Taking a look at the edge

A line sensor enables the reliable checking of double sheeting

No other branch of industry pays so much attention to a high level of automation in the field of production as the automobile industry. However, there are always processes in which the stated aim meets boundaries when it comes to practical implementation. For example, how is it possible to ensure that a robot only picks up one sheet (for further processing) from a pile of thin bodywork sheets? A question which can be answered with an intelligent sensor solution from ipf electronic.

In the case of an automobile manufacturer, several stacked bodywork sheets are fed to a robot. In each case, the robot would then pick up a sheet from the pile for further processing. As the sheets could have oil residue on them, there is a risk that they could stick to one another and the robot could grab more than one bodywork part.

In order to ensure that the further processing runs smoothly, a sensor solution had to be implemented which carries out a check for double sheets and stops the robot by sending a corresponding signal to the system's PLC as soon as there is more than one sheet in its grabber. Several systems were tested on the plant, however none of the solutions brought about the desired result. This is because the area to be detected is restricted to the edge of a piece of sheeting that is only a few millimeters thick.

Looking for an edge with a thickness of only 2 mm

After a detailed analysis of the application, the ipf electronic specialists suggested the use of an OY340145 series line sensor (Fig. 1).

These line sensors work in direct light mode, i.e. the object to be measured is illuminated with lights in a ring formation consisting of nine LEDs. In this special application, white LED lights were chosen in a ring formation with a fixed output. In the specific case, the row sensor would be used to detect an edge of a bodywork sheet measuring around 2 mm thick and in doing so, ensure that the robot does not grab more than one sheet.

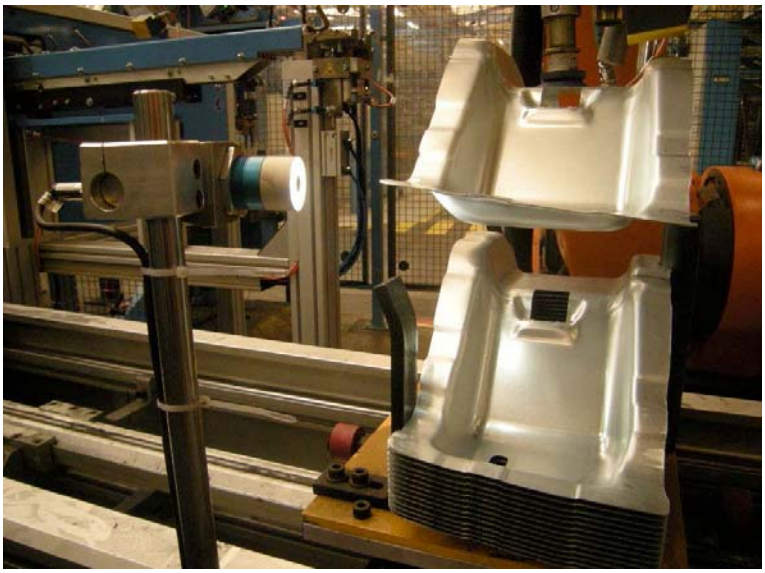

Fig. 1

The CCD line ‘reflects’ the edges of an object

For this, the sensor is mounted on an adjustable construction with a 55 mm gap and is directed towards the edge of the bodywork sheet that is to be detected. A CCD line is built into the receiver lens of the sensor. This is made up of many individual receiver elements that are arranged in a line and very close to each other (512 pixels, 1024 subpixels). If the edge of the sheet is located in the reference gap of the sensor, then the light reflected from the surface of the edge is mapped onto the individual pixels of the CCD line.

As the distance of the pixels on the CCD row and the measured object are known, it is possible to identify both the size and the position of the reflective areas of the measured object with different levels of reflective accuracy. The light quantity of each individual pixel on the CCD line that is collected during the exposure period can be read out as an analog voltage and then evaluated and stored via a microcontroller as a video signal and/or incoming intensity information by means of analog to digital conversion.

