FLIR ThermoVision™ SC6000 Infrared Camera

FLIR Systems launches the ThermoVision™ SC6000 infrared cameras for high-end research and development applications. The ThermoVision SC6000 we have in STEP is a high speed, high resolution, high sensitivity, science grade infrared camera with QWIP (Quantum Well Infrared Photodetector) detector and Gigabit Ethernet interface. QWIP detector works in the long wave part of the infrared spectrum between 8 and 9.2 microns which let us capture very delicate temperature gradients like what is common in the so called isothermal process when all heat transfer processes, if exist, happen locally and there is nothing to see in macro scale.

Technical specification of this camera is as below:

Detector Specification
- Detector Type: QWIP (Quantum Well Infrared Photodetector)
- Spectral Range: 8 – 9.2 µm
- Resolution: 640 × 512 µm (Pixel Size: 25 × 25 µm)

Electronics and Data Rate
- Integration time: 9ms to full frame rate, Snapshot
- Data Rate: 50Hz
- Full Frame Rate: Programmable 1Hz - 125Hz

Performance Specification
- NEDT (Noise Equivalent Temperature Difference): < 35mK
- Well Capacity: 11M electrons

Camera Specification
- Sensor Assembly (f/#): f/2.5
- Sensor Cooling: Linear Stirling Cooler

Physical Specification
- Size (L×W×H): 206 × 143 × 159 mm
- Weight: 4.5 kg

Figure 1: Technical Specification of FLIR ThermoVision™ SC6000 Infrared Camera

ThermoVision™ SC6000 has beendelivered with two software package. FLIR Systems ThermaCAM™ Researcher™ which is necessary for communicating with the camera and controlling and FLIR Systems ThermaCAM RTools™ which is a modular software suite designed for processing and analysis of imagery captured by IR camera.

In the following sections, a brief introduction on the capabilities of the camera as well as a quick guide for the installation and running of it will be presented. More extended data about
the camera could be found in the detailed documentation of the product delivered by FLIR. Documentation CD as a part of package is available in the container of the camera already deposited in the Lab E52.2, CHN Building, ETH Zurich.

Package Contents

FLIR ThermoVision™ SC6000 package delivered in a black container contains following items:

1) FLIR ThermoVision™ SC6000 Infrared camera  
2) Ethernet cable  
3) Electrical power supply  
4) 4 extension rings  
5) 2 black bodies  
6) ThermaCAM RESERCHER 2.8 Pro CD  
7) ThermaCAM RTOOLS 2.3 CD with hardware lock  
8) Etalonnage RTOOLS CD

Quick Guide for the Installation and Running of the camera

Before start using the camera, it should be connected to the computer via Ethernet cable connected to Network port of the computer and to a power supply. ThermaCAM Researcher has to be installed on this computer. In order to be able to show a live image, ThermaCAM Researcher has to establish a software connection to the camera. The first time ThermaCAM™ Researcher is run, you will have to indicate which type of camera you have got and how it is connected physically. This dialog box automatically shows up:
Select ThermoVision SC 4000 / SC 6000 and iPort Grabber as type of camera and type of connection on this dialogue box. If camera connected properly, device would be detected on any of the standard Ethernet network interfaces and the following dialog box will be presented:

Figure 2: Select camera dialogue box

Figure 3: Network Device Finder dialogue box

Press OK to see the following dialogue box:
Press OK once again and you will be in the main environment of the RESEARCHER.

*If there is any problem in the establishment of connection with the camera, refer to “Camera Connections For ThermaCAM™ Researcher 2.8 SR-3” document on the documentation CD.*

If this is the first time you connect camera to the computer, there are several setting parameters under SC6000 M iPort window tabs which you should go through them one by one and adjust them to have a meaningful image. Detailed information for the setting could be found in the above mentioned document under section 1.7 SC4000/SC6000 Camera Control.

The very important procedure which should be done in this stage is the Nonuniformity correction (NUC) procedure which becomes of importance especially in the micro scale imagery when “lens reflection” could disturb the whole measurement field. What is NUC actually does is just averaging over the whole surface to remove fringes we have basically due to the lens reflection. So it changes an image like the left one to something like the right one:
For NUC to apply, there are two ways:

1) Using Internal Procedure in NUC tab of Camera Control window: for that you should first put lens cap on, and then push “Internal” button. Camera takes an image and you hear the shutter sound. After a few seconds screen image will be replaced on the corrected one. If you receive fail error on the box below the button, just disconnect and reconnect the camera and redo the procedure.

2) Using External Procedure in NUC tab of Camera Control window: if you push “External” button, software asks you to put black body in front of the lens. Take one of black bodies from the container and put it in front of the lens while it is not focused and push OK button on the dialogue box appeared on the screen. Again camera takes an image and corrects the field based on that.

In general, External procedure works better than Internal. Use Internal procedure if the black bodies are not available.

The next step would be adjusting object parameters (emissivity, reflected temperature, atmospheric temperature, relative humidity of the air, the distance and the external optics transmission and temperature). They describe the physical properties of the body of interest and its environment and the atmosphere between the object and the camera. You can reach them via Settings in the Image menu.
Now you can see the live IR image by selecting to Camera>Show Camera Image.

Further steps for recording and analyzing of the images could be found in “ThermaCAM™ Researcher Professional edition. Version 2.8 SR-3” document on the documentation CD.

ThermaCAM™ SC6000 IR Camera Capabilities

We already use SC6000 in the project of “Evaporation from porous media” but its super sensitivity let it to be used in a wide range of applications to trace energy transfer via thermal signature.

Two main features of the camera are:

1) High thermal sensitivity (NETD<35mK): it means that the camera could sense and distinguish temperature differences more than 35mK. So very frail temperature gradient could be captured with it.

2) IR Microscopic capability: Mounting extension rings on the lens, let camera to take images in micro scale. The finest image we could take till now has the resolution of about 30 micron when all four extension rings are mounted.

Here are some examples of the experimental setups and images taken with the camera:
Figure 8: IR camera in an experimental setup taking IR images from a heterogeneous evaporative surface

Figure 9: Another experimental setup for the study of salt precipitation and salt crust forming during evaporation using IR imagery technique
Figure 10: IR camera mounted on TOMCAT beam table in SLS, PSI, protected with a lead shield against X-ray beam

Figure 11: IR camera equipped with the extension rings for small scale and microscopic infrared imagery in different setups
Figure 12: Temperature distributions over a heterogeneous evaporative surface

Figure 13: Evaporation from holes
Figure 14: IR image of a pack of spheres

Ebrahim Shahraeeni
Zurich, 22 October 2009