ABSTRACT

In this thesis the problem of range image segmentation and characterization of surfaces has been addressed. For segmentation of range images, edge-based approaches have been attempted. Here, the following contributions have been made - modification of 2-D edge operators (mainly Laplacian and its Zero-crossings) for detecting edges(both step and roof edges) in range images and use of Pseudocoloring and Adaptive Contrast Enhancement techniques for enhancement of edges for improved visual perception.

For application of Laplacian and its Zero-crossings for edge detection in range images, we had to first smooth the image for removing noise . We have observed the effect of both linear and nonlinear lowpass filters for this purpose . Five different lowpass masks were tried as linear filters . The nonlinear filter chosen was median filter of different window sizes. Different discrete approximations of classical laplace filter were tested on the lowpass-filtered image .Next,the effect of a nonlinear Laplacian operator was studied. The lowpass filtering techniques were the same as those for linear Laplacian .

For pseudocoloring, intensity images were derived from range data using a range coding convention .

Next, three independent transformations were applied on the gray levels of any input pixel and then a composite image whose content is modulated by the nature of the transformation function was produced .

In adaptive contrast enhancement tech nique for edge enhancement in range, for each pixel in the image, the edge value is found out

using some standard edge detection operator(Laplacian/Sobel) . Then, the mean-edge-gray value for this pixel is computed using both the edge and gray value at that pixel) . Next, contrast associated with this pixel is found out using the mean-edge-gray value and the gray value . Finally a contrast transformation function is used to modify the contrast as found above and the modified gray value is obtained from this new contrast using the reverse of this procedure for finding contrast .

The proposed method of wire framing is divided into three stages: segmentation of the range image, polygonization of the individual segments and joining of adjacent segments through superposition of vertices. The segmentation algorithm is based on the concept of digital neighbourhood planes where local neighbourhood constraints are propagated to extract almost planar segments patches. In every individual segment, boundary points are first connected vis Grahams scanning to form a simple polygon. This polygon is then refined by removing redundant vertices on straight edges to form a polygonal approximation of this segment.

The method for characterizing the surfaces in segmented range images extracts planar or cylindrical or spherical surface patches. Any surface which does not fall into the category of the above surface types is represented by a combination of these primitive surface types.

Key Words : Range Images, Segmentation, Edge Detection, Nonlinear Laplacian Operator, Contrast Enhancement, Pseudocoloring, Median Filtering, Wire framing, Surface Characterization.