Annals of Warsaw University of Life Sciences - SGGW
Forestry and Wood Technology № 82, 2013: 44-48
(Ann. WULS - SGGW, For. and Wood Technol. 82, 2013)

Light wood using machine vision

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Abstract: *Lighting wood using machine vision*. We analyzed the role of lighting in machine vision. It was great difficulty in lighting the wood. The factors affecting the measurement of the color of the wood.

Keywords: wood machine vision illumination

INTRODUCTION

The importance of the optical information detecting defects in wood products is very important. Optical methods include the use of laser light sources, white light illuminators, black-and-white cameras, color cameras and spectrometers to measure the intensity and color of the reflected light. These methods are able to detect surface features such as knots, cracks, wane, stain, color and the orientation of the fibers. Laser sensors are used to measure the shape and dimensions of the boards. This information is useful for the detection of defects shape suitable timber such as wane, warpstone and cracks. With the laser, using the so-called. "coil effect", you can specify the deviation of fibers on the surface of the wood.

It is important for the quality of the image obtained is proper selection of lighting system, which determines how the image will register the camera. In the selection of light sources should be taken into account, the geometry of the object, the surface structure and characteristics of the whole system. Lighting system should provide adequate contrast and minimize registration artifacts, which can lead to erroneous conclusions in the analysis of images.

The purpose of this article is to show the impact of lighting on visual measurement errors wood and make recommendations as to avoid it.

ROLE OF LIGHT IN MACHINE VISION

Measurement tools are increasingly using optical methods to control the products and processes. Optical measurements are used in 2D or length, angle, area - implemented using matrix and line scan cameras and 3D optical measurement - usually implemented using laser triangulation. A typical configuration of image acquisition based on the registration of light reflected from the surface. The intensity of the reflected light depends on the material of the surface layer, the microstructure, the direction of incidence of the light beam and the direction of observation. The lighting in the machine vision systems is a key factor influencing the quality of the picture and the result obtained in the measurement and control of the test object. It has been established that light affects up to 60% on the success of optical measurements (Hofmann 2007). Factors influencing the choice of lighting, in order to ensure the quality of the image recorded by the camera can be summarized as follows:

- related to the observed object, such as the surface properties of the object (shape and inequality, microstructure, surface color, reflection coefficients)
- related to the environment object (background observations),
- due to the optical properties of the lens (aperture),
- related to the parameters of the camera (sensitivity and spectral range sensor)

- related to the specifics of the process of machine vision (stationary or non-stationary process, the time of image capture).

The vision systems are used in various light, the currently most common approach is to use LEDs. Other solutions use fluorescent and metal halide lamps. Another frequently used light sources are laser line generators to help in sizing components.

The light illuminated the object aimed at is the following physical phenomena: part of it is reflected from the object, part of it is absorbed by it, and some of the incident light can penetrate through the object. The size of each of these three components is dependent on the physical properties of the element.

One of the concepts related to the observation technique is called lighting in the bright (bright field) and the dark (dark field). The version in the light provides even illumination and stable object without exposing its characteristics. Illumination in the dark field type are placed at a slight angle to the object, which provides a slight darkening of illuminated surfaces and exposes the edges of the object.

Typical versions used in industrial machine vision illuminators are red or white, because they are very good "seen" by the camera transducers. Ambient, natural light is rarely used in the industrial measurement. It varies during the day and the season, throwing shadows, and its intensity is far from desirable. You can not measure the colors in all conditions, but with a single, well-defined level of lighting. To ensure a constant level of brightness, you have to completely eliminate light "foreign", illuminate the subject with a fixed light intensity and then examine the contents of the RGB components of the light reflected from the object.

Proper selection of video lighting system is the ability to create a suitable contrast that shows off those parts of the item to be inspected vision.

LIGHT WOOD

Affect the wood properties reflectivity, as shown in Figure 1 (Kauppinen 1999). In addition, mechanical damage at the edges of the board, color defects such as knots, resin pockets and blue stain can cause dramatic changes in the intensity of reflected light.

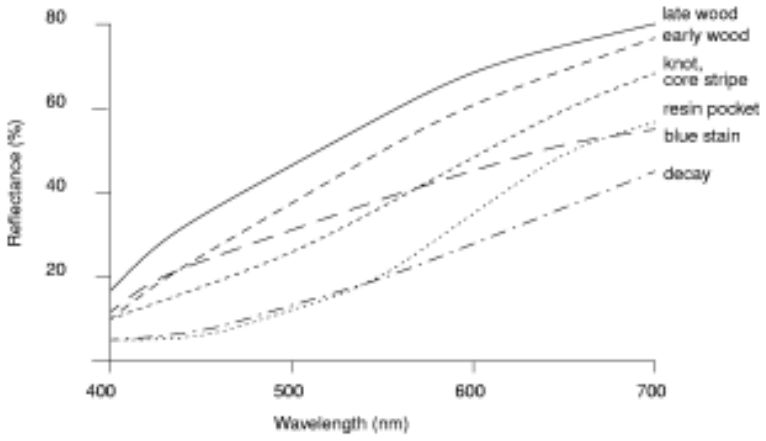

Fig. 1 Spectra of late and early wood and wood defects

Scattering and absorption reduce the reflected energy. Scattering is often impossible to predict. The sawmills are sawdust , flying wood slivers, water vapor, spray and dust at all. Scattering reduces the contrast of the image and is the cause of "haziness" in the image. In extreme conditions, increasing the lighting does not help because it increases the

