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ON THE COMPRESSION OF THE SONAR IMAGES

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Abstract: By SONAR image is understood a 2D signal composed of theta and range values of the targets in the exploratory field of mobile robot. The objective is to reduce the size of the image for storage purposes and efficient computation of navigation strategies. Basically, a set o processing steps are developed which could be summarized by median filtering, range cuantization, angle cuantization and data compression without loss of information. Data size is reduced with a ratio of four to five. The algorithms are adapted to the context of data, by using an optimum size of the filtering window and an optimum number of cuantization levels.

Keywords: Signal processing, SONAR measurements, filters, cuantization, compression.

1. INTRODUCTION

The work is in the context of mobile robots with SONAR based navigation, under the CIRCE project, [1]. By SONAR image is understood a 2D signal composed of theta and range values of the targets in the exploratory field of a mobile robot. The objective is to reduce the size of the image for storage purposes and efficient computation of navigation strategies.

From raw measurements, the size of the SONAR image is 204 pairs x 2 values of coordinates, so a number of 408 real values should be stored. The robot has 17 ultrasonic transducers. In every position, from 1 to 35, the robot is rotating in steps of 30 degrees. Every position will have 12 orientations. In every stop of the robot, 11 measurements are performed. From this set only one measurement is considered by using a median filtering, i.e. sorting based on values the set of 11 measurements and keeping the 6^{th}. Taking into account the number of transducers (17), it results a matrix of 17 x 12 raw data for each position. There are also some outliers, obtained from multiple reflections of echoes on the walls of the environment.

All range data are cuantized using a linear transformation. The number of cuantization levels depends on the desired accuracy in the estimation of the obstacles and used – later – in navigation strategies. A maximum range of 5 meters is considered in this work. The range error, obtained after cuantization, is the maximum range divided by the number of cuantization levels. For an imposed range error of 0.1 meters the number of cuantization levels must be 5/0.1 = 50.

2. COMPRESSION OF THE SONAR IMAGES

SONAR images are redundant in the sense that contain two many points to represents the contour of the environment. Such redundancy is obtained from experiment because the echoes are stored as they arrive from environment and the targets are not sampled on a regular basis. As effect, there is more there one pair of values for the same obstacle. Below, the compression algorithm is summarized.

Compression algorithm
INPUT: angle and range (quantized) vectors, *wq* and *rq*;
OUTPUT: compressed angle and range vectors, *wqc* and *rqc*;
#1: Vectors initializations: *wqc* = [ ]; *rqc* = [ ];
#2: FOR *i* from 1 TO *N*-1 DO
#2.1: IF NOT (*wq(i)* == *wq(i*+1*)*
AND *rq(i)* == *rq(i*+1*))*
THEN *wqc* = [*wqc wcc(i*+1*)*];
rqc = [*rqc rq(i*+1*)*];
End_IF;
END.

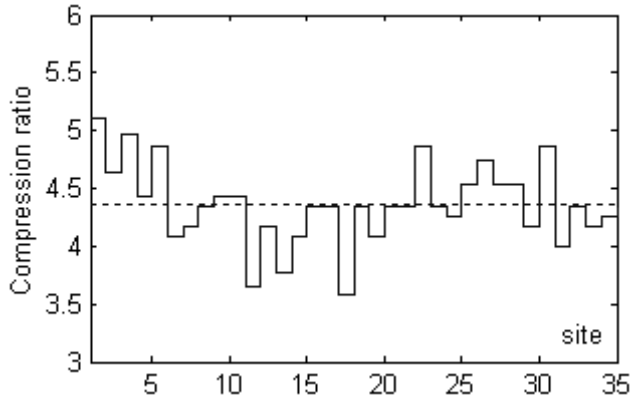

Figure 2. Evolution of the compression ratio

The objective of the compression is to eliminate the points that are irrelevant and thus compression is done without loss of information. From geometric point of view, the contour of the polygon could be regarded as a polygon. The compression algorithm will retain only the points where a change on edges is discovered.

It is true that the compression factor depends on the irregularities of the environment. For example, for position 6, the compressed vector has 50 elements, so a value of $204/50 \cong 4\ldots5$ of the compression ratio is obtained. If all the 35 positions are considered, there the evolution of the compression ratio is presented in Fig. 2.

REFERENCES

[1]. Chiroptera-Inspired Robotic Cephaloid-CIRCE: a Novel Tool for Experiments in Synthetic Biology, http://www.circe-project.org/index.htm, 2002.