DTR system

Refractive image projector

Fig. 1. Photo of DTR test system

BASIC INFORMATION:

Thermal imagers built using optics with very short focal length (range from about 1mm to about 10mm) of wide/ extremely wide FOV (from about 20º to about 120º) are becoming popular. Testing such imagers is a challenge because of their very low resolution (resolution if often below lowest spatial frequency of biggest target in typical test systems).

DTR can be treated as a special version of classical DT system. Both systems work as variable target projectors that use a series of reference targets to project their images to a tested thermal imager. Classical DT systems are built using reflective collimators of relatively long focal length and big aperture when DTR system is built using a refractive collimator of relatively short focal length and small aperture. Therefore the same infrared reference target projected by DTR system will be perceived by tested imager as much large target comparing to situation when the same imager sees this target projected by a DT system. Mathematically it means that DTR systems can project images of 4-bar targets of spatial frequency several times lower than typical DT system.

Nyquist spatial frequency (equal to 1/2 IFOV) of thermal imager tested imager tested using DTR system can to be as low as 0.02lp/mrad (case of an imager built using 17um sensor and objective of focal length equal to 0.68mm.It makes possible testing virtually all imagers of extremely wide FOV offered on market. Next, DT system is equipped with two collimators of two different focal length and FOV. It makes possible to choose optimal collimator depending on resolution and FOV of tested imager.

DTR system is typically offered in version for testing LWIR imagers. However, it can be optionally delivered capable to test MWIR imagers.

DESIGN STRUCTURE

1. Set of two refractive collimators: CROL430 refractive collimator of 300mm focal length and CROL210 refractive collimator of 100mm focal length (collimators offered for LWIR or MWIR band)
2. TCB-2D differential blackbody (reference radiation source)
3. MRW-8 motorized rotary wheel (optimized for a set of eight targets)
4. YWAS45 rotating platform (for positioning tested imager)
5. Set of IR targets (number and type depend on version)
6. Standard analog video frame grabber
7. Digital frame grabber (customer can choose digital image standard including low resolution standards like SPI or UART)
8. PC set - typical PC set working under Windows 7/10 operating system
9. TCB Control - computer program used for control of TCB blackbody and MRW wheel
10. SUB-T program - computer program that offers software support during measurement of subjective parameters like MRTD, MDTD
11. TAS-T - computer program used for semi-automatic measurement of a series of objective parameters of thermal imagers: MTF, SiTF, NETD, FPN, non uniformity, distortion, FOV, Response function, 3DNoise, NPSD, Bad pixels, PVF, SRF, ATF, SNR, MDTD, Auto-MRTD. Program is delivered in different versions of different test capabilities.

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BASIC TECHNICAL DATA

RCOL430 collimator	
Models	RCOL 430L or RCOL430M
Collimator type	refractive
Aperture	40mm
Focal length	300mm
Spectral range	8-14 µm (RCOL430L) or 3-5 µm (RCOL430M)
Spatial resolution	> 3 lp/mrad (on axis)
Transmission	> 93%
Field of view	8º
Mass /size	2kg/300x150x75mm
RCOL210 collimator	
Models	RCOL 210L or RCOL210M
Collimator type	refractive
Aperture	20mm
Focal length	100mm
Spectral range	8-14 µm (RCOL210L) or 3-5 µm (RCOL210M)
Spatial resolution	> 3 lp/mrad (on axis)
Transmission	> 93%
Field of view	16º
TCB-2D blackbody	
Aperture	50 x 50 mm
Absolute temperature range	0ºC ÷ +100ºC at 20ºC ambient temp.
Differential temperature range	-20ºC ÷ +80ºC
Emissivity	0.98 ± 0.005
Temperature uniformity	<0.01ºC or 0.4% |T-Tamb|
Set point and resolution	1 mK
Regulation stability	±2 mK @ ΔT=10ºC
Total temperature uncertainty [ºC]	0.001 x |T-Tamb| + 0.01 [ºC]
Settling time	< 30s
Computer control	USB 2.0
Power supply	115-230VAC 50/60Hz
Operating / storage temperature	+5ºC ÷ +45ºC / -10ºC ÷ +60ºC
YWAS45 rotating platform	
Rotation range	At least up to 90º
MRW-8 rotary wheel	
Number of holes for targets	8
Control type	motorized, digital

DTR system

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Wheel emissivity	0.97 ± 0.01
Targets	
Diameter	54 mm (for wheel holes)
Emissivity	0.97 ± 0.01
Type	4-bar, edge, cross (number and type depends on version)
Computing system	
PC	Typical modern PC set
Frame grabber no 1	Dynamic 8-bit, SNR>256 Input signal formats - PAL, NTSC
Frame grabber no 2	One of interfaces: CL, GigE, LVDS, HD-SDI, HDMI, SPI, UART
TCB Control program	Control of blackbody and rotary wheel
SUB-T program	Computer support in MRTD measurement
TAS program	Measurement support of MTF, SiTF, NETD, FPN, non-uniformity, distortion, FOV, Response function, 3DNoise, NPSD, Bad pixels, PVF, SRF, ATF, SNR, MDTD, Auto-MRTD

VERSIONS

DTR test systems are modular test systems that can be delivered in form of different versions of different configurations, test capabilities and price. In order to select version we need to determine:

1. Spectral band of the collimator,
2. Frame grabbers (acceptable electronic image formats of tested imagers)
3. Test range of thermal imagers (number of parameters to be measured)

Table 1. Definitions of the three letter code used to describe versions of DTR test system

	1	2	3
Code	**Spectral band**	**Frame grabbers**	**Measured parameters**
A	LWIR 8-14 µm	No frame grabber	Basic: MRTD
B	MWIR 3-5 µm	Standard analog video (PAL/NTSC)	Typical: MRTD, MTF, SiTF, NETD, FPN, non-uniformity, FOV
C	Both LWIR and MWIR	Additional software accepting USB 2.0/3.0	Advanced: as in 3c but also: Response function, 3DNoise, NPSD, Bad pixels, PVF, SRF, ATF, SNR, MDTD, Auto-MRTD
D		Additional frame grabber: CL, GigE, LVDS, HD-SDI, HDMI, SPI, UART	

The code DTR-ABB means DTR system of following features:

1. Spectral band: LWIR 8-14 um
2. Acceptable electronic interface: Standard analog video (PAL/NTSC)
3. Test capabilities: MRTD, MTF, SiTF, NETD, FPN, non-uniformity, FOV

Version 1.6

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