A STUDY ON THE FEASIBILITY OF A GLOBAL DESCRIPTION OF 3-D OBJECTS IN RANGE DATA FOR RECOGNITION PURPOSE

STEPHEN H.Y. HUNG

National Research Council of Canada
Ottawa, Ontario, Canada K1A 0R8

Abstract: As an alternative to the common approach in 3-D object recognition, the images of an object from all possible viewing position were considered. The collection of images thus acquired formed a global descriptor of an object and was used to identify the object. This study showed that characterizing the image data in certain way allowed easy handling of the large storage requirement and made fast search possible. This approach is indeed feasible and worth further pursuit..

Key Words: 3-D Object Recognition, Global Descriptor, Range Data, Random Problem.

I. Introduction

The common approach in object recognition is to extract local features such as edges, corners and surfaces from the data as a basis for describing an object. The major drawbacks of this kind of approach are the difficulty and large computational effort required to extract the local features and their relations, as well as the complicated processing of the comparison. The combination of these drawbacks usually makes such methods slow, difficult to implement in realtime and, in some cases, they lead to a combinatorial explosion. An alternative approach is to consider an object from all possible viewing positions. The collection of images thus acquired forms the model or a global descriptor of an object and will be used to identify the object.

In this approach, we are actually treating the object recognition as a random problem whose solution requires knowledge of essentially every possible state of a system. Solving such a problem entails memorizing the set of all possible solutions and quickly selecting the best one from the set, given the input data. The goal of this study is to see whether such an approach is feasible for object recognition problems. The focus will be on overcoming the large storage requirement and developing a fast search algorithm.

II. The Basic Assumption

The objects considered in this study are objects that can be isolated, either from the background or from other objects; there is no occlusion.

For simplicity, we will consider only the geometrical description of objects and ignore shading, colour and texture. Thus, range data instead of intensity grey level data will be more suitable for our purpose.

We assume that the scene is scanned with a laser range finder scanner, described in [1], which provides a two-dimensional image of distances Z(x,y) from a zero reference plane (x,y) orthogonal to the line of sight from the scanner. The scanner makes measurements from a point above the scene, but the readings are the actual Z-values obtained using a mechanical synchronization of two scanners (as in Fig. 1). Such an arrangement provides a reference plane that can be set at any distance along the Z-axis. The readings of X,Y and Z are given in millimetres. Since there is no guarantee that the object is on the reference plane, the Z-value cannot be seen as an absolute measurement of the object. Such an assumption has an immediate drawback in that two objects which have the same visible surfaces but are different in height cannot be distinguished if viewed from certain positions (see Fig. 2). However, this is reasonable and matches the real situation.

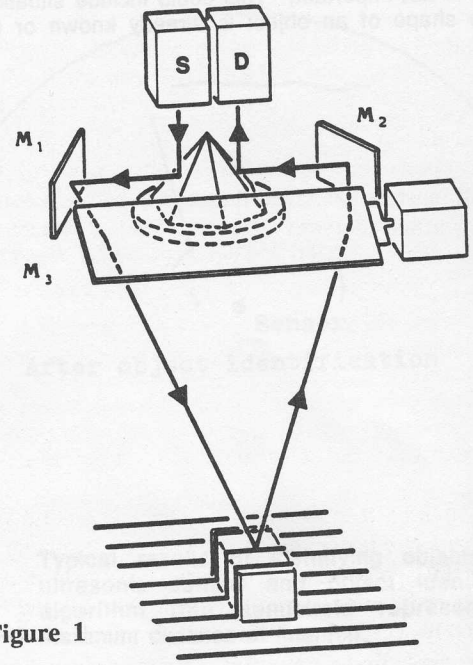

Figure 1