TVT

System for testing long range surveillance VIS-NIR cameras

Fig. 1. Photo of TVT test system

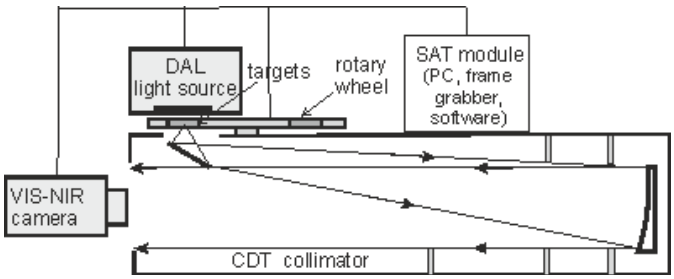

Fig.2. Block diagram of the TVT test system

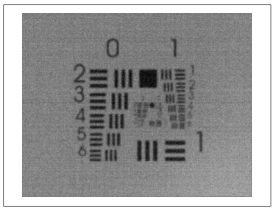

Fig.3. USAF 1951 target image (projected by the TVT station and generated by tested VIS-NIR camera)

BASIC INFORMATION:

Surveillance VIS-NIR cameras (CCD/CMOS/ ICCD/ EBCCD/EBAPS, etc) are used widely in many long range surveillance applications as independent imagers or as part of a bigger multi-sensor surveillance systems.

Majority of VIS-NIR cameras is used for day level applications but an increasing number of these cameras is used to enable surveillance in both night and day conditions. In both cases it is important to verify performance of these cameras under varying illumination conditions from very dark nights to ultra bright days. Important missions can fail due to too low sensitivity of VIS-NIR cameras at night conditions (dark, noisy images) or due to too low dynamic at ultra bright day conditions (saturated, blurred images). Next, it is important to use VIS-NIR cameras that generate high quality images in order to achieve maximal effective surveillance ranges.

The TVT station is a variable intensity image projector that projects images of some standard targets into direction of tested VIS-NIR camera. The tested camera generates copies of the projected images. Quality of the images generated by the camera is evaluated and its important characteristics are measured. The TVT station enable simulation of both ultra dark nights (moonless clouded nights) and ultra bright days (bright sand desert at noon) and accurate testing performance of surveillance VIS-NIR cameras working at any illumination conditions.

Testing surveillance VIS-NIR cameras with TVT test station generate a series of parameters that give vital information about potential camera surveillance capabilities for camera users. In case of camera designers, the tests using TVT system can deliver valuable information about methods to improve design of tested VIS-NIR cameras.

TVT

System for testing long range surveillance VIS-NIR cameras

DESIGN

- Typical TVT test systems are built from the following blocks: DAL calibrated dual-channel light source, CDT reflective collimator, set of exchangeable refractive collimators, MRW-8 rotary wheel, set of targets, PC, set of frame grabbers, and test/control software (DAL Control computer program, SUB-V computer program, TAS-V computer program).

FEATURES:

- Universal modular test system that enable extended tests of all commercially available surveillance VIS-NIR cameras
- Measurement capabilities: Resolution, Minimal Resolvable Contrast, MTF, Distortion, FOV, Sensitivity, SNR, Noise Equivalent Input, Fixed Pattern Noise, Non Uniformity, 1/f noise, 3D Noise, Number of bad pixels and bad pixel localisation, Resposivity function (Responsivity, Linearity, Dynamic, Light Range), Color fidelity. *Typical test systems offer typically measurement of one or two parameters.*
- Ability to simulate both day conditions and night conditions due to extremely wide range of illumination regulation. *There is on the market no test system that could simulate illumination condition in so wide range.*
- Unique light source (dual work mode (halogen 2856K color temperature for simulation of night&typical day conditions and white LED of 5000K color temperature for simulation of bright day conditions), extremely wide range of illumination, continuous regulation). *Typical light sources offer much lower light dynamic, offer step regulation, only single mode, quite often real light output is not measured but estimated.*
- A set of exchangeable refractive/reflective collimators (enable regulation of angular size of the simulated scenery depending on FOV of the tested imager). *Typical test systems are equipped with only one collimator and there is no possibility to optimise collimator field of view depending on VIS-NIR camera field of view.*
- Advanced software for image capturing and analysis that enable measurement of all important parameters of all types of surveillance VIS-NIR cameras.
- TVT systems offer for testing a set of at least six USAF 1951 targets of different contrast. *Typical test stations offer usually only one USAF 1951 target of fixed 100% contrast.*
- A set of different versions of TVT stations of different test capabilities and different price is offered. It is possible to optimize TVTstation depending on local requirements.

Specifications

Parameter	**Value**
Collimators	A reflective of-axis collimator (typical aperture 100mm, 150mm; or 200mm) of narrow simulated FOV and a set of three refractive collimators (max aperture 70 mm) of wider simulated FOV
Light source diameter	40 mm
Modes of work light source:	1) halogen bulb of 2856K color temperature for night and typical day simulation 2) white LED of color temperature over 5000K for simulation of ultra bright days
Total luminance range of light source	10 mcd/m^2 - 10 kcd/m^2 – D (day version) 10 µcd/m^2 - 10 kcd/m^2 – DN (day/night version) (option: luminance range can be expanded)
Simulated illuminance ranges (approximate values)	D version: 30 mlx - 30 klx (0.003 fc-3000 fc) DN version: 30 µlx - 30 klx (0.000003 fc-3000 fc)
Spectral range	Calibrated for testing VIS-NIR imaging sensors of spectral band not wider than 400-1100nm
Spectral modes	a)broadband, b)VIS only, c)NIR only
Targets	Set of six variable contrast USAF 1951 targets, edge target, distortion target, gray scale target
PC Control	RS 232/USB 2.0 (all functions of DAL light source and MRW-8 rotary wheel)
Accepted electronic image formats	PAL, NTSC, Fire Wire, USB 2.0/3.0, analog HD, Camera Link, LVDS, GigE, SDI, DVI, HDMI

