Model informacyjny zintegrowanej cyfrowej regulacji pasowania kolorów w arkuszowych maszynach drukujących

The information model of digital integrated color register control in sheet-fed presses

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Mechanika procesu drukowania ma skomplikowany, dynamiczny charakter, w związku z czym jakość druków jest uzależniona od wielu czynników. Jednym z nich jest pasowanie. Stosowanie technologii automatycznego pomiaru i analizy pasowania po zejściu z maszyny ostatniego arkusza zwiększa straty technologiczne i nie pozwala na utrzymanie stabilności pasowania w czasie rzeczywistym. W artykule zaprezentowano model informacyjny zintegrowanej cyfrowej kontroli pasowania, który może być podstawą opracowania i zbudowania, w oparciu o zaawansowany sprzęt i oprogramowanie, systemów zapewniających niezawodność określania w czasie rzeczywistym parametrów pasowania i ich zachowanie z wymaganą dokładnością. Stosowanie cyfrowego systemu zintegrowanej kontroli pasowania kolorów w druku pozwala zminimalizować czas lokalizacji miejsc występowania usterek w pracy maszyny arkuszowej, umożliwia zmniejszenie strat technologicznych procesu drukowania i wpływa pozytywnie na jakość produktów poligraficznych.

Słowa kluczowe: *pasowanie kolorów, system transportu arkuszy, pasowanie kolorów wzdłuż po przekątnej, pasowanie kolorów w kierunku wzdłużnym oraz poprzecznym, stabilność pasowania*

Quality of formation of prints in presses, where mechanics of the printing process has a complex dynamic character, depends on significant amount of factors, one of which is a color register. Use of technology of automated measuring and analyzing the color register after formation of the last print in sheet-fed presses increases technological losses during printing and does not allow to realize the stabilization of color register in real time. It was proposed information model of integrated digital control of color register, which allows the development and building systems based on advanced software and hardware and objective methods for digital data processing, which ensures the reliability of the determination of color register parameters and their stabilization with the required accuracy in real time in sheet-fed press. Uses of digital system of integrated digital control of color register allows minimizing of the time localization of dysfunction sheet-fed press and provides a reduction of technological losses of printing process and improve the quality of printed products.

Keywords: *color register, sheet transfer system, register the color along the diagonal, longitudinal and transverse colors register, color register stabilization.*

Introduction

One of the main parameters of prints quality, that you want to control when printing on each printing unit of sheet-fed press, is color register accuracy, which depends largely on the accuracy of sheet transfer system operation and has a significant impact on the quality of printed products and print circulation [1, 3, 12].

When printing multicolor prints, the necessary color register accuracy can provide the sheet transfer systems, using the tools of objective digital control and stabilization of the diagonal, lateral and circumferential color register in real time [11].

An analysis of scientific sources [1-3, 12] and patent information indicates the use of technology with the ideology of automated

