Graphical user interface created in Matlab for ultrasonic system

Václav Matz
CTU, Faculty of Electrical engineering
Department of Measurement

_____

Abstract

In ultrasonic defectoscopy it is very important to recognize flaw in material. Ultrasonic system must have the best parameters for recognition of flaw. Recognition of flaw is very dependent on parameters of ultrasonic system and on signal processing of signal measured with system. In this work communication with system and signal processing of measured signal using Matlab toolboxes is described. Signal processing toolbox and wavelet toolbox of Matlab 6.5 were used.

_____

Introduction

For measurement ultrasonic signal system DIO-2000 was used. System communicates with personal computer (PC) through serial port RS-232. For communication, control and set of parameters of ultrasonic system graphical user interface (GUI) were created. GUI provides general data representation. In GUI is possible to change almost all of parameters of measured signal and parameters of signal processing. In GUI are implemented different methods of signal filtering like FIR filter and Discrete Wavelet Transform (DWT) [1]. All of methods are displayed in window image. This work proposes GUI for signal displaying and signal processing of measured data from ultrasonic system.

Graphical User Interface

Communicating through serial port RS-232 and signal processing is considered in GUI. Welcome screen of GUI is shown on Fig.1.
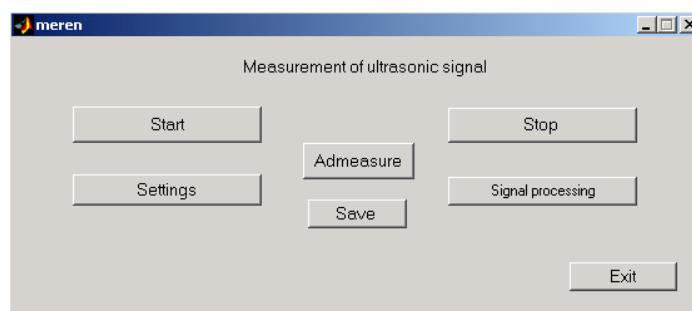

Fig.1: Welcome screen

Communication through RS-232

For link-up with system DIO-2000 functions for control serial port in Matlab were used. As first function *serial* was used. This function is creating serial object. Then parameters for communication with system were set up. It is possible to communicate with all serial ports in PC. In other window (see Fig. 2) it´s possible to change bitrate, size of input and output buffer and other else.
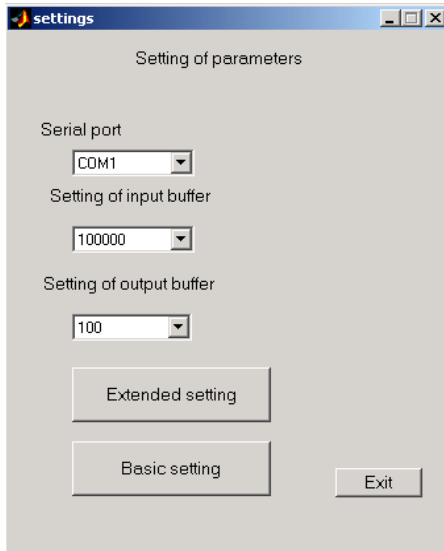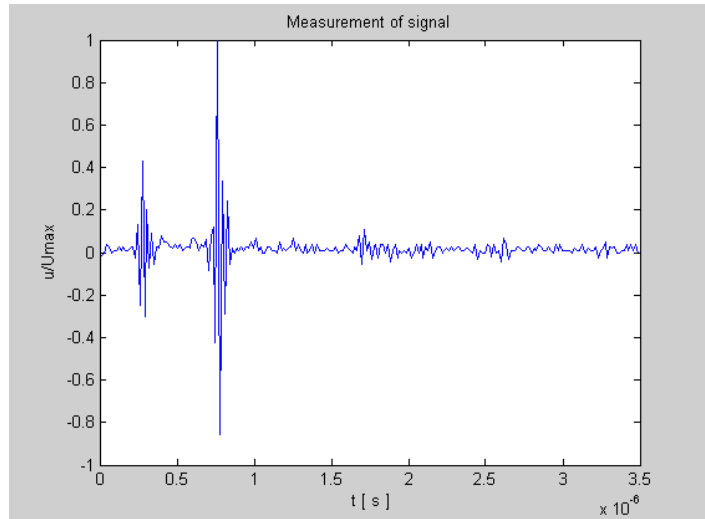