*specifications are subject to change without prior notice

TVT

System for testing long range surveillance VIS-NIR cameras

SYSTEM VERSIONS:

TVT test systems are modular test systems that can be delivered in form of different versions of different configurations, test capabilities and price. The latter parameter can vary several times depending on version.
The basic division of TVT series system is based on output aperture of the collimator (Table 1).
Table 1. Division of VIS-NIR systems based on the collimator aperture

System aperture code	Collimator output aperture [mm]
TVT60	60
TVT100	100
TVT 150	150
TVT 200	200
TVT 250	250
TVT 300	300
TVT X	>300 (optional custom designed)

The rule of thumb for choosing proper aperture is following:

- Acceptable situation: the collimator aperture must be bigger than aperture of optics of tested imager
- Recommended situation: the collimator aperture must be bigger by at least 10% than aperture of tested imager (it is easier to align tested imager).

Collimator aperture is only one of a series of technical parameters that should be determined to optimize TVT system for required applications. We need also to determine:

1. Simulated light conditions
2. Collimators
3. Test capabilities,
4. Acceptable electronic image formats of tested VIS-NIR camera,
5. Boresighting capabilities
6. Simulated distance
7. Optional software.

Therefore collimator aperture code and additional code composed from seven letters are use to describe precisely parameters of TVT series systems. Definitions of seven letter code are shown in Tab.2. The columns 1-7 present what letters are to be chosen to define precisely required version of TVT test system.
By changing letters from A to E we increase test capabilities of TVT test system but also the cost is increased.

Tab. 2. Definitions of the codes used to describe versions of TVT test system

	1	2	3	4	5	6	7
Code	**Light conditions**	**Collimators**	**Test capabilities**	**Image formats of VIS-NIR camera) frame grabber)**	**Boresight**	**Simulated distance**	**Optional software**
A	Day (DAL-D light source)	Only reflective, off axis collimator	Basic: resolution	No frame grabber	No boresight capabilities	Only infinity	No
B	Day/Night (DAL-DN light source)	Reflective collimator and a set of refractive collimators	Typical: resolution, MTF, distortion, FOV, sensitivity, SNR, NEI, FPN, non uniformity, responsivity function, linearity	Standard analog video (PAL/NTSC)	Measurement of aligning errors of zoom/step FOV objective	Regulated from 200m to infinity	Movis computer program
C			As for level B but additionally MRC measurement	Additional software accepting USB 2.0/3.0			
D			Ultra expanded: as in level C but additionally 3D Noise model, PVF, NPSD	Additional grabber: CL, GigE, LVDS, CVBS, YpbPr, Coa-XPress, HD-SDI, HD-CVI, HD-TVI, AHD, DVI, HDMI, Fire			

TVT

System for testing long range surveillance VIS-NIR cameras

				Wire			

Detail interpretation of the codes is presented below:

1) Simulated light conditions

Different versions of DAL light source are used to simulate different light condition.

A) D version: 30 mlx - 30 klx (0.003 fc-3000 fc)

B) DN version: 30 µlx - 30 klx (0.000003 fc-3000 fc) where fc is foot candela

2) Collimators (optimal projector configuration for VIS-NIR cameras of different FOV):

A) Only a single off axis reflective collimator. This is a situation suitable for testing typical VIS-NIR cameras optimized for long range surveillance.

B) Additional set of refractive collimators is delivered. This set is useful for testing VIS-NIR cameras optimized for short range surveillance (wide FOV).

3) Test capabilities

List of test capabilities is presented in Tab.2 column no 3.

4) Acceptable image formats of VIS-NIR camera

4a - no frame grabber is delivered

4b - Frame grabber accepting images in standard analog video format (PAL/NTSC) is delivered.

4c - TAS software is modified to accept cideo in USB 2.0/3.0 format. Attention: Camera should be compatible with MS DirectX.

4d - Second frame grabber is delivered: Customer can choose from a long series of frame grabbers: analog HD/SD TV (CVBS, RGB, YpbPr), LVDS or RS-422, Camera Link, CoaXPress, GigE, IEEE 1394 (Fire Wire), SDI, DVI, HDMI. It is expected that customers know parameters of tested camera needed to configure earlier mentioned frame grabbers.

Attention: More frame grabbers can be optionally delivered. Please contact Inframet with your specific requirements.

5) Boresighting

A) No boresight capabilities

B) Measurement of aligning errors of zoom/step FOV objective

6)Simulated distance

A) The targets are located at focus plane of the reflective collimator. The position is not regulated. The collimator simulate targets at so called optical infinity.

B) Position of the wheel with targets can be regulated. Additional platform to move the rotary wheel. PC control. The collimator simulate targets at regulated distance. Useful for checking boresight errors of focusing mechanism of the optical objective.

7) Optional software

A) No optional software

B) Additional MOVIS software that enables easy calculation of detection, recognition and identification ranges of several targets with tested VIS-NIR camera

Example: TVT 150 -BABB-AAA test station means the TVT test station of the following features:
1)simulated light conditions: day/night, 2) image projector built using a single reflective off axis collimator, 3)typical measurement capabilities, 4)image format: analog video, 5) no boresighting capabilities; 6)non-regulated simulated distance, 7)no optional software.

Data sheet version 4.6 dated 15.07. 2016

CONTACT:

Tel: +48 604061817 Fax: +48 22 3987244 Email: info@inframet.com