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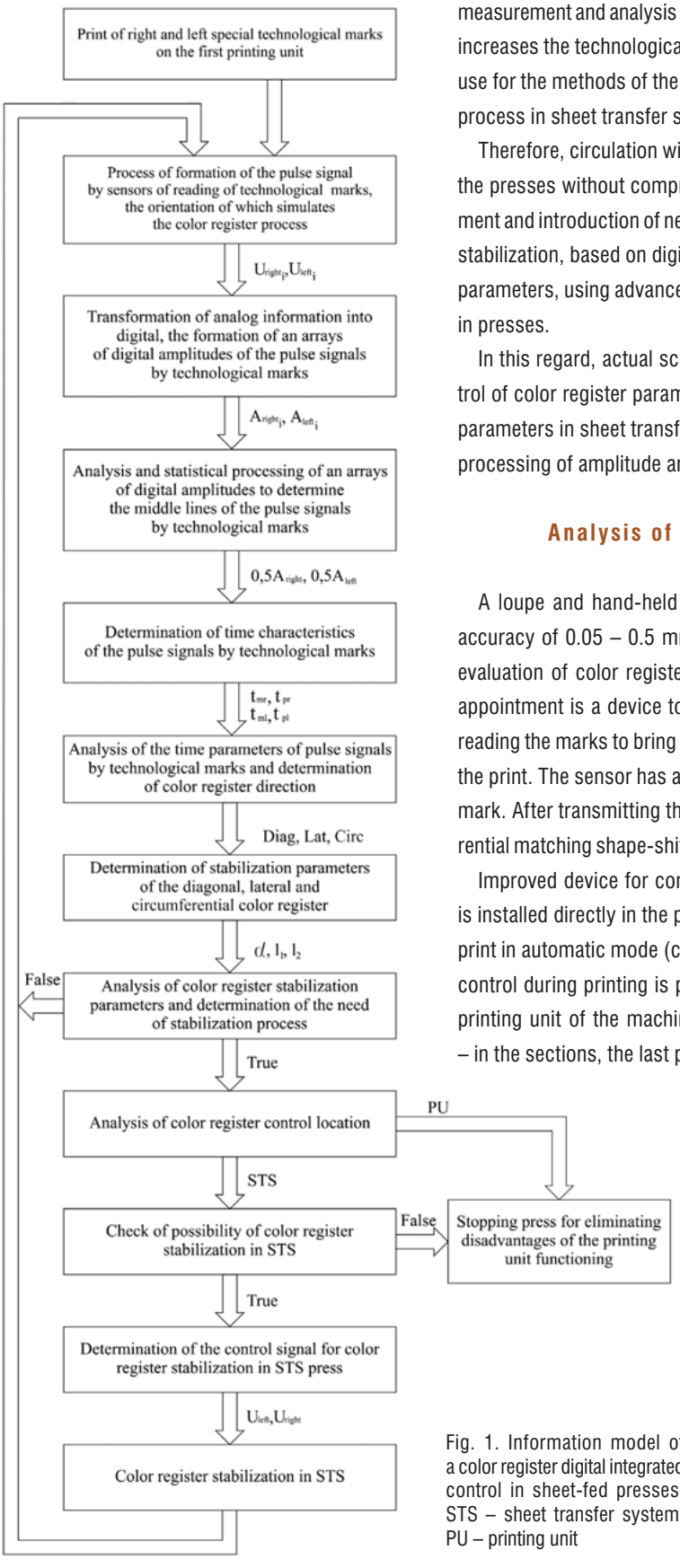

Fig. 1. Information model of a color register digital integrated control in sheet-fed presses: STS – sheet transfer system, PU – printing unit

measurement and analysis of color register after the formation of the last print, which increases the technological losses in the printing process and does not allow their use for the methods of the objective digital control and regulation of technological process in sheet transfer systems in real time.

Therefore, circulation with minimal process losses for maximum productivity of the presses without compromising print production quality, requires the development and introduction of new tools of automation process control and color register stabilization, based on digital tools of measurement and processing technological parameters, using advanced software and hardware control sheet transfer system in presses.

In this regard, actual scientific task is to develop objective tools of digital control of color register parameters, determining the direction and stabilization of its parameters in sheet transfer systems of presses, based on the methods of digital processing of amplitude and time parameters of pulse signals.

Analysis of previous research and objectives

A loupe and hand-held microscope with micrometer scale (paints matching accuracy of 0.05 – 0.5 mm) [7] were served for a long time as instruments for evaluation of color register in sheet-fed presses. Optoelectronic device of such appointment is a device to control color register with a portable register sensor, reading the marks to bring in a cross [12], which is published in the four corners of the print. The sensor has an eyepiece with a crossroads, which is aligned with the mark. After transmitting the data into the press control panel, axial and circumferential matching shape-shifted paint relative to the base are automatically adjusted.

Improved device for control and stabilization of color register parameters that is installed directly in the press, allows to monitor the matching of paints on each print in automatic mode (color register accuracy of 0.01-0.05 mm) [2, 12]. Marks control during printing is performed by measuring beam, which is set in the last printing unit of the machine in one-sided printing and double-sided in the case – in the sections, the last paint printing on either side.

Analysis of the current state, problems and color register control trends in sheet-fed presses showed, that its implementation is performed after the passage of the sheet of printing units, resulting in the detection of defective products with delay and leads to an increase of paper waste, requires further improvement of control and stabilization processes of color register parameters, using digital tools of objective measurements, processing and analysis in sheet transfer systems in real time.