Software intelligence with many evaluation options

In order to parameterize the control system electronics for activating the line sensor, the ipf elec-tronic specialists use specialized software that enable the measured values supplied by the sensor to be visualized on a Windows user interface.

Among other things, the upper and lower tolerance values for the measurement were set via this software. As the robot carries out an upward movement when removing a sheet from the pile, the upward tolerance limits had to be selected so as to be larger than the downward tolerance limits.

The parameterization software enables different evaluation modes to be set: Left edge, right edge, width and center. In the ‘left edge’ mode, the first left edge that is recognized in the intensity profile of the CCD line is evaluated. The ‘right edge’ mode serves to evaluate the right edge in the intensity profile of the CCD line. On the other hand, in the ‘center’ mode, the so-called middle position between the first and the last edge is outputted as the measured value.

The sheet thickness provides information concerning the correct handling of the robot

In the application used by the automobile manufacturer, the ‘width’ evaluation mode was required for the special task to be performed by the ipf electronic line sensor. This is because the sheet thickness within the given tolerances provided information as to whether the robot picked up more than one bodywork part. Figure 2 shows a part of measured value that has been visualized via a PC user interface as a graph. Here, the y-axis represents the analog signals of the individual pixels whilst the x-axis virtually represents the individual pixels of the CCD line.

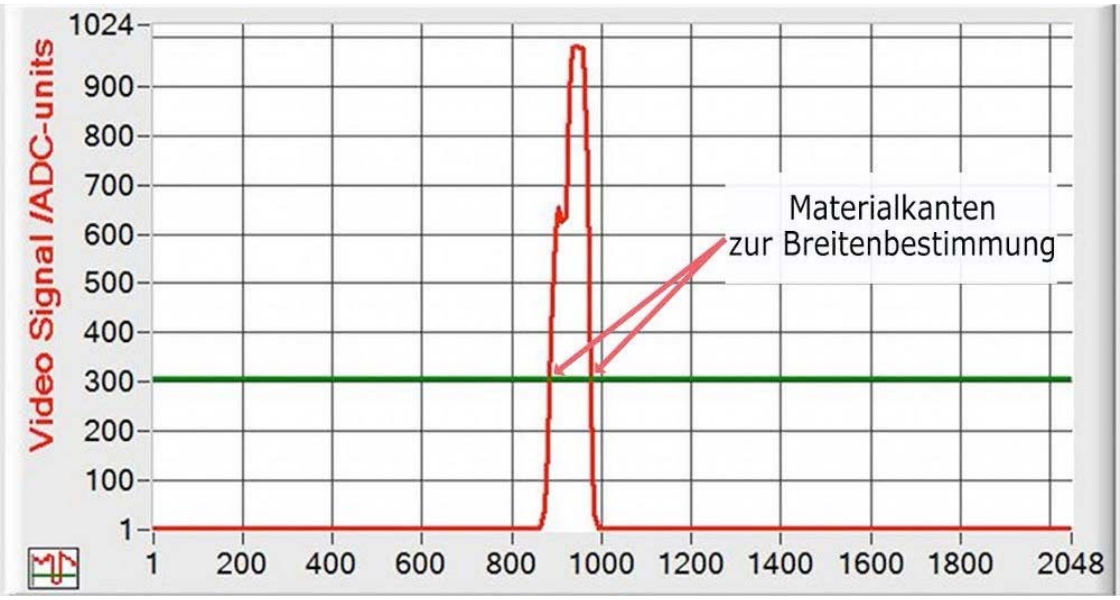

Fig. 2

Two pixels with a lot of information contained in them

The green horizontal curve shows the so-called video threshold which has been set with an OK part when ‘teaching in’ the sensor on the basis of the intensity course (red curve) of the receiver signal. As such it is possible to establish two pixels from the intersections between the video threshold and the intensity course in which a transition from brightness to darkness takes place which marks the upper and lower edge of the sheet. As the x-value of these intersections is, in each case, assigned to a pixel on the CCD line, it was possible to work out the material thickness and/or material width for an OK bodywork part from this information and the known intervals of the pixels on the CCD line. In the ‘width’ mode, it is always the two outermost edges that are used to establish the width.

