Application & Technical
NOTES & TIPS

Presence-Absence Inspection in Packaging

ADVANCED ILLUMINATION
November 20, 2007

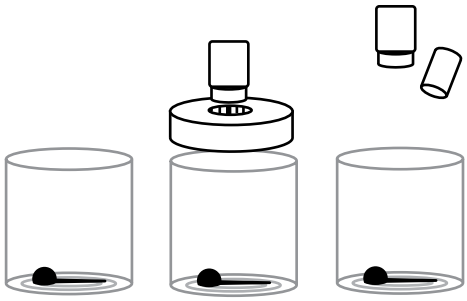

Fig. 1a 1b 1c

Fig. 2a - Off Axis Spot Light

Packaging inspection has typically presented a variety of challenges for machine vision developers and integrators, primarily because of the wide range in packaging types – materials, sizes, shapes and textures used. Additionally, limitations to part access for vision equipment and line speeds and feed rates, pose challenges.

One typical packaging application is inspecting for the presence-absence of objects either purposely or inadvertently inserted into packaging containers. In this instance the vision inspection is verifying the presence of a plastic powder scoop purposely inserted into an empty metal can before the powder is added and the container is sealed (Fig. 1a).

In this particular example, there are several issues to consider when determining appropriate lighting: 1) limited access to the open can, 2) the differential reflectivity of the metal can bottom, sides, and the plastic scoop, and 3) the size and depth of the can. Because the viewing angle for this type of inspection is limited, one of two possible lighting geometries, both direct point sources, is typically employed: 1) a co-axial ring light (Fig. 1b), and 2) an off-axis spot light (Fig. 1c). If sufficiently focused, the spot light has the advantage of being deployable at a longer working distance when access directly above the container opening is limited. Remember that the goal of this inspection is to verify the presence of the scoop uniquely in the can.

If we examine images captured from the off-axis spot light and co-axial ring light geometries, we see that whereas we can visually determine the presence of the scoop, neither image is particularly appropriate for a vision system inspection (Figs 2a & 2b).

This circumstance is primarily the result of differential reflectivity from the metal can interior and the plastic scoop, and the lack of light uniformity, incident on all of the surfaces. If we agree, however that a co-axial geometry is the most appropriate, and yet have ruled out a direct point source, such as a ring light, what are the remaining choices?

Given the limitations of this inspection, we are restricted to two other possible co-axial lighting techniques – dark-field and full bright field diffuse. With a few exceptions, it is important to note that one of the limitations of both dark-field and diffuse lighting is that the light must be mounted relatively close to, and often directly above the sample.

Assuming top-down access is not a restriction, we see that the image from a 45 degree angle dark-field ring light shows better uniformity than the standard ring light, primarily because the light is effectively "bounced", or diffused around the container because it is incident on the can sides at 45 degrees (Fig. 3). However, are we really fully utilizing the capabilities of the dark field light? Is there still a better, more appropriate solution?

It is useful to note that full bright field lighting differs from partial, or direct point source bright field in that it is uniform, and typically diffuse

Fig. 2b - Co-Axial Ring Light

Fig. 3 - Dark Field Ring Light

Fig. 4a - Axial Diffuse Illuminator

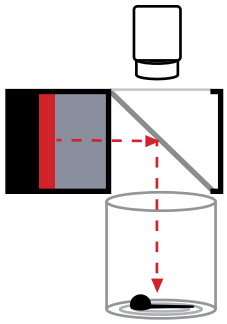

Fig. 4b

in nature. The light can be multi-directional, such as from a dome light, or unidirectional from a wide area source, such as an Axial Diffuse Illuminator (ADI). Because we already suspect that multi-directional light, like that from the dark field light is not necessarily optimized for this application, we can view the sample under the ADI (Fig. 4a). We can see that the ADI image is the most robust in uniformity, and sample contrast regardless of where the scoop is located, or likely how it is oriented in the can. In this instance we have taken full advantage of the unique attributes of the ADI "showering" the bottom of the can with light all from the same direction and of the same intensity (Fig. 4b). In this particular application, the sample required a large ADI, one with a 6" x 6" field-of-view – The DL085-660C3 (Fig. 4c).

Up to this point, our analysis and discussion have assumed that we have full access to the top of the can opening. One restriction for using the DL085 is height – an ADI is typically as tall as it is wide – in this case ~ 6" high. If space above the can is limited we would need to try another solution, hoping for similar positive results. For situations with limited Z-axis space above the part, we can use the DL083-66024, a thin diffuse light with a co-axial viewing port (Figs. 5a & 5b), and achieve similar, if less distinguishable results.

Fig. 4c - DL085-660C3 (ADI)

Fig. 5a - Flat Diffuse Illuminator

Fig. 5b - DL083-66024

About Ai

A lighting solutions company, Advanced illumination is based in Rochester, VT and manufactures a full line of LED-based lighting products and industry-leading control electronics, primarily for industrial vision inspection. Our technologies include Evenlite LED sorting and aiming; Signatech and Signatech 2 LED protection for maximizing both light output and LED life.

Ai sells through a world-wide network of distributors and strategic vision partners. Standard products ship same day; Standard variations offer customized options in two weeks. We also provide Free lab services and evaluation products for on-site testing.

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