3D STEGANALYSIS USING THE EXTENDED LOCAL FEATURE SET

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ABSTRACT

This research study proposes to use a set of new 3D features, such as the edge vectors, represented in both Cartesian and Laplacian coordinate systems, together with other steganalytic features, for improving the results of 3D steganalyzers. In this way the local feature vector used by the steganalyzer is extended from 76 to 124 dimensions.

EXTENDED LOCAL FEATURE SET

- Calculate differences between features from the original mesh and its smoothed counterpart.
- We estimate: mean, variance, skewness, kurtosis
- We append to the feature set LFS76, proposed in [1], the following new features:

1. Edge vector in Cartesian coordinate system

➢ $e_{c,x}(i,j) = v_{c,x}(j) - v_{c,x}(i)$

2. Edge vector in Laplacian coordinate system

➢ $e_{l,x}(i,j) = v_{l,x}(j) - v_{l,x}(i)$

We consider four different measurements of differences between the two vectors:

➢ Absolute difference between the two vectors for each component

$$\emptyset_{20}(i,j) = |e_{c,x}(i,j) - e'_{c,x}(i,j)|$$

➢ The Euclidean difference between the vectors

$$\emptyset_{23}(i,j) = \|e_c(i,j) - e'_c(i,j)\|$$

➢ Absolute difference between the norms of the two vectors

$$\emptyset_{24}(i,j) = \big|\|e_c(i,j)\| - \|e'_c(i,j)\|\big|$$

➢ The angle between the two vectors

$$\emptyset_{25}(i,j) = \arccos\frac{e_c(i,j)\cdot e'_c(i,j)}{\|e_c(i,j)\|\cdot\|e'_c(i,j)\|}$$

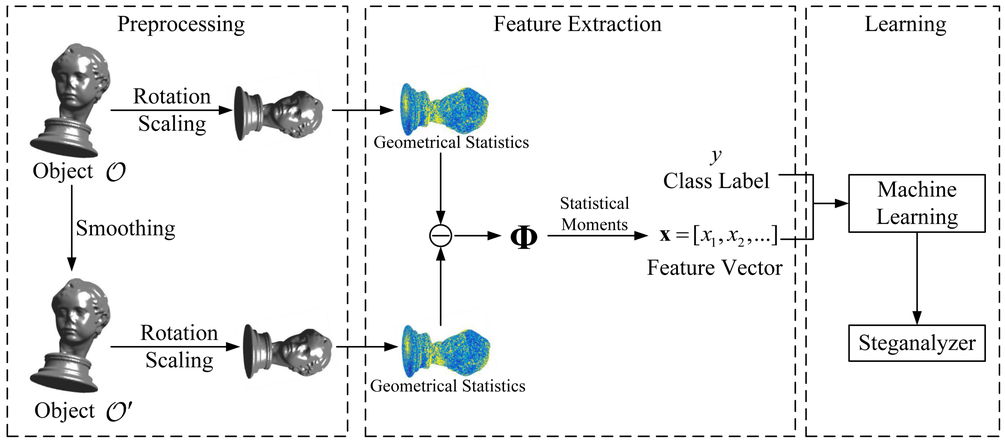

Fig.1 3D steganalysis framework.

EXPERIMENTAL RESULTS

➢ Database: Princeton Mesh Segmentation project database, which consists of 354 meshes of 3D objects.

➢ Information embedding methods: WHC, WFR, MLS, MRS, VRS and SRW.

➢ Machine Learning method for steganalysis: FLD ensemble

➢ Feature sets: (1)YANG208 [2]; (2)LFS52 [3]; (3)LFS64; (4)LFS76 [1]; (5)LFS124.

➢ Training/testing: 260/94 3D objects and repeat 30 times.

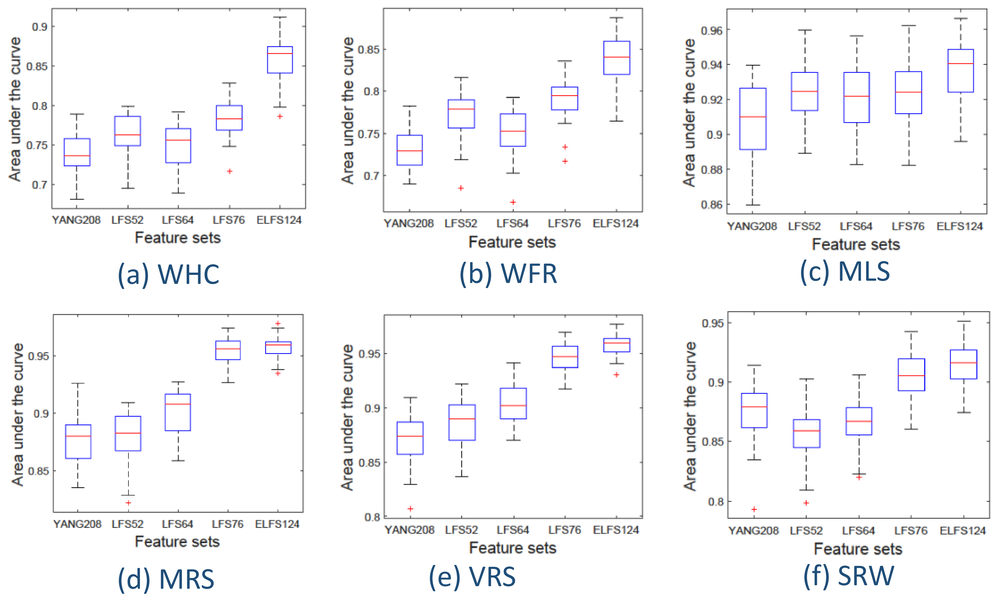

Fig.2 Box plots showing the area under the ROC curves of the detection results.

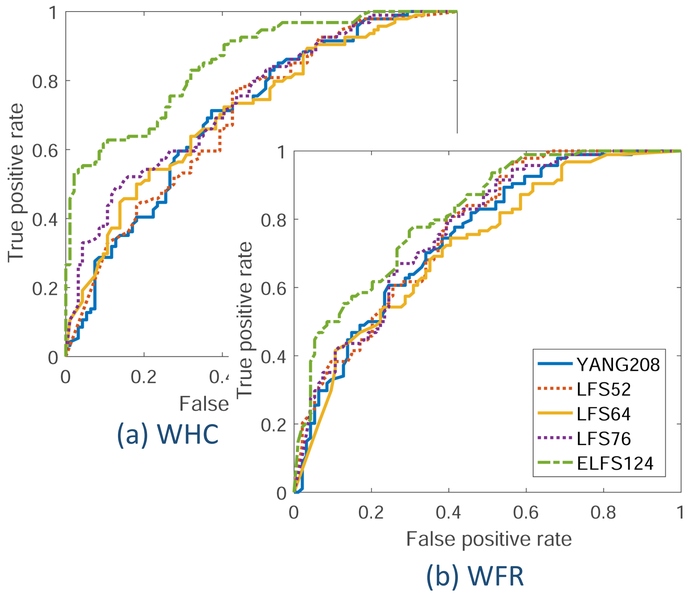

Fig.3 ROC curves for the detection results for the 3D steganalyzers.

CONCLUSION

The contribution of the paper consists in proposing a new set of local features for 3D steganalysis. We consider the edge vectors of the mesh, represented in both the Cartesian and the Laplacian coordinate systems, which are extracted from the geometric features of the original mesh and its smoothed version. Then, an extended local feature set is obtained by combining the newly proposed features with the existing feature set, LFS76 for best results.

REFERENCES

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