A RIGOROUS EVALUATION OF PROGRESSIVE IMAGE TRANSMISSION METHODS FOR TELEMICROSCOPY OF BIOLOGICAL SPECIMENS

V.G. Ruiz, J.J. Fernández, M.F. López, I. García

Dept. Computer Architecture and Electronics
University of Almería.
04120 Almería. Spain
E-mail: vruiz@ual.es, jose@ace.ual.es, mflopez@ace.ual.es, inma@ace.ual.es
Tel: +34 950 015711

ABSTRACT

This work presents a rigorous and objective evaluation of two progressive image transmission techniques in a framework of telemicroscopy of biological specimens. First of all, a Lossless Progressive Image Codec (LPIC) which is based on a specific wavelet transform and an efficient encoding method is introduced. This system is then compared to the standard Progressive-JPEG (P-JPEG) for the specific task of detecting biological specimens in the images progressively received by a biologist controlling a remote transmission electron microscope (TEM). Both methods have been quantitatively compared by means of a task-oriented methodology that guarantees an objective comparison. The results that have been obtained allow to claim with statistical significance that our method outperforms the standard P-JPEG throughout the transmission process.

Keywords: Discrete wavelet transform, progressive image transmission, SPIHT, JPEG, figures of merit in Telemicroscopy.

1. INTRODUCTION

Telemedicine, Telemicroscopy and Teleastronomy provide access to expensive and unique instruments for the scientific community, allowing one or several remote users to control devices in real time and/or to share the images obtained from the current experiment or to consult databases of images obtained from previous experiments. For these purposes, remote links must provide high rate transmission with short latencies in order to make the instrument available as a research tool. Apart from using a high transmission rate, a remote visualization procedure can be accelerated by using an appropriate image compressor. Most of the telemetry and remote control systems in Telemedicine, Teleastronomy or Telemicroscopy use the standard JPEG compressor/decompressor. The goal of this work is to describe and analyse a mechanism for the efficient transmission and lossless storage of the images, facilitating the remote operation of the TEM by the biologist.

In this paper a Lossless Progressive Image Codec (LPIC) is proposed for this objective. Based on a rigorous methodology, the efficiency of the standard progressive compressor P-JPEG will be compared to LPIC for the specific task of searching and detecting biological specimens in the progressively sent images. In addition, a subjective visual comparison between both progressive compressors will also be provided. Subjective observations and numerical results obtained from an exhaustive analysis based on many experiments show that LPIC outperforms P-JPEG.

2. THE LOSSLESS PROGRESSIVE IMAGE CODEC

Progressive image transmission systems are structured into two main blocks [1]. First, the transformation stage, which plays an important role in decorrelating and compacting image data by using a spectral de-

This work has been partially supported by the Spanish CICYT through grants TIC99-0361 and TIC2002-00228.