XIAOFEN ZHENG
BSc (Computer Science), Taiyuan University of Technology, 1998
BArt (English Language), Taiyuan University of Technology, 1998
MSc (Computer Science), Taiyuan University of Technology, 2001

FACULTY OF COMPUTER SCIENCE

TITLE OF THESIS: PERCEPTUAL ORGANIZATION BASED CURVE PARTITIONING, CLASSIFICATION AND GROUPING

TIME/DATE: 1:00 pm, Wednesday, August 22, 2007

PLACE: Room 1170, Marion McCain Arts and Social Sciences Building, 6135 University Avenue

EXAMINING COMMITTEE:

Dr. Robert Dony, School of Engineering, University of Guelph (External Examiner)

Dr. Norm Scrimger, Faculty of Computer Science, Dalhousie University (Reader)

Dr. Evangelos E. Milios, Faculty of Computer Science, Dalhousie University (Reader)

Dr. Qigang Gao, Faculty of Computer Science, Dalhousie University (Supervisor)

Dr. Denis Riordan, Faculty of Computer Science, Dalhousie University (Departmental Representative)

CHAIR: Dr. Jan Kwak, PhD Defence Panel, Faculty of Graduate Studies

ABSTRACT

Image feature segmentation, classification and grouping form the base of all image understanding applications, with shape being one of the most important features. Human vision can best identify objects by their shapes. The biological and psychological aspects of human vision may provide clues to the complex process of extracting and interpreting shape information from the vast amount of data in an image. Although shape-based solutions are widely studied, most existing methods are based on the geometric equations of curves computed from processing an entire image. These processes are computationally intensive, lack flexibility and take little advantage of the Gestalt rules of human vision. By applying certain mechanisms based on the human visual perception process, we attempt to improve computers ability to process images. Although the existing research in this direction has shown great potential, most of the work has been specific task oriented. A generic architecture for formalizing shape perception rules would greatly aid the efficient development of real world applications.

The aim of this research is to develop a coherent approach to shape feature extraction, classification, representation and grouping based on perceptual principles and organization laws. A framework for perceptual shape feature partitioning, classification, grouping and evaluation is proposed and developed. A perceptual shape language, including shape vocabulary and a set of grouping rules, is proposed. The shape vocabulary consists of generic classes of basic line and curve segments and commonly used low-order association structures of the segments. A statistically based evaluation method is developed for measuring the correlation and accuracy of the classified features. Examples of both closure-based and clustering-based groupings are used to demonstrate how to interpret the image data into meaningful forms based on the perceptual vocabulary. The perceptual shape language can potentially support various shape-based vision applications, in particular the development of real-time systems, such as content-based image retrieval, motion analysis, robot navigation and medical image registration. As a demonstration, a shape-based natural image retrieval system is implemented.