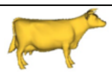
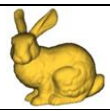
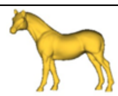
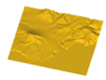
Name	**cow**	**fandisk**	**teeth**	**bunny**	**horse**	**bone**	**terrain**	**dragon**
# vertices	2.905	6.475	29.166	35.947	48.485	60.537	65.829	437.645
# triangles	5.804	12.946	58.328	69.451	96.966	137.072	130.630	871.414
Picture								

Table 1: Models used for presented results.

Table 2 shows the running times of 80% reduction. It is obvious that rapid-flat method (approach without vertex memory) is faster but the resulting mesh contains long and thin triangles. On the other hand the approach with vertex memory produces nicely shaped triangles but the running times are slightly worse.

Name	**cow**	**fandisk**	**teeth**	**bunny**	**horse**	**bone**	**terrain**	**dragon**
Mem	1.244	4.604	11.700	13.304	21.032	26.116	31.728	141.980
No mem	1.160	4.116	10.120	12.320	19.848	24.008	28.872	131.804

Table 2: Reached times [sec] for 80% reduction. Thresholds have been set to mark 15% vertices as extreme.

On Fig. 15 you can see the resulting meshes of both methods for *fandisk* model. However, at most drastical reduction (99% and more) the resulting meshes are similar for both, with and without memory, approaches.

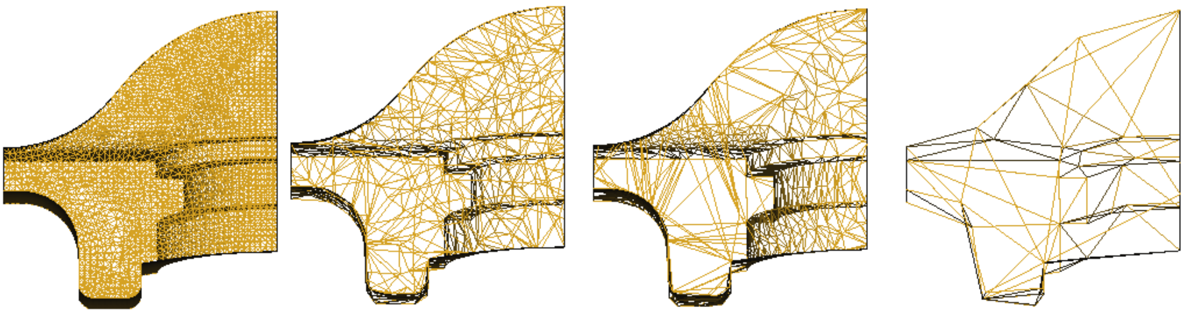
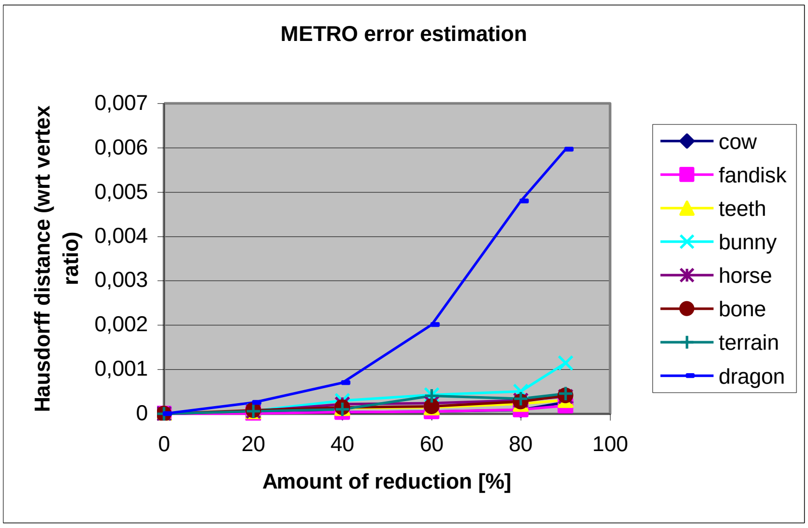


Fig. 15: Example of reduced model. The original mesh (left), 90% reduction with and without vertex memory (two in the middle) and drastical 99% reduction (right).

