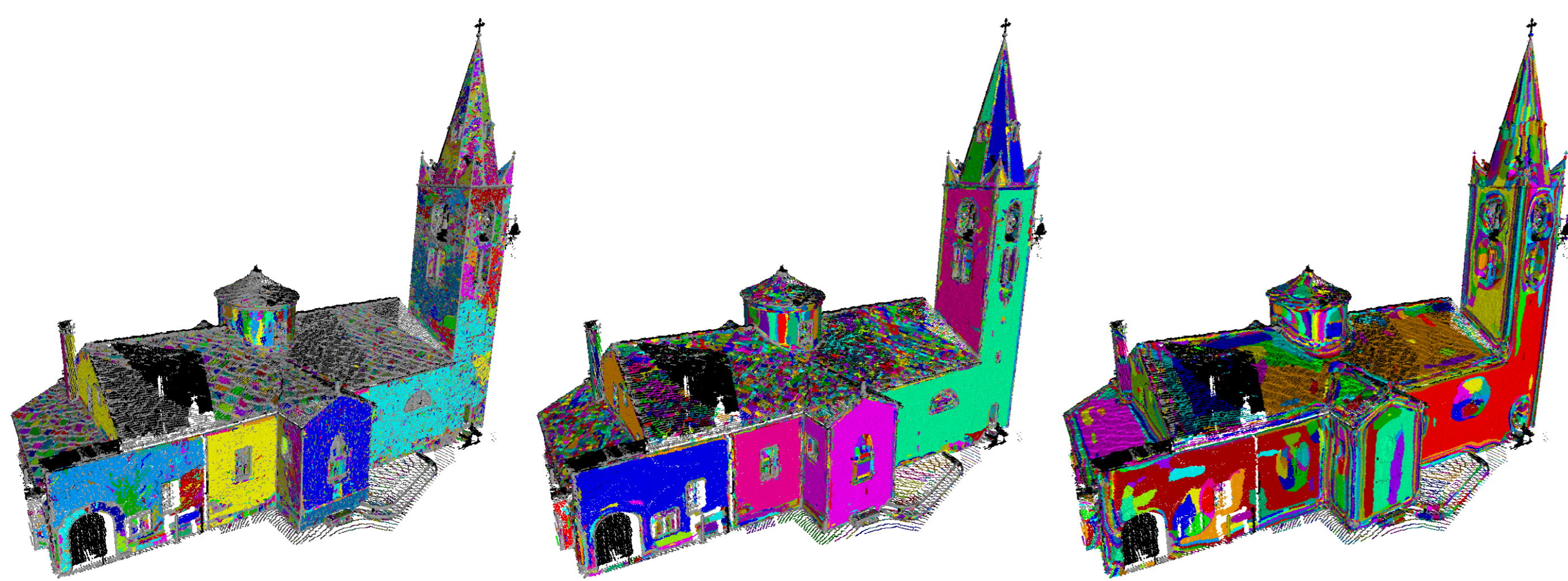
Related Works

Algebraic Point Set Surfaces (**APSS**) [1]
Scale of analysis : neighborhood radius $t \in \mathbb{R}^+$ [2]

