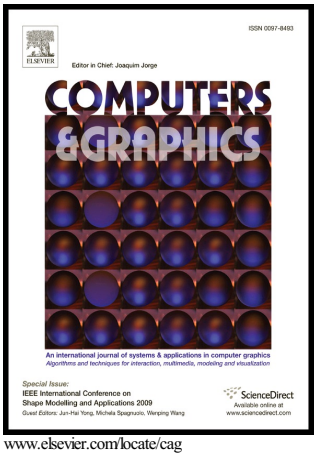
Shape context based mesh saliency detection and its applications: a survey

Xianyong Liu, Ligang Liu, Weijie Song, Yanping Liu, Lizhuang Ma



www.elsevier.com/locate/cag

PII: S0097-8493(16)30014-0
DOI: http://dx.doi.org/10.1016/j.cag.2016.03.001
Reference: CAG2683

To appear in: *Computers and Graphics*

Received date: 30 October 2015
Revised date: 1 March 2016
Accepted date: 9 March 2016

Cite this article as: Xianyong Liu, Ligang Liu, Weijie Song, Yanping Liu and Lizhuang Ma, Shape context based mesh saliency detection and its applications: a survey, *Computers and Graphics,* http://dx.doi.org/10.1016/j.cag.2016.03.001

Shape context based mesh saliency detection and its applications: a survey

Xianyong Liu[a], Ligang Liu[b], Weijie Song[c], Yanping Liu[d], Lizhuang Ma[a]

[a]*School of Computer Science and Technology, Shanghai Jiao Tong University, Shanghai, China*
[b]*School of Mathematical Sciences, University of Science and Technology of China, Hefei,, China*
[c]*School of Science, Northwestern Polytechnical University, Xi'an, China*
[d]*School of Marine Science and Technology, Zhejiang Ocean University, Zhoushan, China*

Abstract

Mesh saliency was introduced and joined the community of computer graphics ten years ago, which can benefit various applications, for instance, mesh reduction, mesh segmentation, self-similarity matching, scan integration, volume rendering, 3D printing, etc. Before, saliency detection had been successfully applied to image processing and pattern recognition to study how the world is perceptually intelligible for robots. In contrast with color of images and coherence of videos, geometric signals are defined with two-dimensional manifolds whose discrete representation is irregular, leading differences to the nature and difficulties to the solution of mesh saliency. To tackle the challenge, the last decade has witnessed significant advances in mesh saliency detection. However, a survey of recent advances in mesh saliency detection as well as its applications does not yet exist to date. This paper provides a first and comprehensive reference source of shape context based mesh saliency for researchers from a wide range of domains, including but not limited to computer graphics and vision. It reviews main contributions, advantages, drawbacks, and applications of known mesh saliency detection methods and discusses current trends and outlook for future study.

Keywords: the human visual system, geometric analysis, mesh saliency, shape descriptor, shape spectrum

1. Introduction

> *"Seeing comes before words [1]." "Most of what our eyes take in is filtered, as we cannot process all that is within the field of our vision [2]."*
>
> John Berger

The human visual system (HVS) is a significant part of how we process sensorial information and a key factor in how we learn. In order to reveal the brain's perception processing mechanisms, over the past decades, a large number of neurophysiological and cognitive neuroscience researches have provided in-depth and detailed experimental data and theoretical models. For example, *Science*, *Nature*, and *Neuron* published several remarkable findings [3, 4, 5, 6] relevant to the behaviors within the process of the HVS. The visual media, including digital images, videos, and three-dimensional (3D) models, contains superfluous visual information, of which the portion that is visually interesting is filtered and referred to *saliency* [2]. *Saliency detection*, thereby, imitates the ways of seeing and becomes an interdisciplinary scientific study of theoretical computer science and the human perception.

This article, in particular, surveys recent developments in *shape context based* mesh saliency. By "mesh saliency" we mean enabling a machine system to automatically reason about which points or regions of a 3D *polygonal mesh* are perceptually important [7], so the artificial intelligence can observe like the humans. The term of "perceptually" distinguishes the topic surveyed from others detecting *interest points* [8] or *keypoints* [9], though they do have overlaps (see Section 7.1).

Moreover, the task of mesh saliency is relevant to a relatively mature research area called *visual saliency* in image analysis (see Section 7.2), as both are related to the nature of the HVS but from different perspectives. Compared to 2D images, 3D meshes have several deviations, leading challenges to mesh saliency detection. For instance, (i) 2D images and videos have regular discrete representations, which are irregular for 3D meshes [10]; (ii) 3D meshes provide more geometrical (depth) information which are hidden from static 2D images, also 3D shapes are believed to encode surface metric

Email address: ma-lz@cs.sjtu.edu.cn (Lizhuang Ma)