Automated optical inspection

Johannes Hoehne, Sales/Product Manager at Germany-based Dr Schenk, explains the technology behind the company's approach to automatic optical inspection of hides.

Cowhide inspection

Automatic optical inspection (AOI) of natural marks on genuine leather is finally available to be used in production. In the past, the extremely varied appearance of natural marks, combined with the difficulty of judging the resulting quality zones, made it impossible to use objective and reliable automated inspection in the leather industry. Machine vision solutions manufacturer Dr Schenk hopes to offer a solution. Building on inspection expertise from more than 35 years, the company offers a combination of hardware and software for leather inspection and the solution was recently successfully introduced in a German premium car manufacturer's production line.

How does it work?

Proprietary Dr Schenk high-speed smart line scan cameras are combined with dedicated illumination units to create different optical configurations. This makes it possible to highlight all characteristics relevant for detection and qualification of natural flaws in cowhides which, given their endless variety and shapes, was challenging in the past. A single row of cameras acquires all images with Dr Schenk's Multiple Image Defect Analysis (MIDA) technology. At the same time, they are analysing the images with sophisticated artificial intelligence models.

The first illumination unit enhances differences in colour and gloss, while the second illumination unit is more sensitive to the structure of the hide's surface and the third illumination unit makes even more structural details in the hide visible. It also allows analysis of features such as roughness and depth. This third illumination unit is aligned perpendicularly to the transport direction of the hide (CD), offering maximum sensitivity for detection of scars, wrinkles and folds oriented across the hide. When these three-dimensional, mostly elongated, natural flaws are aligned in transport direction (MD), the CD configuration does not deliver optimum results. For this common scenario, Dr Schenk uses oblique illumination, which makes all natural flaws visible for further processing.

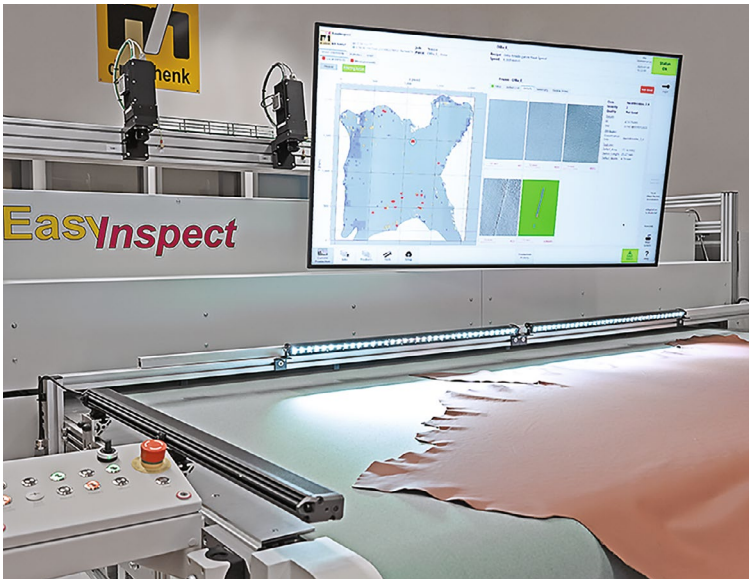

Figure 1. Automated inspection system for finished leather.

Artificial intelligence and deep learning

This configuration is the foundation for clear identification of all marks in at least one of the four images it gathers. These images are then analysed using an AI model. The images also enable leather experts to judge the results, a crucial step in gaining customers' confidence during introduction of new technology, as well as for the collection of more training data to customise the results according to demands and experience.

Using all four images, the deep learning model segments and classifies all natural flaws and irregularities on the hides. With a particular focus on inspection of genuine leather, the software department at Dr Schenk has tested various approaches to find a robust and user-friendly evaluation method. The model was trained on data from thousands of hides to offer users of the system a very good starting point. The variety of industries that use leather, ranging from automotive to leather products such as shoes or handbags, meant that many different quality specifications had to be met. Thanks to the proprietary software and experience from these various industries, the user can now easily perform any necessary changes.

Transportation of hides and detection conditions

Besides the challenging optical aspects, handling of the hides is a hurdle in achieving inspection results at reasonable throughput. To make things even more challenging, certain defects such as "butcher cuts" (thin areas in the hide), can be critical regarding quality grading but are not visible on the hide's surface. To avoid time-consuming inspection of the hide's flesh side, the Dr Schenk solution uses a strong vacuum beneath the scanline of the cameras so that a butcher cut mark creates a clearly visible dent in the hide's top side. Defects which are only visible by stretching a hide can also be detected in this manner. Furthermore, a light vacuum supports placement of the hides on the conveyor and ensures optimal inspection conditions with minimal wrinkles or folds.

The advantages of reliable, objective and accurate defect detection and marking before cutting the finished leather are numerous. All inspection results are stored in a database of the inspection system and the automatically created "DXF-file" ensures seamless integration into existing upstream systems, for example automatic nesting of cut parts. The inspection system performs inspection automatically (without human interaction) at a rate of more than 80 hides per hour.

Accurate detection of the defect size allows for a significantly larger usable area, unlike manual marking with chalk or digital marking. AOI can greatly increase yield and the nesting job can be optimised over multiple digitised hides. Its consistent and accurate inspection performance allows for continuous reduction of rejects after cutting.