Mean curvature

I. Feature Plane Extraction

1. Region growing at several scales

Region grows from $\mathbf{p_i}$ to $\mathbf{p_j}$ if $angle\,(\mathbf{n}_i, \mathbf{n}_j) < \theta$
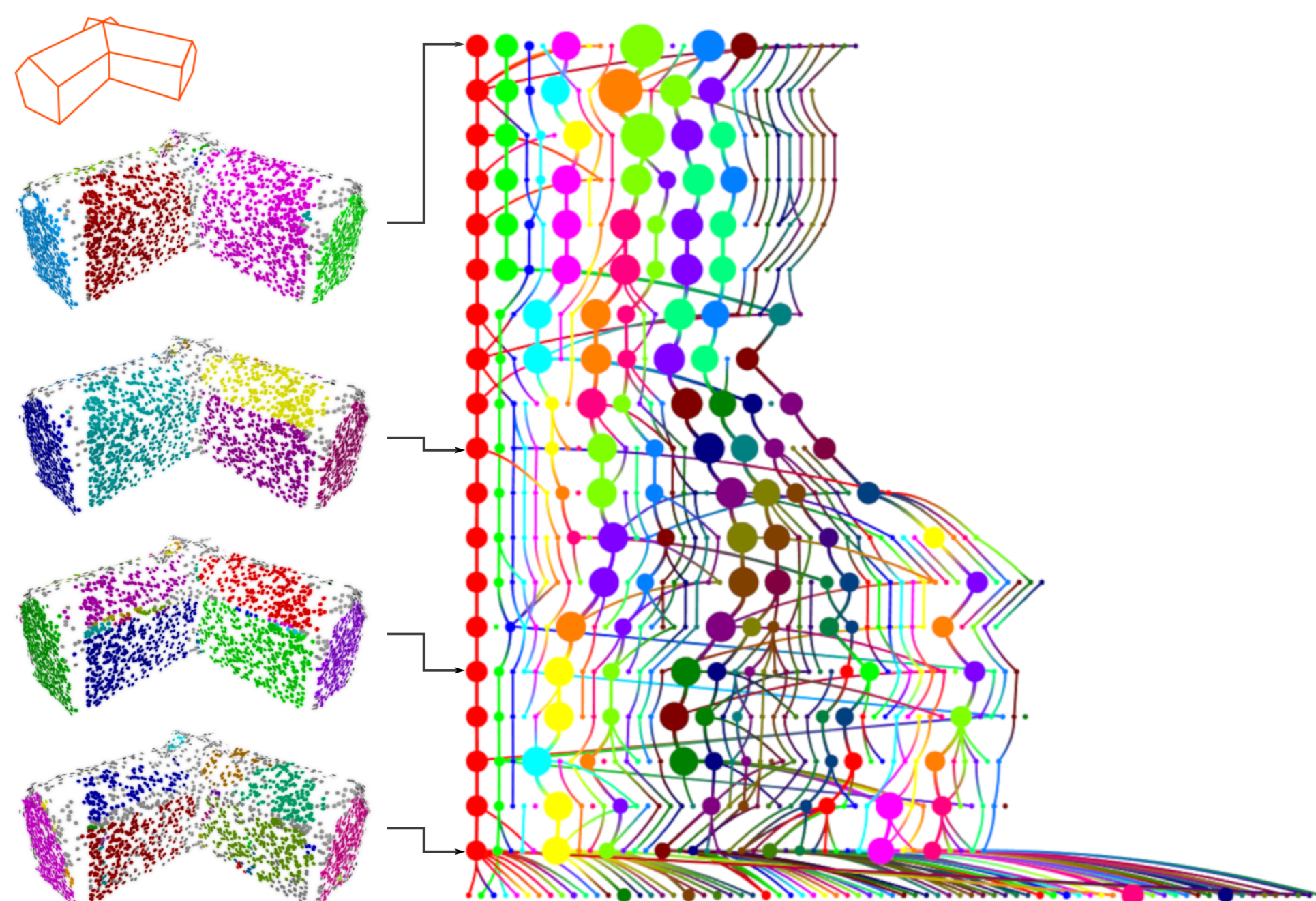