proportion of energy used, and can cause excessive "white noise" in the camera signal. Absorption causes the overall strategic light reflected back from the object. It also depends on the quality of the color of the object and the light source. For example, if the object is illuminated blue-greenish red light, the reflection coefficient is very low and the object appears black. Both scattering and absorption are the variables that are constantly changing in a sawmill. These changes in surface quality - water, ice, sawdust, coloring, knots, bark. The vision for the rough lumber will have to deal with a fresh, rough, dirty material. It will be more difficult to design than dried, planed lumber. One reason for this is that the green timber has a large surface fresh humidity. Gray-scale difference between the majority of defects and clear wood is then small. The dried lumber changes in intensity between the defect and significantly increasing clear wood. A major problem in the sawmill are dirty boards. In addition, the rough surface can itself cause problems. Lighting boards can cast shadows that can be misinterpreted by a computer vision system.

COLOR WOOD

For the study of wood, including color as an important parameter, it is necessary to know the relationship between lighting and viewing conditions and anisotropic characteristics of the wood surface. It was found that for different wood species observed color change depending on the angle of illumination. The change is related to fiber orientation according to the direction of illumination (Rinnhofer 2003). Different color models have been used to describe the color of the wood. However, the most common color model used for the classification of defects in the wood to the RGB color space (Kauppinen 1996).

Over the recent years techniques of optical scanning using the colour were intensely drop-down, to differentiate many features on the surface of the wood. The information on the colour can improve the exactitude of the diagnostics, of course, if the investigated material or each zones have certain proprieties of the colour eg. is required the information on the colour for the purpose of of the distinction of the sapstain and the wood with the resin. However the measurement of the colour is more difficult than the vision black and white. Has on this an influence the change of the lighting, in the greater degree than at the measurement black and white. The success of the constancy of the colour is difficult, because the signal of the colour is relative to lightings, the spectral reflectivity of observed object and the geometry of the scene. The spectral change of the lighting can be caused, eg. by changing spectral proprieties of illumination, or by some unexpected light sources, as the daylight or the lighting of secondary importance. Changes of spectral proprieties of illumination can be long-term or short-term. Long-term changes of spectral proprieties are mostly due by the senescence of lamps or by the presence of the dust. Short-term changes take place within the ten to hundreds of microseconds and are caused eg. by proprieties physical fibres of the lamp in the wolfram of the halogen or by changes of the current flow through the lamp.

A difficulty of automatizing investigation is the change of the look of defects of the timber among defects of the same type. Variable is also the look of the background, that is to say the clear wood. There is easily for mistakes of factual defects with due disturbances by the natural variability of the colour of the surface of the clear wood. The disturbance can also be due by external such conditions as the dirt, the roughness, the moisture and changes of the colour on account the ultraviolet light. At the use of the coloured camera one received too much changes of the colour on consequently the wood. The coloured camera reacts on cosmetic changes which are not real defects. The software must filter these changes. On that score the use of the camera black and white is better.

Conceptually both the planed lumber how and rough has investigative problems seemingly very similar. However the computer analysis of the rough timber is more complicated than the analysis of the surface of the timber planed. The investigation of the surface of the timber planed eliminates certain the number of problems of the analysis. On the surface of the timber planed removed are no matter which superficial changes of the natural colour which could take place during the drying and under of the activity of weather conditions. Removed is then also no matter which external dirt which would be able to be due through the transport or the storage. The moisture of the surface of the timber bears on the characterization of the colour of the material. Such changes in the colour can create problems for methods of the computer vision. If grows less the moisture of the surface of the timber this is the then greater difference in the colour between defects and a wood free from defects. Thus, if the timber to the classification is with the high superficial moisture, is then the recently sawed material, is then the more complicated process than the classification of the timber which has the lower superficial moisture.

An example of the use of optical methods in the sawmill industry is the use of coloured cameras for automatized optimization of edging of the timber and the utilization of the information on the colour to the classification of the timber and parquet floor slats.

CONCLUSIONS

1. The lighting in the machine vision systems is a key factor in the quality of wood.
2. Wood properties greatly affect the reflectivity.
3. Terms work existing wood plants cause considerable difficulty in the selection of wood lighting system.
4. The stability of spectral lighting is an important aspect in determining the colors using machine vision.
5. The physical properties of the lamp may change during the illumination spectrum.
6. On the color of the wood is affected by many factors such as humidity, temperature drying, surface roughness, and exposure to ultraviolet light. It has to be taken into account.

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Streszczenie *Oświetlenie drewna przy zastosowaniu wizji maszynowej.* Przeanalizowano rolę oświetlenia w wizji maszynowej. Stwierdzono duże trudności odpowiedniego oświetlenia drewna. Określono czynniki wpływające na pomiar koloru drewna.

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