On Fig. 15 you can see graph of error estimation for several models during simplification process. The models has been simplified from 0% up to 90%. The results are taken from METRO ver. 4.05 [13], using default values (vertex, edge and face sampling enabled, montecarlo sampling, 10times more samples than triangles in a mesh). To have all the values comparable, the METRO results were taken with respect to Dragon model, thus re-computed using following formula (21):

$$E_r = E_M \frac{V_c}{V_{\max}}, (21)$$

where E_M is the value evaluated by METRO, V_c is the number of vertices of current model in certain level of detail and V_{max} is the number of vertices of Dragon model, which is the maximum number of vertices for certain LOD.



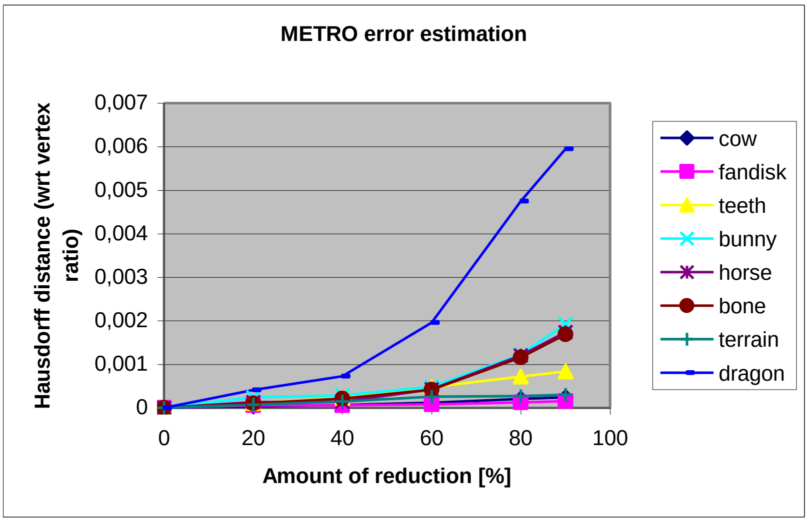


Fig. 16: Aproximation error for certain LOD for approaches with (upper) and without (lower) memory.

It's obvious that memoryless approach gives worse result in meaning of the Hausdorff distance. However, vertices distribution follows ones assumption that flat regions needs to be built from much less number of vertices than rugged surface. Here is noticeable difference between geometrical and perceptive evaluation of the approximation quality.

Also the oversampled models such as dragon, bunny and bone have error values higher than other datasets. Although, the values are higher than other simplification methods, it must be pointed out that METRO computes the error based on Hausdorff distance which is not considered during a simplification in this case. The main goal of presented algorithm is to keep the similarity of appearance. However, the geometrical error is also important in mesh simplification to be able to compare the results with other methods. In Table 3 there are outputs of METRO in detail for cow, bunny and dragon models.

name	reduction	vertices	faces	area	bbox diag.	H-dist
dragon	0%	437645	871414	0.1452	0.266905	0.005964
	90%	41603	81808	0.1446	0.266801	
bunny	0%	35947	69451	0.1143	0.250246	0.022444
	90%	3824	5368	0.1125	0.249250	
cow	0%	2905	5804	2.1802	1.271114	0.032040
	90%	391	776	2.0851	1.267350	

Table 3: METRO details for chosen models.

6 Conclusion

A new approach for triangular mesh simplification with respect to similarity of appearance was presented. This original method is based on vertex importance evaluation to select the least important vertex to be removed from the mesh. This evaluation uses vertex average normal vector which lowest values concern specific model features to be kept in approximations. Simplification itself is performed as an edge collapse where new vertex position is evaluated with respect to supposed surface of the original object given by the endpoints of the edge, the normal vector at these points and opposite corners of adjacent triangles.

We showed that geometrical error doesn't have to be the only criterion of approximation quality and that a visual appearance can lead to opposite observation. This could be quite important in application such as computer games, 3DTV and other multimedia where mathematical precision is not a principal value. Conversely, preserving main visual features is more relevant.

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