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K. Bühler, L. Linsen, and N. W. John (Editors)

# A Statistical Method for Surface Detection

S. Smith and I. Williams

[1] Digital Media Technology Laboratory, Birmingham City University, United Kingdom

**Abstract**

*This work presents a new method for 3D surface detection using a statistical dual-region filter. The method improves over traditional 3D surface detection techniques by resolving interfaces between different stochastic textures, while maintaining the accuracy for gradient based interfaces.*

*Segmentation is commonly applied to 3D image formats such as MRI and CT data to aid high level visualisation and anatomical model creation. Often segmentation is a process which is reliant on accurate surface information and typically gradient-based surface detection methods are applied. These gradient methods identify sharp changes in the image intensity profile, however are known to fail when high levels of noise are present. Often within MRI and CT data, the regions to be segmented are areas of stochastic texture, such as soft tissue structures, this can resemble intensity boundaries corrupted by noise where the intensity profile across the regions remains constant, rendering gradient-based operators less effective. To overcome these issues, we present a surface detection method that employs a dual-region neighbourhood mask, alongside a statistical comparison test. Within this method we assess eight different statistical tests which measure the similarity between the neighbourhood mask regions. The tests presented are mean based, variance based, non-parametric or distribution based. Results from this method show that when a high degree of similarity is found between image regions a non-surface point is detected, and likewise where a low degree of similarity from the tests is found signifies a surface location. Through this process, improved surface segmentation is achieved even in the presence of stochastic texture.*

*We present results to show significant improvements over the 3D Canny method of surface detection and also the 3D Steerable filter method, notably in the detection of surfaces between regions of stochastic texture with high intensity variance. This improvement is further illustrated by our method achieving fewer missed interfaces, more complete surfaces and a measured reduction in spurious surface responses. We employ a Monte-Carlo analysis, involving the development of a synthetic texture interface datasets and the corresponding ground truth solutions. Receiver Operator Characteristic and Precision Recall quantitative performance measures are used to compare against existing state of the art filter methods, and application in real CT and MRI data shows where the improvements can be found.*

Categories and Subject Descriptors (according to ACM CCS): I.1.4.6 [Image Processing and Computer Vision]: Segmentation—Edge and Feature detection

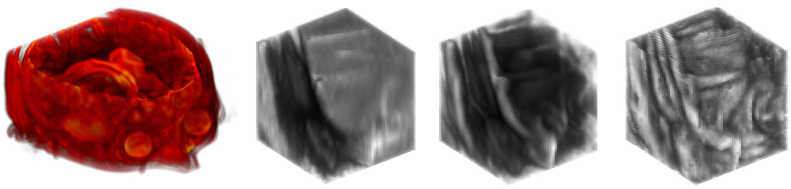

**Figure 1:** *This figure shows from left to right, a typical surface map that is required for segmentation, a small section of MR data, and results from gradient and statistical surface detection from the same area. The gradient based operator identified the strong intensity based boundary, but did not locate the interfaces which exist between regions of stochastic texture; represented here by differences in soft tissue structure. However, the statistical operator is able to identify both intensity and texture surface interfaces.*



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