Fig.2: Setting of parameters

Fig.3: Display of measured signal

Measurement of signal

Measurement and display ultrasonic signal is the basic property of ultrasonic system. Ultrasonic signal characterizes measured material. Typical ultrasonic signal in display A-scan with fault echo and backwall echo is shown on Fig.3. A lot of operations is possible to perform in window illustrated on Fig.1. The measurement can be achieved by two manners. The first is continual measurement and the other is only one measure. The continual measurement is created by callback function of *TimerFcn.* The measured signal can be saved. Saved signal is prepared for signal processing. In created GUI it´s possible to see the signal in display-Bscan (see Fig.4). Display B-scan is based on measuring of the ultrasonic signals in display A-scan. A transducer is moved along the material and signals in display A-scan are recorded.
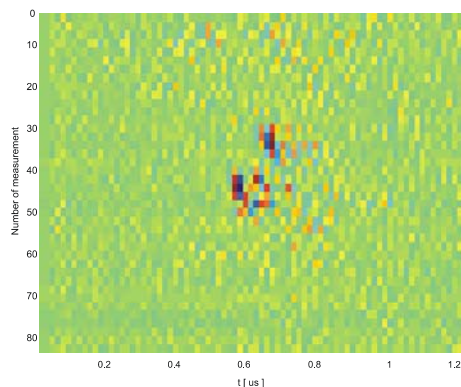

Fig.4: Display B-scan

Signal processing of ultrasonic signal

For signal processing, window with display of signal was created (see Fig.5). In this window user can change allmost all parameters of signal processing. For construction this window signal processing toolbox and wavelet toolbox were used. From signal processing toolbox function as *fft* or function for FIR filter construction *filtfilt* were used. Different kind of signal as spectrum of signal, filtered signal, part of signal, noise and spectrum of filtered signal is possible to display in this window. For filtering ultrasonic signal Discrete wavelet transform (DWT) was used. DWT is based on decomposition of signal to detail and approximation coefficient, thresholding of detail coefficient and inverse discrete wavelet transform. In this method user can change mother wavelet, level of decomposition and rule for thresholding of detail coefficients.
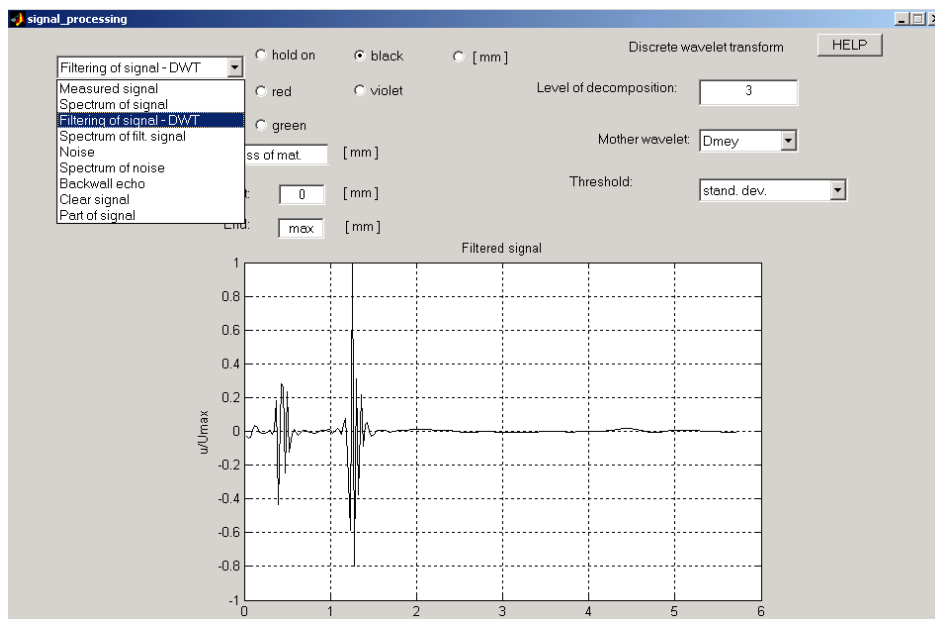

Fig.5: Signal processing window

Discrete wavelet transform used for filtering of signal is using standard functions of wavelet toolbox. For decomposition of signal mother wavelets implemented in toolbox were used. For thresholding of detail coefficients basic threshold rules were used. For best results of filtering ultrasonic signal other threshold rule was added. The new rule is standard deviation. Other rules weren´t able to bring good results.

Conclusion

This paper describes graphical user interface for ultrasonic system. System communicates with PC through serial port RS-232. With graphical user interface (GUI) is possible to set up communication with ultrasonic system. GUI consider windows for measurement of ultrasonic signal and window for signal processing. Function of wavelet toolbox and signal processing toolbox were used.

Acknowledgements

References

[1]   Šmíd, R., Matz, V., Kreidl, M.: *Ultrasonic signal filtering.* Defektoskopie 2003. Praha: Česká společnost pro nedestruktivní testování, 2003, s. 259-262. ISBN 80-214-2475-3.

[2]   Misiti, M., Misiti, Y., Oppenheim, G., Poggi, J-M.: *Wavelet Toolbox For Use with MATLAB, User´s Guide, version 2.* The MathWorks, Inc. 2002.

[3]   Mathwork´s group: *Signal Processing Toolbox*. The Mathworks,Inc.1998-2004.

Ing. Václav Matz
CTU, FEE, Department of Measurement
Technická 2, Praha 6, 16627
e-mail: vmatz@email.cz
Phone: +420-22435 2346