Independent segmentations

2. Hierarchical graph representation

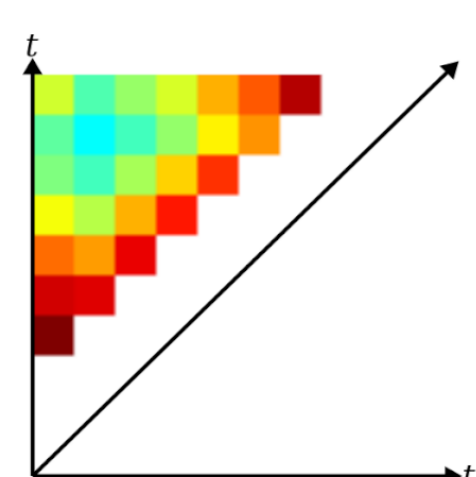Region at one scale $\equiv$ node at one level
Connection of nodes at successive scales
Similarity : number of shared points between regions

3. Persistence analysis

Extraction of persistent regions across scales

Persistent diagram   *Some of the most persistent regions*

II. Feature Line Extraction

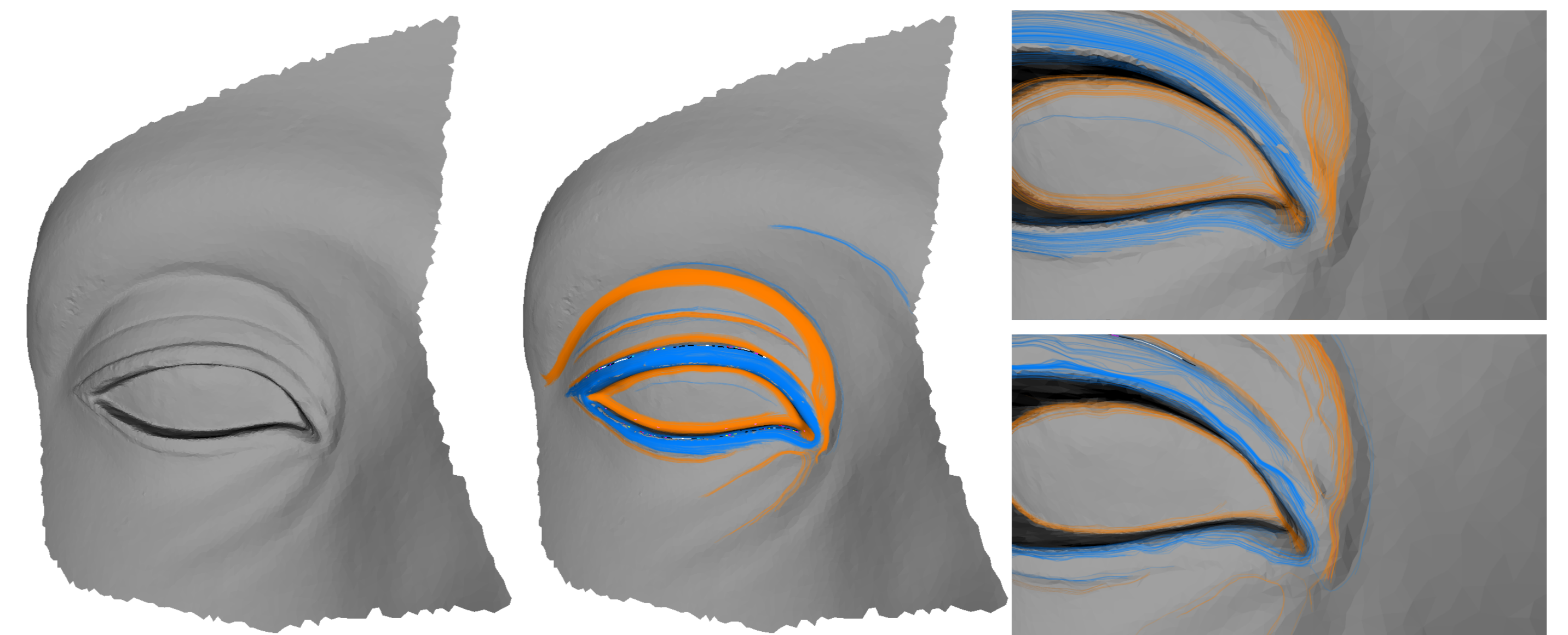**SHREC'19 :** Feature Curve Extraction on Triangle Meshes [3]

