TECHNICAL NOTE TN2021_6 – HEAT EFFECT ON ARTWORK SAMPLES

Introduction

For hyperspectral imaging, relevant illumination is needed. This may cause heating on the samples. This TN illustrates how much heat is then transferred to the samples while being imaging, especially within the context of artwork inspection.

LED = LIGHT-EMITTING DIODE

VNIR = VISIBLE NEAR INFRARED (400 – 1000 NM)

SWIR = SHORT WAVE IFRARED (1000 – 2500 NM)

MWIR = MID WAVE INFRARED (2700 – 5300 NM)

LWIR = LONG WAVE INFRARED (8000 – 12000 NM)

Article

Several illumination sources are available for hyperspectral imaging (see TN2021_7_Illumination). Some of them are hot and may heat up the samples. In order to do not damage samples, careful attention needs to be addressed to this topic.

An application where temperature needs to be monitored is the inspection of paintings. This technical note is written within this context. However, conclusions are still valid and transferable for other applications.

- VNIR – SWIR illumination
  To cover this spectral range, several sources of light are available: sun, LEDs, supercontinuum lasers and halogens. Since art works are often placed in conservation laboratories, artificial lights are needed.
  For color inspection, only the visible part of the spectrum is needed. Hence LEDs are relevant and their absence of heat makes their use even more relevant. However, for art material inspection, IR light is needed. Indeed, those penetrates deeper into the painting and may reveal valuable under-drawing.
  This is because of this that halogens are mostly used, because they can cover the full spectral range (400 – 2500 nm) at a low expense.

  The issue with halogen illumination is the heat. Those may increase the paint surface, especially on darkest areas. Black painting includes carbon (most probably) and carbon is absorbing through the wavelength range between 400-2500nm.
  This can be reduced simply by adding a fan to move air close to surface. To show this a simple test was made with very dark absorbing oil painting. Painting was illuminated with 2x45° line illuminators and total power was 200W (this is quite high). Distance to surface was 50cm. Following image shows temperature increase within first 5 minutes with and without the fan. Fan was installed parallel to surface.

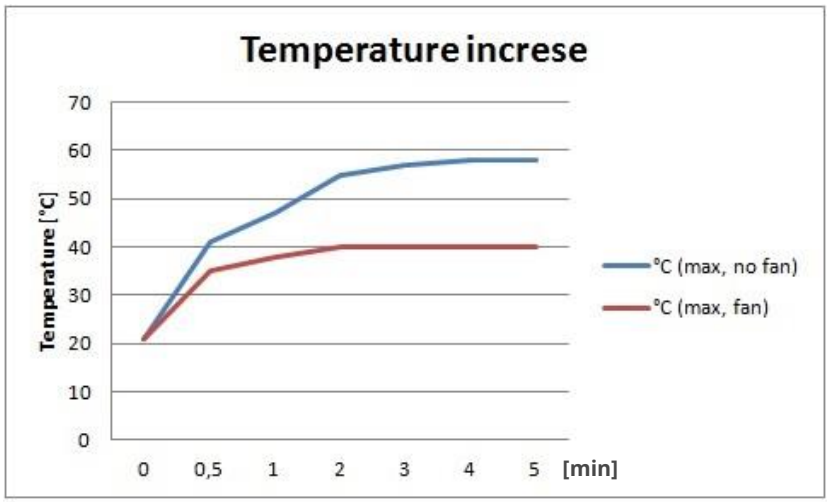

Figure 1: Temperature increase on painting surface with and without a fan.

However, the user needs to keep in mind that those measurements were static. SPECIM camera are line scan devices, and a movement is needed in order to measure a full painting, limiting the heat load.

- MWIR- LWIR thermal illumination
  Still within the context of painting inspection, the heat produced by SPECIM MWIR – LWIR radiators has been tested on samples. Here the influence of the scanning speed was highlighted.

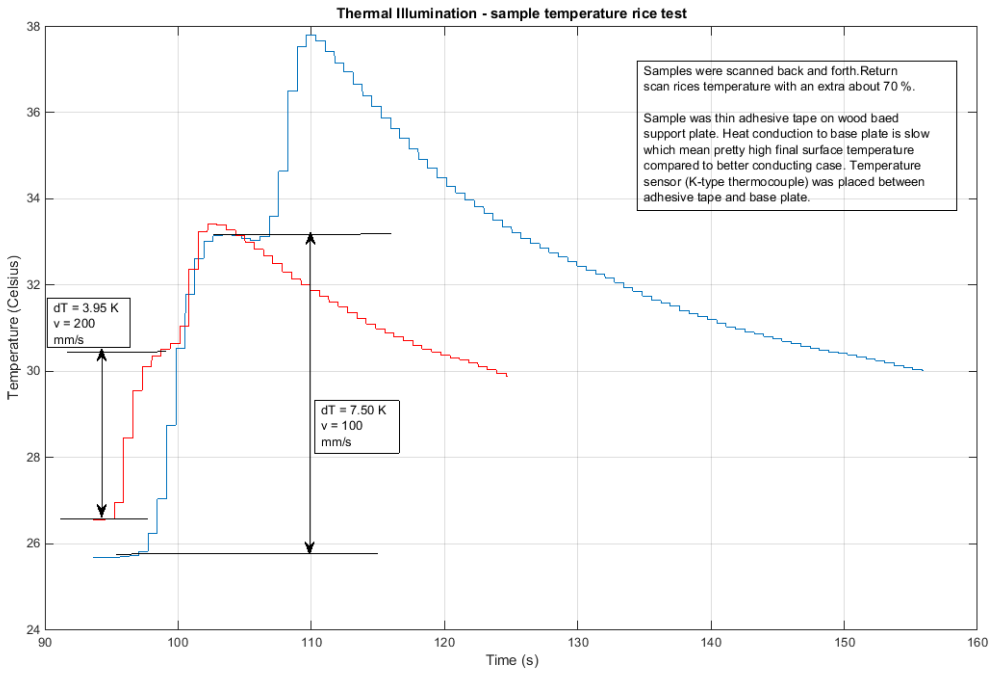

Figure 2: Temperature increase on painting surface at 2 different scanning speeds.

The blue curve represents the temperature raise when the scanning tray was moving at 100 mm/s, whereas the red curve corresponds to a scanning speed of 200 mm/s. For each curve 2 temperature raises appear as they relate to the scanning and retracing of the scanner (meaning that twice the sample was passed under the illumination). The surface temperature of the sample rose of +4 and +7.5 degrees at respectively 200 and 100 mm/s.

Once again, the use of fan would limit the raise of the sample temperature.

Disclaimer

Version history

Version	Date	Author	Comments
1.0	Feb 18th 2022	MMA	