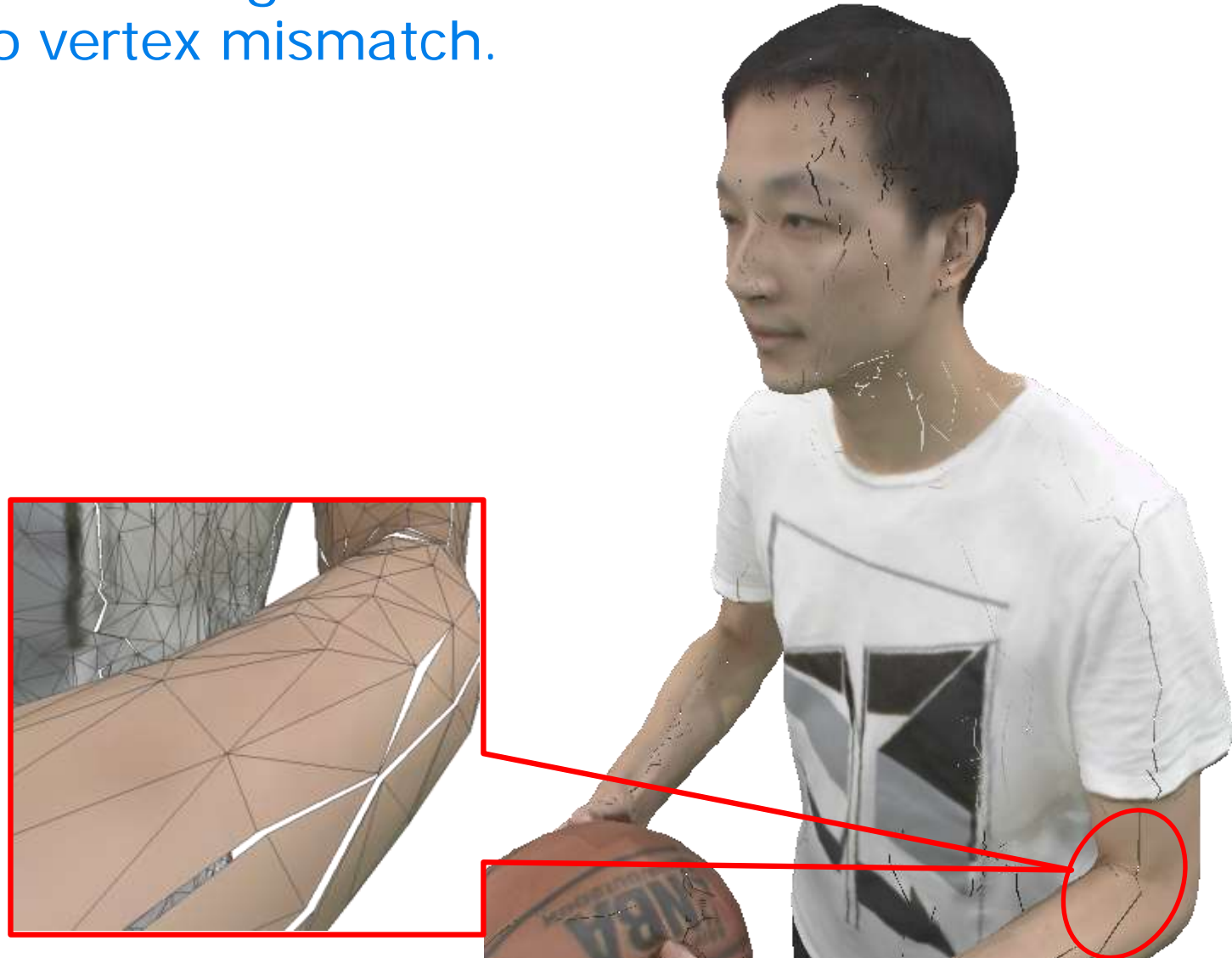


<m55374> Mesh Geometry Smoothing Filter

Danillo Graziosi, Alexandre Zaghetto, and Ali Tabatabai

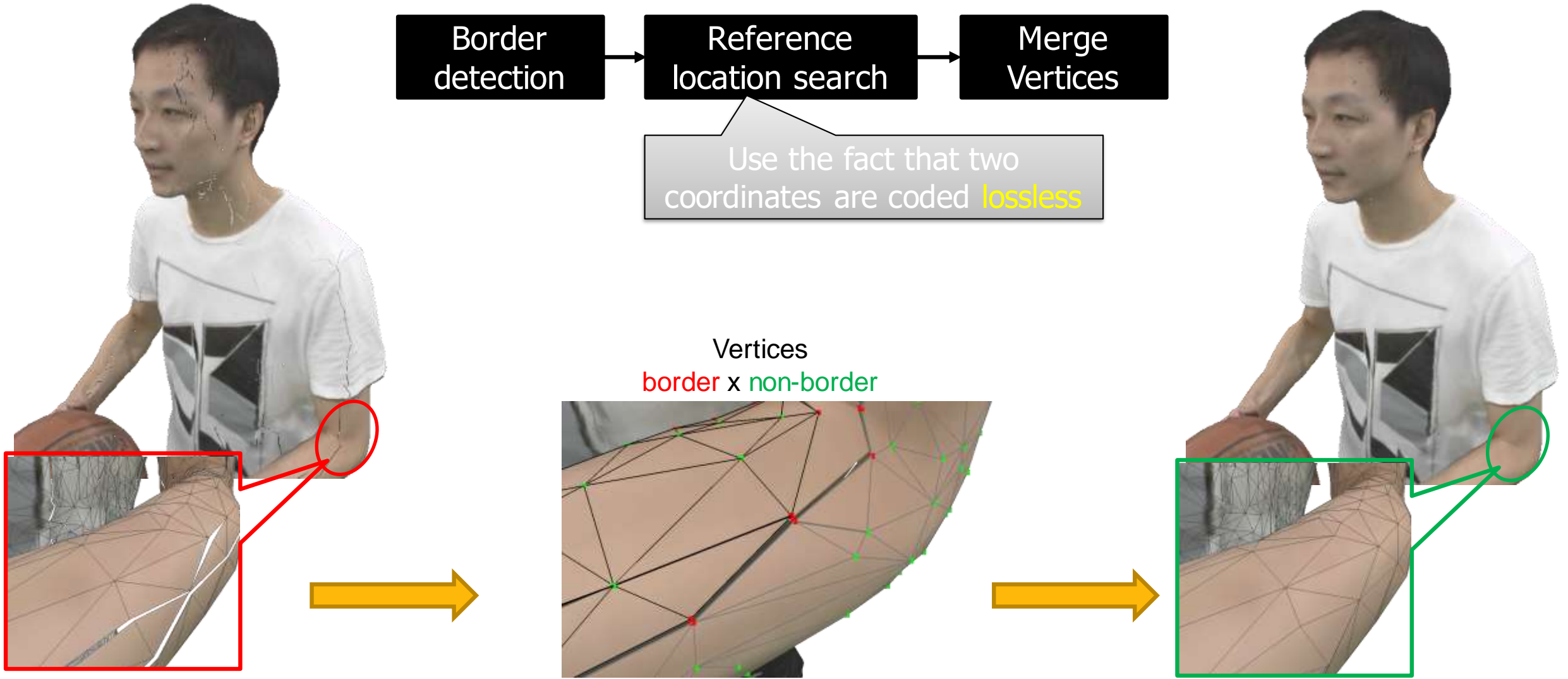
<Problem statement>

