Gastric assessment by images processing of ultrasound in LabVIEW platform: preliminary results

Avaliação gástrica pelo processamento de imagens de ultrassom na plataforma LabVIEW: resultados preliminares

T. Córdova¹,², M. Sosa¹, J. J. Bernal¹, A. Hernandez¹, G. D. Gutiérrez¹, D. Rodriguez¹, S. Solorio³, M. A. Hernandez², M. Vargas¹, I. Delgadillo³, G. Moreno¹, J. G. Villalpando² and C. R. Contreras²

¹Departamento de Ingeniería Física, Universidad de Guanajuato, Campus León – México.
²Facultad de Ingeniería en Computación y Electrónica, Universidad De La Salle Bajío – México.
³Unidad Médica de Alta Especialidad, Clínica T1-León, Instituto Mexicano del Seguro Social – México.

Abstract

Nowadays, the gold technique in gastric evaluations still is scintigraphy in spite of ionization radiation dose per patient undergoing this procedure. Gastro images with ultrasound technique are controversial, because the stomach is a hollow cavity filled with gas in basal conditions or in fast state. Fortunately, a stomach with food is recommended in gastric motility and gastric emptying assessment. So, a lack of air in stomach contributes in this kind of study and in recordings of excellent images by ultrasound. In this study, a digital image processing of gastric ultrasound is presented. Whole automated routine and implemented filters are described in order to use this procedure in gastric peristalsis and gastric emptying evaluations. Ten volunteers were recruited and required to attend the measurements about dominant frequency, with values of at least 3 cpm. Although the behavior stomach activity is observed in dynamic graph, an analysis in frequency space is performed.

Keywords: gastric, peristalsis, ultrasound, emptying, LabVIEW.

Resumo

Hoje em dia, a técnica de ouro nas avaliações gástricas ainda é a cintilografia apesar da dose de radiação de ionização por paciente submetido a esse procedimento. As imagens gástricas com a técnica do ultrassom são controversas, pois o estômago é uma cavidadeting preenchida com gás em condições basais ou em estado rápido. Felizmente, um estômago com comida é recomendado em motilidade gástrica e esvaziamento gástrico. No estômago com comida contribui para este tipo de estudo e para gravações de excelentes imagens por ultrassom. Neste estudo, o processamento da imagem digital do ultrassom gástrico é apresentado. Uma rotina totalmente automatizada e filtros implementados estão descritos para usar este procedimento no peristaltismo gástrico e nas avaliações de esvaziamento gástrico. Dez voluntários foram avaliados em relação à frequência dominante, com valores de no mínimo 3 cpm. Embora a atividade gástrica seja observada em gráfico de dinâmica, uma análise em frequência temporal é realizada.

Palavras-chave: gástrico, peristaltismo, ultrassonografia, esvaziamento, LabVIEW.

Introduction

The gastrointestinal system evaluation is, currently, as important as other clinical procedures, like heart monitoring. If patients are not adequately treated, they may die. This is especially important for some kinds of patients, for instance, diabetes patients with problems of gastroparesis. The scintigraphy technique is now the gold standard in this evaluation, despite ionizing radiations that undergo the persons¹. There are other imaging techniques for this study, like the ultrasound, that has been an alternative for assessment and monitoring of the gastric activity in the last years²-⁴, although it has still not taken off, which could be due to a lack of conclusive results and proper procedure, leading to results highly correlated with the gold standard technique, scintigraphy.

A routine for processing ultrasound images of stomach, implemented in LabVIEW platform, is presented. This has been used to perform evaluations of
the peristaltic activity and gastric emptying in preprandial and postprandial conditions in healthy subjects and patients.

**Procedure**

An ultrasound equipment model Medison SONOACE 8000 SE was used in this study. A group of ten healthy volunteers with no history of gastrointestinal diseases and two patients were recruited and required to attend the measurements after a night of fast. Each subject swallowed 300 mL of water previous to first measurement; then, a solid test meal was ingested in order to estimate the gastric area. Each subject was in supine position during the auscultation and along the data acquisition time, that lasted one minute. It is important to point out that this work was carried out according to the Helsinki agreement for studies in human.

**Protocol**

Once the gastric area was identified, a video of 1740 frames was recorded in B Mode and in M modes (Figure 1). Then, the M mode video was split in each one of its frames and the image processing was performed.

From the M mode video, a representative frame is selected and the region of interest (RI) is studied (Figure 2); the superior and inferior bands are identified. In the RI of the frame, the points x1,y1, x2 and y2 are determined and the same action is automatically executed in each of the 1740 frames. Simultaneously, a new file (Figures 2 and 3) of this new outage image is created in order to perform the imaging processing over all of it.

**Imaging processing**

The upper and lower bands, in the image of the Figure 4, correspond to the upper and lower walls of the stomach, respectively.

Here, a series of filters were implemented during image processing in order to reduce the area of each band to a single line (IMAQ MathLookup + IMAQ GrayMorphology + IMAQ MathLookup + IMAQ BCGLookup + IMAQ LowPass + IMAQ Convolute + IMAQ RejectBorder). When the filtering process is over, one distance from inferior to superior band is measured through a subroutine of find Vertical Edge of the IMAQ software; this leads to determine only one couple of coordinates, selected from each one of the edge points of the band. With that couple of coordinates, the distance from one to other side of the stomach is measured (Figure 5).

It is important to point out that only one distance is measured from each couple of coordinates. If we have 29 frames in one second, then, this corresponds to have a rate frequency of 29 samples per second. These points are simultaneously plotted (Figure 6).

**Results and discussion**

The above description is appropriated for gastro evaluations. The peristaltic information is seen from first measurement (Figure 7) in time domain, in which about three contractions are shown. Nevertheless, physicians are interested in the exact value of the dominant frequency.
so a FFT (fast Fourier transform) is obtained from above signal in order to present this value (Figure 8).

**Conclusions**

This new ultrasound gastric imaging processing is presented as a powerful technique, with relatively easy implementation, because the ultrasound equipments are very common in hospitals and the LabVIEW routine can be executed in any personal computer.

**Acknowledgment**

Authors want to thank DAIP grant No. 000017/10 and UDLSB grant of 2010.

**References**