Based on an analysis of factors, that have a weighty impact on color register of printed products [6, 13], it was determined the main two: first - disruption of the functioning of sheet transfer

system (instability of friction, wear of the working mechanisms, their vibration, displacement clearances in capture mechanism, circular displacement of sheet transfer cylinders at the time of opening and closing grippers, etc.), the second – a violation of functioning of the mechanisms and printing unit devices (considerable pressure in the printing nip zone, change of position of the printing plate, moving the plated cylinder, a violation of the geometric parameters of the contacting cylinders, etc.). Definition of non-normalized moving the orientation of prints on the sheet, which characterizes color register, is an urgent task of real-time control.

The objective of this work is to study color register control processes in sheet transfer presses systems before applying the print and post it on the basis of the proposed analytic dependences of color register parameters from amplitude and time characteristics of pulsed signals, that simulate the parameters of the diagonal, lateral and circumferential color register for building software of digital measurement, processing and analysis of color register parameters of prints.

Main part

The actual solution of the problem of objective digital control of color register parameters and determine the reasons for their deviations from the rated values is the use of software and hardware, based on analog-to-digital conversion of information from optical sensors of scanning special marks in the form of right-angled triangles, which are printed on both sides of the sheet, and computer software for the management control process of color register in sheet-fed presses [8].

Information model of digital system of color register integrated control (represented in Fig. 1) based on the information from the right and left technological marks, which are printed on the first printing unit.

After identifying the sheet by synchronization sensor, which is performed before each printing unit, starting from the second, are input of analog-to-digital converter of the right and left of technological marks analog pulse signals from the optical sensors ($Uleft_i$, $Uright_i$), which ensures the formation of a digital representation of the signals in the form of an array amplitudes ($Aleft_i$, $Aright_i$) of converted signals at the appropriate times.

Analysing the digital form of presentation of pulse signals, statistical determining of the base (P_B) and vertex lines (P_T) and further midline lines (0,5Aleft, 0,5Aright), is the main method for increasing of the time characteristics of pulse signals (t_{pr}, t_{mr}, t_{pl}, t_{ml}), which model color register process [4].

To determine the direction of color register are analyzed time characteristics of pulse signals of right (t_{pr}, t_{mr}) and left technological marks (t_{pl}, t_{ml}), taking into account the allowable wrong register 0.01 mm, and are determined by the values of the three parameters, that characterize the diagonal displacement of the left (Diag=1) or right (Diag=2) edge of the sheet, lateral shift of the sheet to the left (Lat=1) or right (Lat=2) and circumferential sheet displacement against its movement (Circ=1), and, also, sheet position without displacement (Diag=0, Lat=0, Circ =0) [5, 9, 10].

According to the calculated direction of sheet displacement (Diag, Lat, Circ), 17 possible combinations are analysed [6] and analytical calculation formula is selected for determination of the color register stabilization parameters (α – the angle of the diagonal register color; l_1 – distance of the lateral register color; l_2 – the distance of the circumferential register color).

The process of color register integrated digital control concludes with an analysis of the monitoring place for localization reasons of prints displacement on substrate (disruption of the functioning of sheet transfer system or printing units) and check possibility of realization of color register regulation in order to determine a control signal (Uleft, Uright) of stabilization of technological process in the sheet-fed presses.

Conclusions

The developed information model of color register integrated digital control allows the design and construction of systems using modern software and hardware and objective methods for digital data processing, which provide reliability of determination of color register parameters and their stabilization with the required accuracy in real time in a sheet-fed presses.

The use of color register integrated digital control system allows minimizing the time localization of sheet press dysfunction, which provides a reduction of technological losses of the printing process and improve the quality of printed products.

SYMBOLS

0,5Aleft, 0,5Aright – midlines amplitude values of pulse signals from the left and right optical sensors

α (°) – angle of the diagonal color register

$Aleft_i$, $Aright_i$ – digital values of arrays of amplitudes of analog signals from the left and right optical sensors to determine the color register

Circ – direction of the circumferential sheet displacement

Diag – direction of the diagonal sheet displacement

l_1 (mm) – distance of the lateral color register
l_2 (mm) – distance of the circumferential color register
Lat – direction of the lateral sheet displacement
$Uleft_i$, $Uright_i$ (V) – voltage supplied from left and right optical sensors to determine the orientation of the sheet
P_B, P_T – the values of the amplitudes of the base and the vertex lines of pulse signals
t_{pr}, t_{pl}, (μs) – pulse durations from right and left optical sensors
t_{mr}, t_{ml}, (μs) – time from the start of pulse signals before the advent pulse of the right and left optical sensors

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