1. Curves generation at several scales

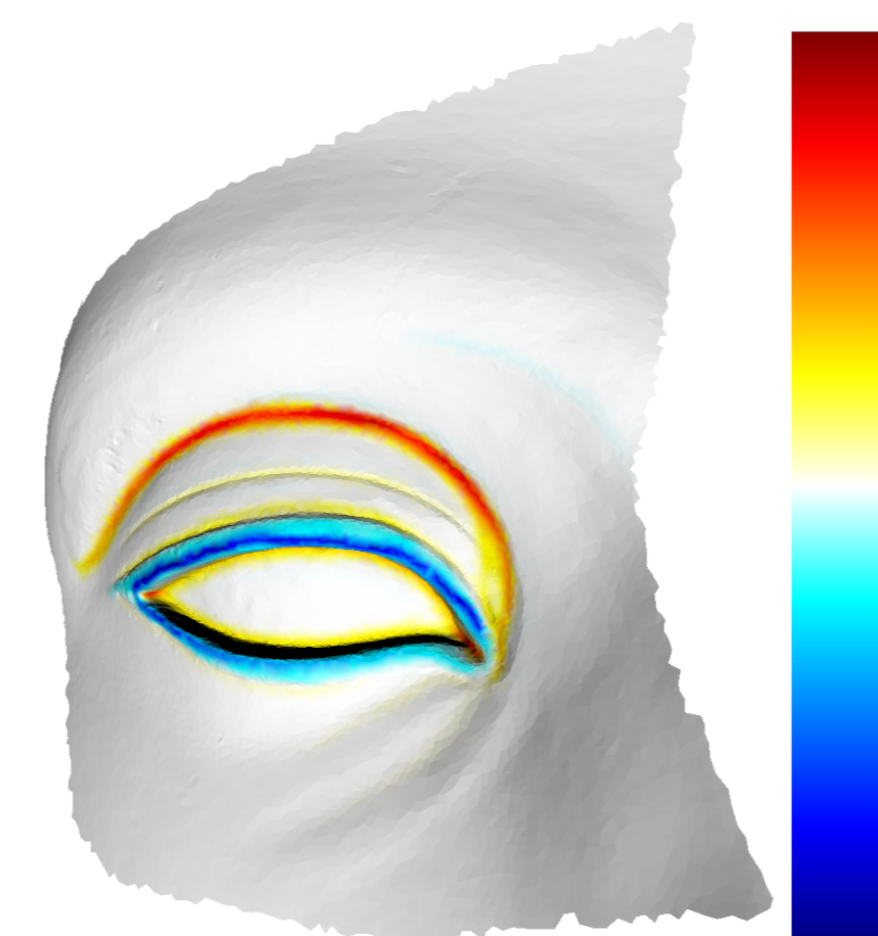$$\mathbf{q}_{k+1} = proj\,(\mathbf{q}_k + \Delta\,\mathbf{v}_2)$$

