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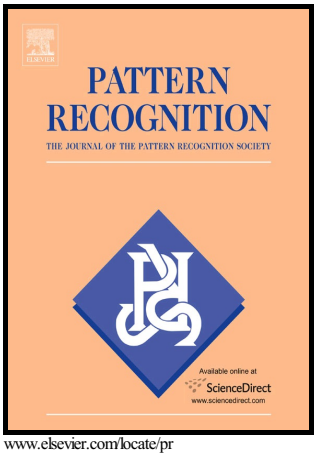

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PII: S0031-3203(16)30395-8
DOI: http://dx.doi.org/10.1016/j.patcog.2016.12.009
Reference: PR5981

To appear in: *Pattern Recognition*

Received date: 1 June 2016
Revised date: 11 December 2016
Accepted date: 12 December 2016

Cite this article as: Xun Yu, Yongsheng Gao and Jun Zhou, Sparse 3D Directional Vertices vs Continuous 3D Curves: Efficient 3D Surface Matching and Its Application for Single Model Face Recognition, *Pattern Recognition* http://dx.doi.org/10.1016/j.patcog.2016.12.009

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Sparse 3D Directional Vertices vs Continuous 3D Curves: Efficient 3D Surface Matching and Its Application for Single Model Face Recognition

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Abstract

Traditionally, point clouds and meshes are used to represent and match 3D shapes, which often cannot meet the computational speed and storage space requirements in many 3D data matching and retrieval applications. In this paper, we present a novel 3D directional vertices ($3D^2V$) approach to efficiently represent and match 3D surfaces by much fewer sparsely distributed structured vertices that carry structural information transferred from their deleted neighbouring points. A $3D^2V$ conversion and similarity measurement method is developed to compute the distance between two different $3D^2Vs$. The performance of the proposed method is evaluated on 3D face recognition using Face Recognition Grand Challenge v2.0 (FRGC v2.0) and GavabDB databases and compared with the curve-based benchmark method. The experimental results demonstrate that the proposed $3D^2V$ method can significantly reduce the data storage requirement and computation time with a moderate increase of accuracy at the same time. It provides a new tool for developing fast 3D surface matching algorithms for large scale 3D data classification and retrieval.

Keywords: 3D surface matching; 3D directional vertex; fast 3D matching; storage space; 3D face recognition; 3D curve; Hausdorff distance; iterative closest points

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