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Edge detection is one of the earliest and most fundamental operations in most image understanding systems. Literally thousands of edge detection algorithms have been described in the literature. However, most new algorithms are described with no objective performance comparison to algorithms which already exist. The general area of work that we are pursuing is to develop methods of comparing the performance of edge detection algorithms. This goal is made potentially difficult by a number of factors. One is that the output of edge detection generally becomes the input to the first of a succession of operations which lead to a final object recognition result. Thus, a comparison of edges independent of the recognition task may not reflect the operation of a complete system. Also, since there currently are no image understanding systems that solve the general object recognition problem, it is not possible to use edge detection results as the input to a complete, general recognition system.

The performance characterization method that we are pursuing at this time is to use ANOVA analysis of human ratings of the quality and completeness of information contained in the edge detection output. We have acquired a set of images to use in this work. We have also acquired implementations of several of the best-known and most widely used edge detection algorithms. We have developed a method of sampling the parameter space of each edge detector and reducing the number of points to a set which is practical for use in a human rating experiment. In the first stage, each edge detector is considered independently of the others and the goal is to find the "best" parameter settings for that edge detector. In the second stage, the edge detectors are considered as a group, and directly compared against each other. ANOVA statistical analysis of human ratings is used in both stages. We will apply this method to obtain comparative performance rankings of edge detectors. Then we will follow up by pursuing some combination of two further research directions: (1) performance comparison of edge detectors by other methods, to see if some simpler method can produce equivalent results, and (2) performance comparison of algorithms other than edge detection, such as region segmentation.