IR-Fusion™ Technology

By Roger Schmidt, Fluke Thermography

Application Note

Thermographers have always wanted an infrared camera that produces images with both a wide field of view (FOV) and detailed spatial resolution. An infrared-only camera with this combination is prohibitively expensive for most applications. A less expensive way of providing both features in a single camera is to blend a wide FOV visible image with a smaller FOV infrared image. The major benefit of this combination is that thermographers can pinpoint and identify infrared problem areas in a clear visible picture. Maintenance technicians now have a direct correlation between a visible picture and an infrared identified problem area. Building inspectors can use this technology to their advantage in negotiating and litigating problems. A commercial camera with IR-Fusion technology has been available since May, 2006. This paper describes thermography examples that benefit from this combination.

Introduction

Visible-light images are generally sharper, clearer and have higher spatial resolution than infrared images. One obvious reason is that visible sensor arrays are made with many more detector elements. Not so obvious, is that visible images are generally produced from reflected radiation where infrared images that are used to display temperature must record emitted radiation. Reflected visible radiation can produce sharp contrast with sharp edges and intensity differences; for example, a thin white line can lie next to a thin black line. On the other hand, heat from hot objects in an infrared scene will transfer to neighboring objects producing temperature gradients and eliminate sharp edges in an infrared image.

A third reason why visible-light images are sharper than infrared images is that visible images can be displayed in the same colors, shapes and intensities as that seen by the human eye. As a result target structure and character are more easily interpreted in visible images. The non-visible intensities of infrared images are shown in false colors, sometimes confusing interpretation. The desire to have a camera that can capture an image that will show the detail of a visible-light image and the temperature measurement of an infrared image has prompted Fluke Thermography to market an infrared camera that blends the two images into a single image. This camera design uses a patent pending novel low-cost approach to solve the parallax problem of combining images from separate visible and infrared optics. Without IR-Fusion™ you are likely to have confusion.

Showing an infrared problem area in a visible picture

Figure 1 shows an example of how the fusion technology can identify the exact location, or precise envelope, of an infrared identified problem area. The example is a cinderblock wall where some of the blocks were not filled with cement as they were contracted to be. The image was taken inside the building in the morning when the unfilled blocks, as a result of

Figure 1. The location of missing fill in a cinder block wall is clearly identified using IR/visible fusion

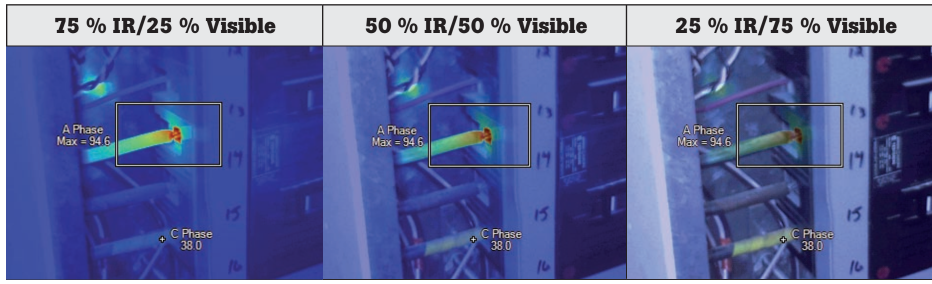

Figure 2. Percent IR/visible blending can be adjusted for optimum interpretation

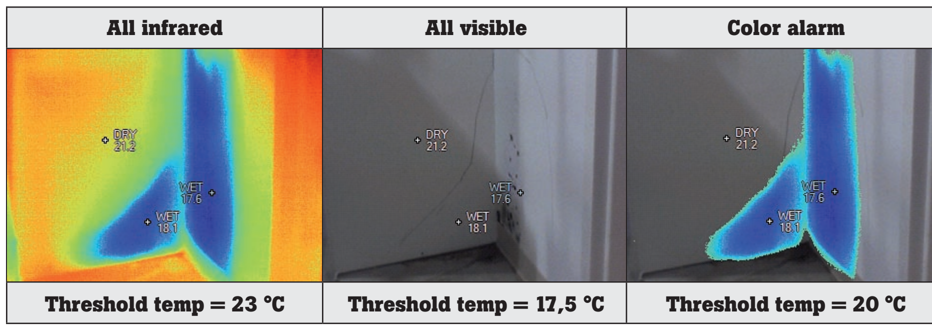

Figure 3. Color-alarm can outline wet wall area by selectively displaying specific temperatures in infrared colors and the remaining image in visible black and white

their lower heat capacity, have cooled down over-night to a lower temperature than the filled blocks. The exact location and extent of the problem was identified using fusion technology by setting the IR-Fusion blend on the camera to 50% IR and 50% visible.

The blending is adjustable from full infrared to full visible and anything in between. Figure 2 shows a breaker image with different percent blending. The blending can be adjusted real time on the camera or later from a saved image either on the camera or in SmartView™ software.

