EVALUATION OF A STATISTICAL PROCESS CONTROL (SPC) SYSTEM BASED IN A LOSSY COMPRESSION DATA ENCODING.

IRANZU SOTÉS, JUAN LUIS LARRABE, JOSÉ IGNACIO URIARTE, MIGUEL ANGEL GÓMEZ
Department of Nautical Science and Marine Systems
H.T.S. Nautical and Naval Machines
Maria Díaz de Haro, 66, Portugalete 48920 Bizkaia, SPAIN
Tfn: 034 94 6014847 email: miguel.solaetxe@ehu.es

Abstract - The aim of this research is to proof that data acquired on board, packed by Principal Components Analysis (PCA) and transmitted by satellite connection, are suitable for statistical process control, monitoring and predictive maintenance task. X-bar&S Chart statistical method will be used for monitoring, both, the original data and compressed data and the criteria for determinate if the process is in control or not, will be applied. Further, a comparative study using one dimensional variance analysis ANOVA is done between the original data and compressed data for determining if (p £ 0.05) for process variables taken in a random way.

Keywords - Principal Components Analysis (PCA), Statistical Process Control (SPC), Predictive Maintenance

INTRODUCTION

In this paper the suitability of a non-exact compressed data packets is discusses and it is use for implementing a monitoring system and for a statistical process control (SPC), all that from the view point of reliability in a liquefied natural gas (LNG) ship.

The hypothesis of this study was to evaluate the reliability of a monitoring system using the theory of Principal Component Analysis (PCA) to compress, with sufficient accuracy, the large amount of data being collected on board a ship and then send via satellite in a more economical or faster way than the traditional. We make an analysis of both data (the real data and non-exact compressed data) making the distribution of the average and the standard deviation establishing the control limits using (X-bar & S) chart [2]. Then we will see if these data collected on ground are sufficient to make telediagnosis and predictive maintenance decisions of the machinery on board using ground equipment [3]. Using these control charts we will initially identify whether the variables are in or out of control, by British or American conventions [2], so, significant cost and timesavings in telecommunications are obtained. The propulsion systems used today have more electronics systems, so a diagnosis on ground is becoming increasingly necessary.

The data used were collected on board a ship which transport liquefied natural gas LNG (Catalunya Spirit) through its integrated automation system (IAS, Norcontrol, Norway). This device generates a spreadsheet file every 1 hour, which represents the condition of 176 different variables signals of the major subsystems of the vessel, twenty four times every day, during nine days from February to April.

Non-exact compression is performed by applying the method of the PCA for monitoring the condition of the equipment on board, which allows a lower cost communication or reduce the occupation time of bandwidth for a given amount of data. A lossy compression technique includes a loss of information, where the exact original data cannot be recovered. So this compression is possible if some loss of fidelity is acceptable.

It is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. Since patterns in data can be hard to find in data of high dimension, where the luxury of graphical representation is not available, PCA is a powerful tool for analysing data. The other main advantage of PCA is that once you have found these patterns in the data, is possible compress it, by reducing the number of dimensions, without much loss of information. In the modern process industry, PCA is widely used for SPC for datasets with large number of highly correlated variables recorded in real time by sensors located in continuous or batch processes.

The (X-bar & S) chart are the charts where the average is X-bar; figure (1) and the standard deviation s, figure (2). These graphics efficacy join the central tendency graph and the variability of the process graph.

The (X-bar & S) chart are use when the number of samples is very large.

Using ANOVA method for compare populations, the result was that there were no significant differences (p £ 0.05) using real data or using non-exact compression data and the interpretation of out of control using British conventions also did not differ significantly.

REFERENCES