- Lossy compression of vertex data using textured meshes can create gaps between patches due to vertex mismatch.



<PROPOSAL>

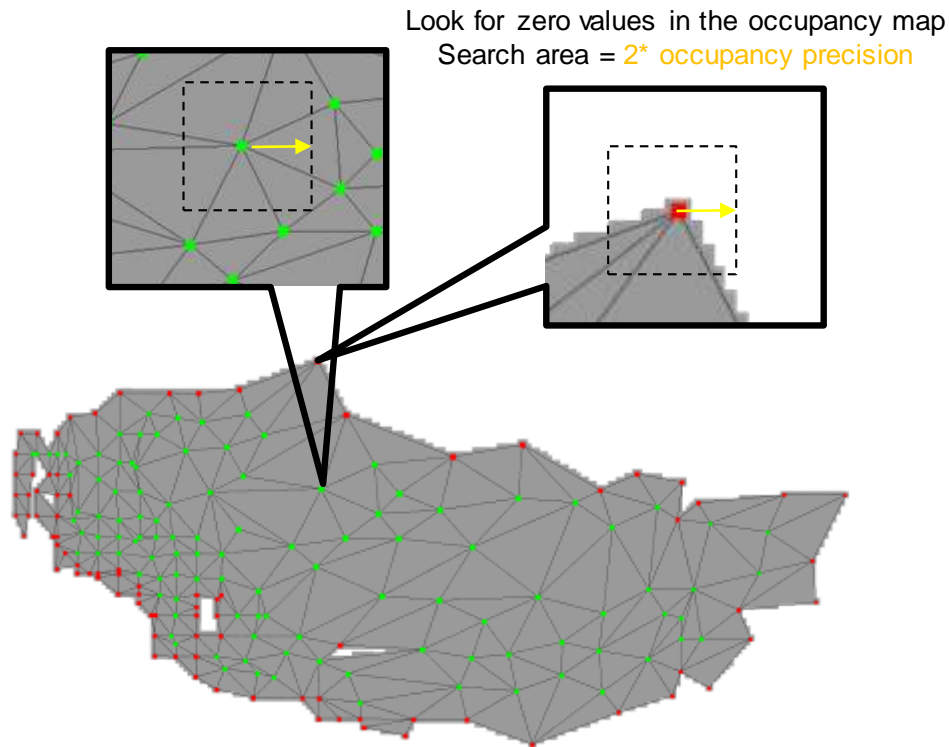
- New geometry smoothing filter: mesh zippering