Another feature of IR-Fusion called Color-Alarm can be used very effectively to define infrared points-of-interest in a visible picture. Figure 3 shows a wet wall example where the moisture evaporation causes the wall to cool. To outline the section of the wet wall the Color-Alarm threshold temperature is set just below the wall ambient temperature. Any temperatures below the threshold temperature will be shown in infrared colors while any temperatures above the threshold temperature are shown in visible black and white. In panel 1 of Figure 3 the threshold temperature is above the wall ambient temperature 22.5 °C so the full infrared image is shown. In panel 2 the threshold temperature is set below the coldest wall temperature, 18.6 °C, so the entire image is displayed in visible black and white. In panel 3 the threshold temperature, 20 °C, is set just below the wall ambient temperature so the infrared colors outline the wet wall in a visible picture.

Eliminate confusion in interpreting infrared problems

Sometimes thermographers may need to show an identified problem to a less-than experienced customer, supervisor or maintenance technician. The blending of the visible and infrared image can greatly help in showing the specific problem and its location.

Figure 4 is an example of a serious 266.8 °C temperature problem shown in a not-so-clear infrared-only image. By putting the camera image in a 50/50 % visible and infrared blend the problem and its location becomes much clearer.

Identification and overall location of the problem becomes even clearer when the camera blended image is displayed in a Picture-in-Picture mode. The Picture-in Picture mode puts the blended image into a wider FOV visible-light image. See Figure 5.

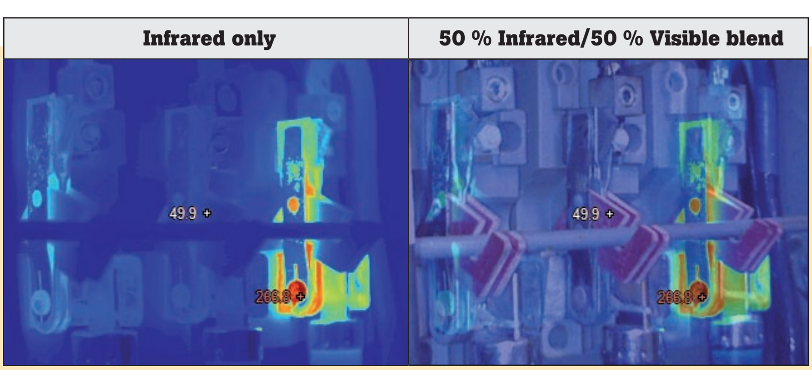

Figure 4. Infrared problem areas become much clearer when blended with visible-light image

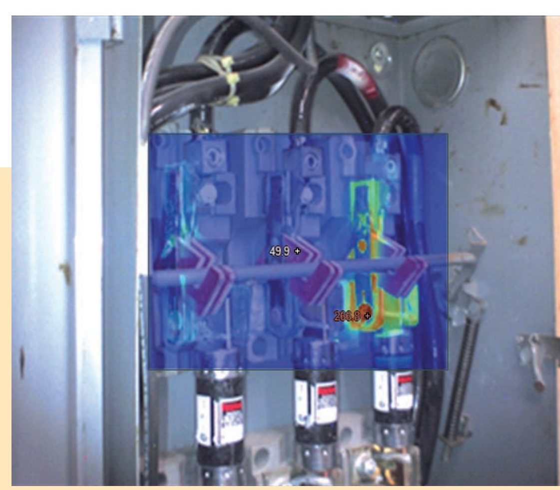

Figure 5. Putting camera image into the picture-in-picture mode helps further identify problem location

Being able to see an infrared point-of-interest and visible labels on the device in a single image is another very useful benefit of IR-Fusion. See the example in Figure 6 where the visible and infrared images are blended together showing the labels along with the infrared highlighted breaker.

Identifying location of a problem in a featureless or confusing visible image

The spot produced by a visible laser pointer can be seen in a visible-light image but not in an infrared-only image. However, the laser spot can be seen in a blended infrared/visible image. By matching the laser spot with the infrared problem area in the blended image, the laser spot on the target marks the exact location of the problem area. An example is shown in Figure 7 where a small infrared identified problem is found in a room wall with no visible features other than the joint between the ceiling and vertical wall. The camera pointing is adjusted so the laser spot is coincident with the infrared problem area in the blended image. The laser spot then marks the exact location on the wall of the infrared problem area.

In an electrical cabinet where there are several identical or similar components grouped together it can be difficult in an infrared-only image to identify the exact component that is over heating. Because a finger can be seen in an infrared-only image sometimes a tech will dangerously place a finger near the problem area to point out the exact location of a problem component. No longer should this be necessary; use IR-Fusion fusion with a laser pointer instead.

IR-Fusion eliminates the dangerous practice of sticking a finger in an electrical cabinet to show which component is overheating.

