

Active Contours and Color Space Invariance in the FLUFFER Software

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Abstract

The FLUFFER (Flexible Labeler Used for Fundamental Edge Research) software developed at Swarthmore College provides an excellent tool for developing image databases. Using an implementation of Active Contours [1], we successfully improved the segmentation capabilities of this software for simple images. With the help of the new segmentation techniques, we built a ninety-nine image database of labeled images and used this database to examine published findings in the hue, opponent, normalized rg, and RGB color spaces [2]. Our image analysis showed that the color space invariance qualities of geometry and illumination edges in real world images often do not meet with H.M.G. Stokman's findings.

Summary

The FLUFFER program is useful for determining image segmentations and labeling regions and edges for database construction. This first part of this paper describes an implementation of active contours with balloon forces within the software that attempts to improve the edge detection and segmentation through perceptual grouping of edges detected by an edge detection method.

The fully autonomous active contour implementation is successful at grouping edge pixels in close proximity and with similar orientation into closed and partially closed contours. The active contours, however, will not seal up large holes or extrapolate edges into regions where local descriptors do not find them. The method improves FLUFFER's segmentation of images with distinct regions and mostly linear salient features proving itself useful for image analysis.

The second part of this paper describes a study we performed to determine the color space characteristics of geometry, material, and illumination edges in simple images. To do this study, we built an image database of simple objects using the FLUFFER software.

After building the database, we analyzed the edges in the RGB, normalized rg, opponent, and hue color spaces according to the methods put forth by H.M.G. Stokman of the University of Amsterdam [2]. While some edges confirmed his findings, most edges contradicted them in one or more color spaces. This paper shows that geometry and illumination edges often have variance in unexpected color spaces, and that Stokman's assumptions are often too simplistic to be applied to real world images.

In both parts of this paper, we have shown that FLUFFER is a robust and useful tool for computer vision research and image analysis. Its edge detection, segmentation, and labeling techniques are excellent resources for building image databases. The software's modular design allows its use for analysis of various techniques and its expansion into more advanced levels of techniques such as perceptual grouping.

References

- [1] Kass, M., A. Witkin and D. Terzopoulos. "Snakes - Active Countour Models." International Journal of Computer Vision, 1(4): 321-331, 1987.
- [2] Stokman, H.M.G. and Th. Gevers. "Classification of Color Edges in Video into Shadow-Geometry, Highlight, or Material Transitions." University of Amsterdam, Amsterdam, The Netherlands.