Mesh Zippering

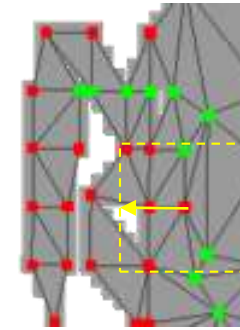
- Border detection

- Classify vertices **border** x **non-border**
 - Look for zero value of occupancy map in a neighborhood around the vertex given a **zipperingBorderDistance**

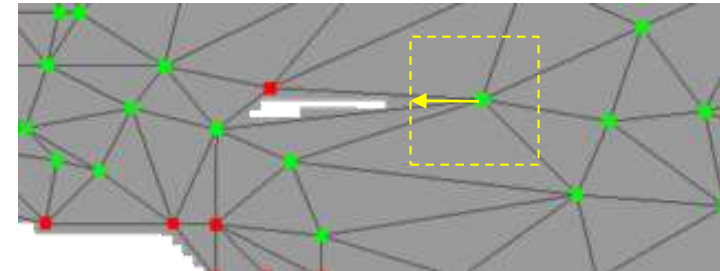


Some points may be misclassified if

1) Search area is too large



2) Search area is not large enough

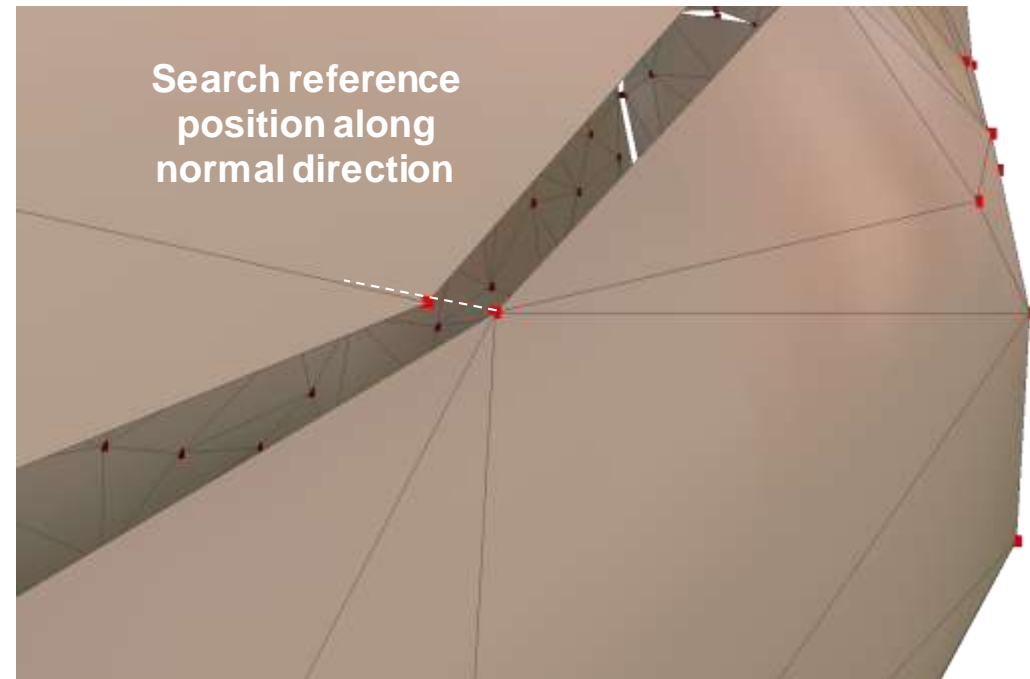


Note: Could use patch mesh topology to identify border edges (only belong to one triangle)