Figure 6. Equipment labels and the problem area can be read in an infrared and visible blended image

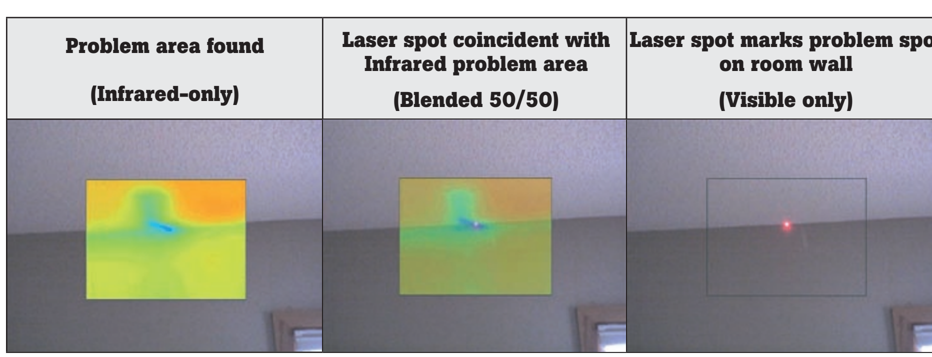

Figure 7. Matching a laser pointer spot seen in a blended image with an infrared point-of-interest assures that the laser spot on the target marks the target point-of-interest

IR-Fusion can help focus an infrared camera

Focusing an image by observing the clarity of the image doesn't work as well as for measuring temperature in an infrared image as it does for showing features in a visible image. This is because infrared images are generally not as sharp as visible images, as described in the introduction of this paper. Achieving a more precise focus on an infrared image may not make the image appear any clearer but it generally will produce more accurate temperature measurements when the temperature features are small. This is particularly important when imaging targets that have features in the order of one or two Instantaneous Fields of View (IFOV[1]).

Because the infrared focus for cameras with IR/Visible fusion is calibrated in the factory, focusing can be done by adjusting the lens until the infrared and visible images match as shown below in Figure 8. It is best to pick out a horizontal line in a blended image and adjust the lens focus until the infrared horizontal line matches the visible horizontal line. This technique helps to achieve precise infrared focus.

Conclusion

IR-Fusion Technology from Fluke Corporation provides thermographers many benefits because it combines the temperature measurement of an infrared image with the clarity and spatial resolution of a visible image.

Acknowledgment

The author wishes to thank Paul Twite of 24-7 Power, Inc. and Rod Hoff of Restoration Consultants, Inc. for supplying example images of real application.

References

1. Kirk Johnson, Tom McManus and Roger Schmidt, "Commercial Fusion Camera", Thermosense XXVIII, SPIE Proceedings Vol. 6205, 2006

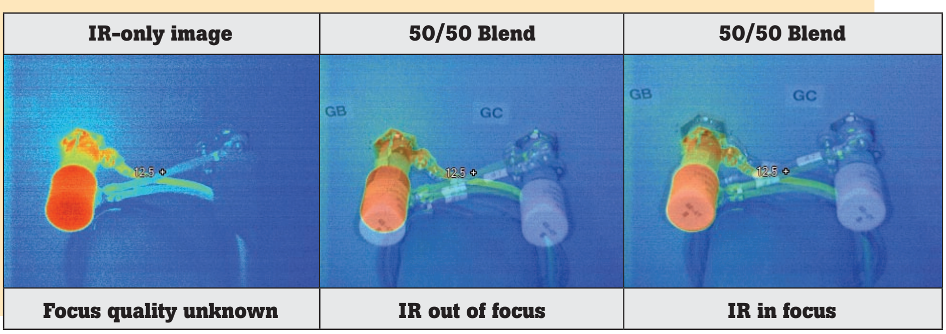

Figure 8. Fusion can help in focusing an infrared image by adjusting the focus until the IR and visible images match

[1] IFOV used here is the geometric Instantaneous Field of View specified as equal to the pitch of the detector array (51 microns) divided by the focal length of the lens (20 mm) which equals 2.55 mrad for the specific camera used for this paper. To achieve an accurate temperature measurement the target area dimension should be three or more sizes larger than the geometric IFOV.

To find out more about Fluke thermal imagers go to www.fluke.eu/ti

Fluke. *Keeping your world up and running.™*

Fluke Corporation
PO Box 9090, Everett, WA USA 98206

Fluke Europe B.V.
PO Box 1186, 5602 BD
Eindhoven, The Netherlands

For more information call:
In the U.S.A. (800) 443-5853 or
Fax (425) 446-5116
In Europe/M-East/Africa (31 40) 2 675 200 or
Fax (31 40) 2 675 222
In Canada (800) 36-FLUKE or
Fax (905) 890-6866
From other countries +1 (425) 446-5500 or
Fax +1 (425) 446-5116
Web access: http://www.fluke.com

Printed in The Netherlands 05/2007.
Pub_ID: 11255-eng