$\mathbf{v}_2$ minimal principal curvature direction at $\mathbf{q}_k$
$proj()$ projection operator on the *APSS*
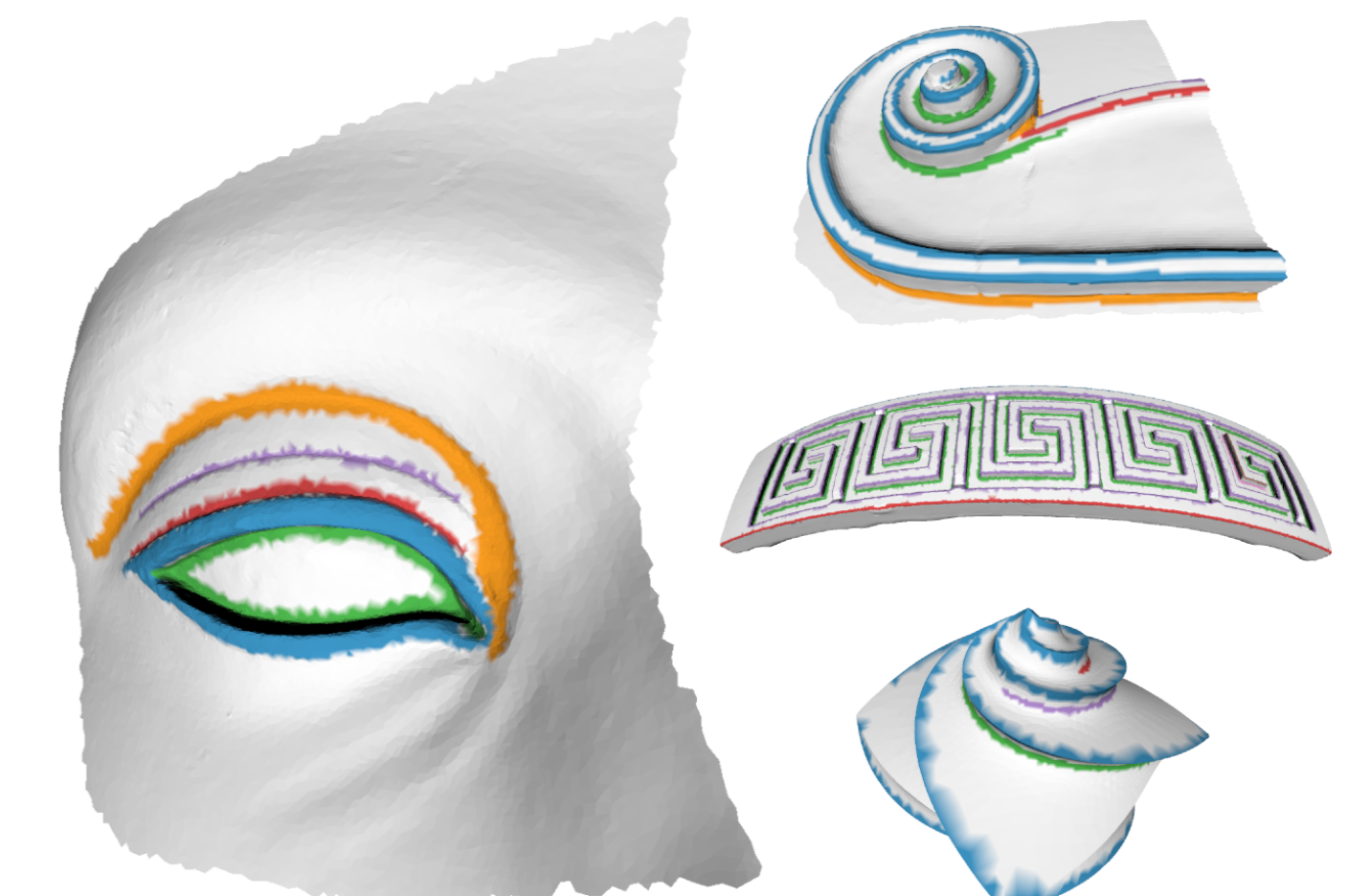Δ integration step

Valley and crest lines

2. Accumulation vote

Sum of votes

3. Feature lines extraction

Individual lines

References

[1] Gaël Guennebaud and Markus Gross.
Algebraic point set surfaces.
In *ACM Transactions on Graphics (TOG)*, 2007.

[2] Mark Pauly, Richard Keiser, and Markus Gross.
Multi-scale feature extraction on point-sampled surfaces.
In *Computer graphics forum (CGF)*, 2003.

[3] Elia Mosco Thompson et al.
Shrec'19 track : Feature curve extraction on triangle meshes.
In *Eurographics Workshop on 3D Object Retrieval (3DOR)*, 2019.