Mesh Zippering

- Reference location search

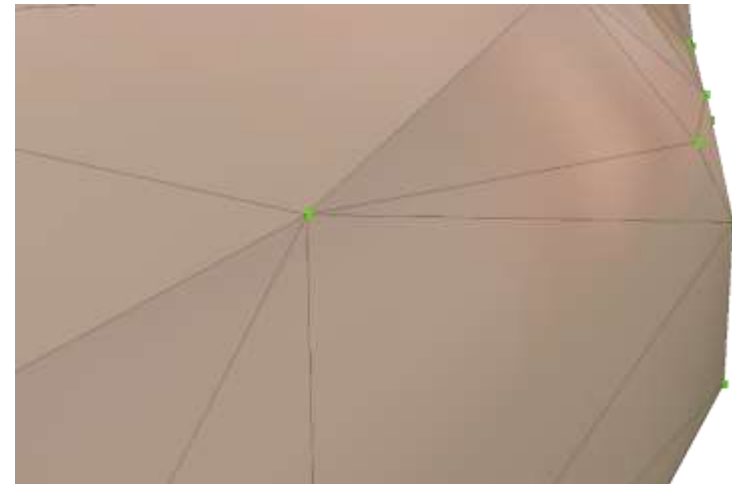
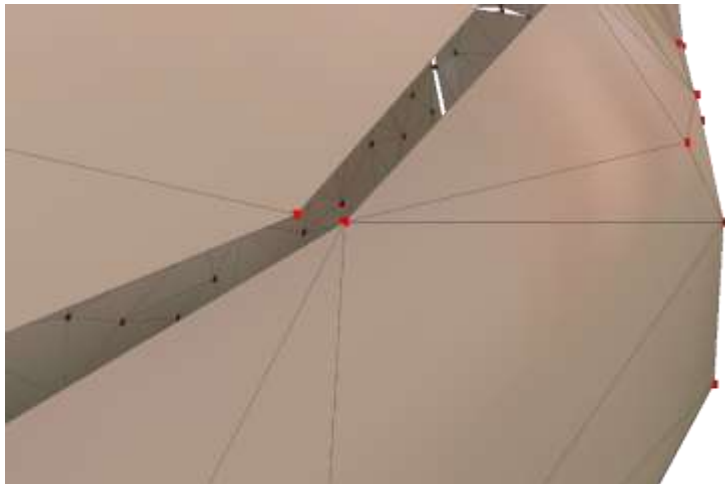
- Reference location is the location in 3D space where border points should meet, that is, where border points were located before compression. The location of the reference point for a border point is obtained as follows:
 - Given a reference point at the border of a patch:
 - Search for a new reference position by modifying the border vertex coordinate along the normal direction until it meets at least one potential candidate, that is, another border point, or reach the maximum distance (given by the user-defined variable `zipperingMaxMatchDistance`).
 - In case of multiple matched candidate positions, modify the reference to the position that generated the greatest number of matches.



Mesh Zippering

- Merge operation

- With the reference from previous step, search for the closest border pixel from neighboring patches
- If a border vertex is found,
 - Modify the border vertex value to the reference point, and remove that border vertex from the list
- Otherwise, search for matches in the list of non-border vertices. If a match is found,
 - Modify the non-border vertex value to the reference point



Geometry filter syntax and semantics

geometry_smoothing(payloadSize) {	Descriptor
gs_persistence_flag	u(1)
gs_reset_flag	u(1)
gs_instances_updated	u(8)
for(i = 0; i < gs_instances_updated; i++) {	
gs_instance_index[i]	u(8)
k = gs_instance_index[i]	
gs_instance_cancel_flag[k]	u(1)
if(gs_instance_cancel_flag[k] != 1) {	
gs_method_type[k]	ue(v)
if(gs_method_type[k] == 1) {	
gs_filter_eom_points_flag[k]	u(1)
gs_grid_size_minus2[k]	u(5)
gs_threshold[k]	u(8)
}	
else if(gs_method_type[k] == 2) {	
gs_zippering_border_distance_minus1[k]	u(8)
gs_zippering_max_match_distance[k]	u(8)
}	
}	
}	
}	

Table H.7 – Definition of gs_method_type[k]

Value	Interpretation
0	No geometry smoothing
1	Grid based geometry smoothing
2	Zippering filtering
3-255	Reserved

gs_zippering_border_distance_minus1[k] plus 1 specifies the value of the variable zipperingBorderDistance[k] used for identifying border vertices in the process of the current mesh frame for geometry smoothing instance with index k when the zippering filtering process is used. The value of gs_zippering_border_distance_minus1[k] shall be in the range of 0 to 255, inclusive.

gs_zippering_max_match_distance [k] specifies the value of the variable zipperingMaxMatchDistance [k] used for processing the current mesh frame for geometry smoothing instance with index k when the zippering filtering process is used. The value of gs_zippering_max_match_distance [k] shall be in the range of 0 to 255, inclusive.

<EXPERIMENTAL RESULTS>

- The method improves mesh quality by closing gaps between patches. Study to optimize parameters are still on-going.



<Conclusion>

- We have implemented a mesh geometry smoothing filter method based on zippering algorithm
- The method is sent using an SEI message and can improve the reconstructed quality of the mesh.
- Additionally, the method could remove duplicate vertices, and represent merged vertices as a single vertex, reducing the number of vertices of the reconstructed mesh.
- We suggest the group to consider the proposed technique and keep investigating mesh geometry smoothing methods.