Development of acoustic test device for laser welding processes in metals

Ievhen Zaitsev, Vladimir Shelyagin

Abstract − **The conception of on-line testing device using acoustic effect for laser welding control is given in this paper.**

Keywords − **Acoustic effect, control, laser welding, signal processing.**

I. INTRODUCTION

The correlation between arc welding results and acoustic emission (AE) signals was shown in [1-3]. These signals are produced by expulsion and vibration of molten metal, and by post welding processes such as cracking and cooling deformation. But presented results were obtained for different methods, moods and conditions and for different frequency ranges. The necessity of automatic control of laser welding processes resulted to designing described device

II. DEVICE DESCRIPTION

After analysis and generalization of materials presented in [1-4] the recommendation list for acoustic tester was created:
- ability to record and data processing directly on PC.
- minimal number of specialized external devices
- data recording /processing results versatility and ability the proper signals database creation.
- frequency range from 0 up to 400 kHz
- ability to connect at least two AE transducers
- adequate operation in the noised premises
- sufficient processing speed for laser welding control and ability to modify the welding condition in real time mode.
- tracking the weld spot relatively the seam beginning.

According the purpose to get AE signal from the molten pool and the necessity to provide adequate control filtering the noise and cranking sounds the following schematic, software solutions are proposed.

Universality and simplicity of tester realization imply that signal recording and data processing are provided by means of PC. The most simple case is using the line in stereo channel of AC'97sound card for recording the *.wav files to storage the AE data. But there is some specific features are proposed for that. The left channel should record signals in its basic range 20…22000 Hz. The right channel is used for 22 kHz … 440 kHz signals recording, whose range is precompressed in 20 times (to 1100 Hz … 22000 Hz). So the rest of right channel range (20… 1000 Hz) is used for specialized tracking signal recording, whose zero crossing initiated by coordinate transducer (tracking sensor) fixed on the welding machine. (Fig.1). The number of zero-cross points directly shows the number of coordinate samples whose size is defined by transducer.

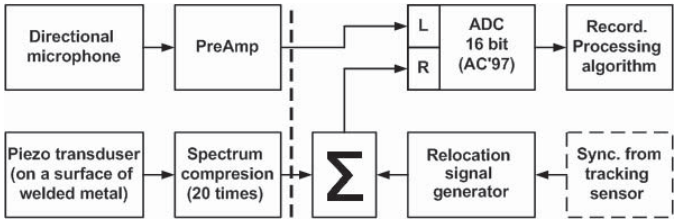

Fig. 1 The block diagram of proposed device

The signal processing algorithm [4] allows receiving tabled data adequate the AE instantaneous spectrum. This data includes the amplitudes of 30 channel sub-bands, RMS and Peak amplitude in channel, and coordinate value (Fig. 2). Comparing the data being received at the welding moment and gathered before device can alarm operator about process deviancy or initiate predefined control signal. Also structure of proposed tester allows studying on-line control system gathering the proper welding signals as reference ones.

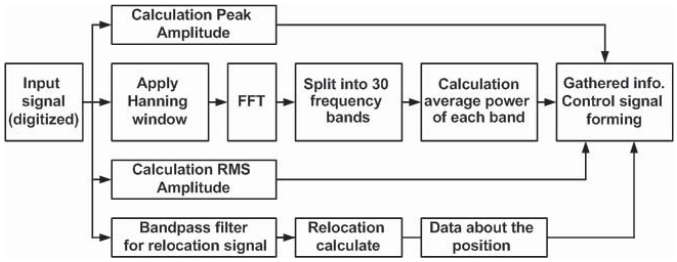

Fig. 2 The block diagram of processing algorithm

III. CONCLUSION

Processing algorithm and the devise construction allows the interconnection with different type transducers including also non acoustic - electromagnetic, for example.

REFERENCES

[1] Бартенев О.А и др. Акустико-эмиссионный контроль соединений, выполненных лазерной сваркой. - Автомат. сварка.- 1998. №9.

[2] Грешников В.А. Дробот Ю. Б. Акустическая эмиссия. Применение для испытания материалов и изделий. М. Издательство стандартов.- 1976. 272с

[3] Hahn O., Rostek W., Buddle L. Computer aided analysis of sound emission in the Welding and cutting technology. - IIW. - Dok. 212-625-1985.

[4] US Patent № 5,306,893. "Weld acoustic monitor". R. A Morris, R. C. Tate. April 26 1994.

Ievhen Zaitsev − National University of Ukraine "Kyiv polytechnic institute". Build. 12, Prosp. Peremohy 37/1, Kyiv, UKRAINE, ievhen.zaitzev@gmail.com

Vladimir Shelyagin − Ph.D., E.O.Paton Electric Welding Institute NASU. 11, Bozhenko st., Kyiv 03680 UKRAINE laser-77@online.ua