If the robot grabs two sheets it is not critical if these are not stuck directly on top of each other and/or there is a gap between them. It is only necessary to ensure that the sheets are located in the detection range (20mm wide). The established thickness and/or width of the edge is also outputted as a numerical value in a dis-play element. In this display, the area for results that are not OK is highlighted in red and results that are OK are highlighted in green.

The material thickness/width display at a glance

Below the graphical display there is also another display (Fig. 3) that shows the established material thickness and/or width as a red bar. In the middle of this bar there is a circular cursor that represents the central position of the width area in the CCD line. The two green horizontal bars represent the tolerance range in which the ends of the red measured value bar have to be in the case of an OK part. If these ends are outside of the two green tolerance bars, then the part in question relates to a component that is not OK, i.e. a component that is either too wide or narrow.

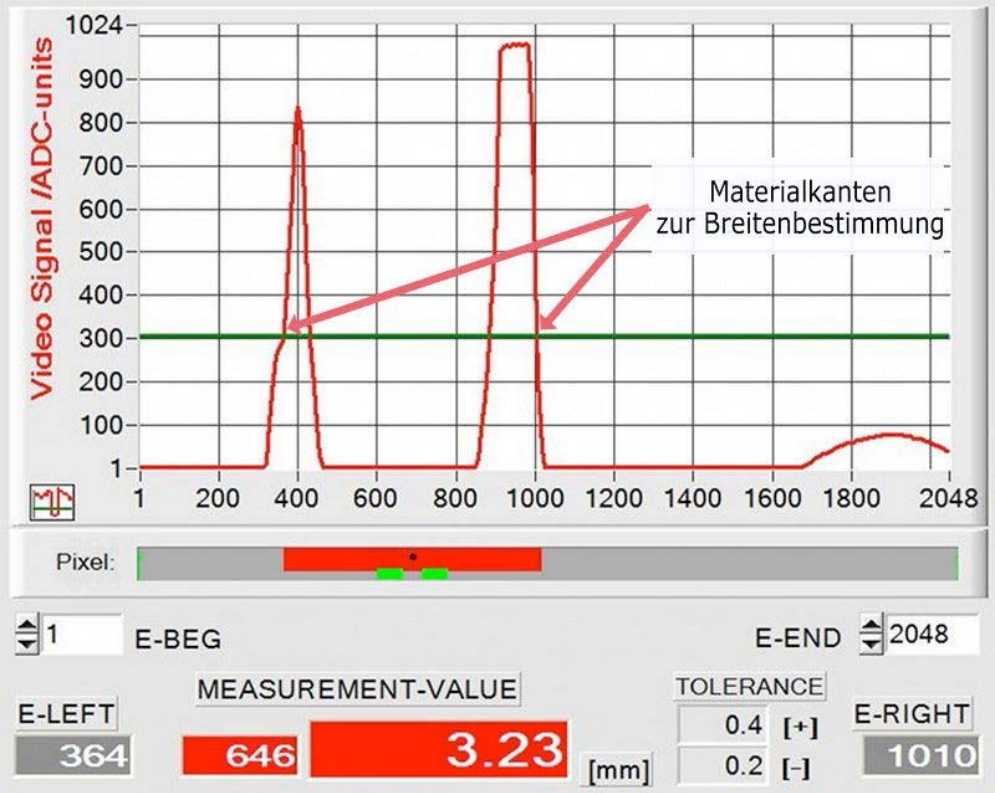

Fig. 3

Plenty of potential for further applications

On the basis of a specific application, the case of the automobile manufacturer just highlights the potential of ipf electronic line sensors for identifying object edges securely and reliably. To name a few, possible other applications are found in the field of taking width measurements, sheet edge control, the recognition of positions, determining middle positions, contour checks and diameter checks.