TCAR

System for testing automotive thermal imagers

Fig. 1: Photos: a)TCAR1 system, b)TCAR2 system

1 BASIC INFORMATION

Thermal imagers are becoming an increasingly popular tool in modern cars for driving assistance at night and in low-visibility environment. Market of automotive thermal imagers grows rapidly and equipment for testing such imagers for R/D project, manufacturing, quality control, maintenance and repairing is needed.

Automotive thermal imagers are basically one of groups of short range surveillance thermal imagers of following features: 1)type: uncooled LWIR imagers, 2)FOV from about 18ºx14.4º to about 46ºx36.8º (focal length from about 8mm to about 20mm), 3)non-focusable optical objective (minimal focus distance over 5m), 4)aperture of optical objective below 20mm, 5)output image: electronic video image, 6)small size/mass cameras, 7)located at front of cars at the same level as lights.

The automotive thermal imagers can be treated as a group of imagers between portable surveillance thermal imagers like monoculars (more narrow FOV, focusable optics) and wide FOV imagers used for security applications. Therefore the TCAR systems for testing automotive imagers offered by Inframet can be treated as a fusion of DT/TAIM systems for testing portable thermal imagers and DTR system for testing imagers of very wide FOV.

2 How TCAR is built?

The TCAR is built from five main blocks: collimator (two types possible), TCB-2D blackbody, MRW-8 rotary wheel, set of targets, and computing block (PC set, frame grabber, software). TCAR system works as an image projector that projects image of several reference targets (4- bar targets for MRTD tests, edge targets for MTF tests, or cross target for FOV/distortion tests) located at collimator focal plane into direction of tested thermal imager located at collimator output. Parameters of tested imager are determined on basis of output image generated by the tested imager that sees images projected by TCAR system. These output images can be subjectively evaluated by human operator (MRTD function, infinity focus) or objectively evaluated by software (MTF, NETD, distortion, FOV, etc.).

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3 Versions of TCAR system

TCAR system is offered in two main versions:

1. TCAR-1 system based on a refractive RCOL430L collimator (aperture 40 mm, focal length 300 mm, spectral band LWIR),
2. TCAR-2 system based on a reflective CDT650 collimator (aperture 60 mm, focal length 500 mm, spectral band: both LWIR and MWIR).

Inframet recommends TCAR-1 system because small RCOL430L refractive collimator of 40mm apeture is totally enough for testing automotive imagers having small optics of aperture below 20mm. However, some customers prefer to use a bigger reflective collimators due to a habit to use such collimators when testing medium range/long range imagers. Therefore Inframet offers also TCAR-2 system based on a bigger reflective CDT650 collimator of aperture 60mm and focal length 500mm. Optionally, collimator aperture can be increased up to 100mm. However, optics of automotive imagers is never bigger than 20mm and therefore logically bigger CDT650 reflective collimator is not needed. Therefore the more expensive version TCAR-2 is not recommended but can can be delivered.

4 Test capabilities

Test capabilties of both version are the same: measurement of basic parameters (MRTD, MTF, NETD, FOV, infinity focus) and optional parameters: FPN, non uniformity, distortion, bad spots, 3D Noise, Auto-MRTD.

5 List of blocks

TCAR is a modular system built using a series of blocks:

1. Collimator: refractive RCOL430 or CDT650HR off axis reflective collimator
2. TCB-2D differential blackbody
3. MRW-8 motorized rotary wheel
4. Set of IR targets
5. PBP passive blackbody plate (special passive area blackbody used only during noise/sensitivity tests of thermal imagers)
6. Analog video frame grabber for capturing analog video image
7. Digital frame grabber. Customer can choose one of digital interfaces: CameraLink, GigE, LVDS, HD-SDI/DVI/HDMI, AHD/HD-TVI/HD-CVI, CoaXPress, USB2.0, USB3.0, SPI, UART.
8. PC set – typical PC set working under Windows 10 operating system
9. High performance analog video monitor for subjective image quality tests of tested imagers (if analog video imagers are tested),
10. TCB Control– computer program used for control of TCB blackbody and MRW wheel
11. SUB-T program – computer program that offers software support during measurement of subjective parameters like MRTD,
12. TAS-T – computer program used for semi-automatic measurement of a series of objective parameters of thermal imagers

6 TCAR-1 system specifications

RCOL430 collimator	
Models	RCOL 430L
Collimator type	refractive
Aperture	40mm
Focal length	300mm
Spectral range	8-14 µm
Spatial resolution	> 3 lp/mrad (on axis)
Transmission	> 93%
Field of view	8º
Mass /size	2kg/300x150x75mm

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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
MRW-8 rotary wheel	
Number of holes for targets	8
Control type	motorized, digital
Wheel emissivity	0.97 ± 0.01
Targets	
Diameter	54 mm (for wheel holes)
Emissivity	0.97 ± 0.01
Type	Set of 4-bar targets, edge target, cross target
PBP passive blackbody plate	
Type	passive area blackbody
Emissivity	Over 0.96
Diameter	At least 100mm
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: CameraLink, GigE, LVDS, HD-SDI/DVI/HDMI, AHD/HD-TVI/HD-CVI, CoaXPress, USB2.0, USB3.0, SPI, UART
TCB Control program	Control of blackbody and rotary wheel
SUB-T program	Computer support in MRTD measurement
TAS program	Measurement support: basic (MTF, NETD, FOV) and optional (distortion, FPN, non-uniformity, 3DNoise, NPSD, Bad pixels)

7 TCAR-2 system specifications

Specifications of TCAR-2 are the same as TCAR-1 but refractive RCOL430 collimator is exchanged for bigger CDT650HR collimator of specifications as below.

CDT650 collimator	
Model	CDT650HR
Collimator type	Reflective off axis
Aperture	60mm (option up to 100mm)
Focal length	500mm
Spectral range	Broadband
Spatial resolution	> 60 lp/mrad (on axis)
Transmission	> 93%
Field of view	2.8º
Mass /size	12kg/640x130x150mm

8 Options

TCAR is a test system to be used for testing automotive thermal imagers at laboratory/production room/depot conditions. TCAR system is not big and can be easily transported from one room to another.
TCAR typically used when both this test system and tested imager are located on the same larget optical table. However, Inframet can deliver optional MTX movable table of regulated height that can be as a mobile platform to locate TCAR system opposite tested thermal imager fixed to a car/truck. MTX tables can be treated as economic simplified version of MTAB mobile tables.

9 Summary

TCAR is an optimal economic solution for testing automotive thermal imagers.

Version 1.3

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