SIMIT

Dynamic target simulator

Fig. 1. Photo of Simit simulator

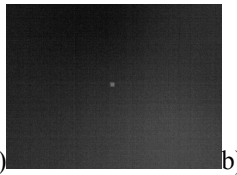
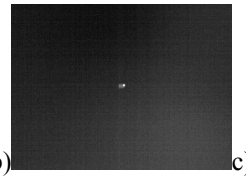
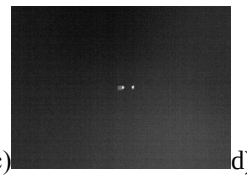
a)  b)  c)  d)  e) 

Fig. 2. Exemplary simulated scenario: static primary target ejecting four secondary dynamic targets. The secondary targets are ejected by the primary target and travel horizontally.

1 Basic information

SIMIT is a dynamic target simulator capable to projects simplified images of dynamic space/airborne targets (astronomical objects, aircraft, helicopters, decoys etc.) in infrared spectral range (can be extended to UV band).
In detail, Simit projects into direction of tested EO system a fused image combined from two sub-images:

1. image of a spatially static simulated target of variable angular size and variable radiation intensity,
2. image of a set (typically four) of spatially dynamic simulated secondary targets of constant angular size but of variable radiation intensity.

Both images are presented on a uniform background.

Simit is a general purpose simulator. It can be used for both for astronomy applications (simulation of dynamic astronomical objects), military applications (simulation of aircraft/helicopter ejecting decoys), scientific applications (evaluation of detection of small size source that radiate in different bands of optical radiation).

In contrast to the modern military type infrared scene image projectors, Simit enables simulation of only relatively simple scenarios: several static/dynamic targets on an uniform background. However, Simit offers precision high dynamic regulation of both light intensity and spectrum of simulated targets important in many scientific applications. In addition, price of Simit is modest comparing to infrared scene projectors.

2 Main blocks

Simit simulator is built from five main blocks: 1)primary image generator, 2)secondary image generator, 3)dual image projector, 4)image combiner, 5)PC/software. However, the image combiner block is integrated with the dual image projector. Therefore from mechanical point of view Simit is delivered as a set of four blocks: primary target generator, secondary target generator, base block (dual image projector and image combiner), PC/software.

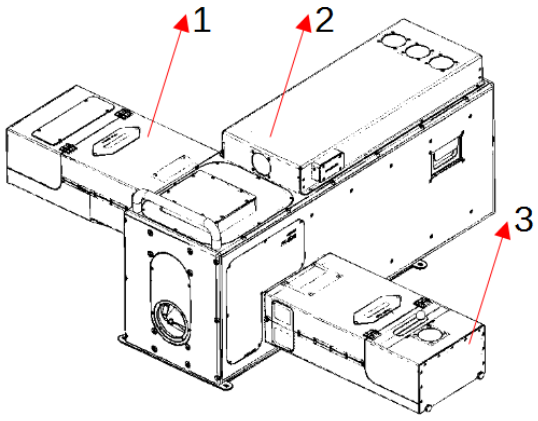


Fig. 3. Main blocks of Simit: 1- Primary target generator; 2 – base module; 3 – secondary target generator

3 Technical specifications

Simit can be delivered in a series of different versions depending on customer preferences. Below presented parameter of basic version of Simit simulator.

Table 1.

FUNCTIONS	DESCRIPTION
Typical tested IR system	
Maximal aperture of optics of tested IR	80 [mm]
Type	dual spectral (option: multispectral)
Height of optical axis of tested IR system	not lower than 125 mm (option: can be higher)
Typical spectral bands	Dual spectral band system (typical: SWIR band and MWIR band) option: SWIR band and LWIR band
General parameters	
Simulated scenario	static simulated target ejecting dynamic simulated secondary targets in form of four pinholes
Type of background	uniform
Direction of movement of the secondary target	1) horizontally to the right, 2) horizontally to the left, 3) vertically up, 4) vertically down
Field of projection	Image of simulated scenery of at least 6° circular (or 4.25°x4.25° square) angular size can be projected.
Spectral band of radiation emitted by simulated targets	primary target: 1.1-8 μm secondary target: 0.4-15 μm
Primary channel	
Shape of the primary target	rhombus (regulated size)
Angular size of the primary target	regulated in range from 0 to 2 mrad (option 5 mrad)
Resolution of regulation of size of the primary target	not worse than: 0.05 mrad
Radiation source that irradiates primary target	blackbody of regulated temperature and angular size
Temperature range of the blackbody	from 300ºC to about 600ºC
Angular position of the primary target	at center of projection field (non regulated)
Irradiance at simulator exit at MWIR band due to the simulated primary target	continuous regulation in range up to 4000 10^{-10} W/cm^2 (option: at least to 20000 10^{-10} W/cm^2)
Aiming target	Optional high intensity target irradiated by infrared lamp (manual exchange of the blackbody for the IR lamp)
Secondary target	
Shape of simulated secondary targets	simulated secondary targets have four pinholes arranged on a line
Irradiance at simulator exit at MWIR band due to the single pinhole of simulated secondary target	step regulation in range up to 3300 10^{-10} W/cm^2 for target of 8' size (option: up to 16 000 10^{-10} W/cm^2 or more)
Ration of radiance of secondary target at SWIR band to radiance at MWIR band	Fixed – about 0.7 (option: regulated in range from about 0.25 up to about 2.5)
Number of plates with different simulated secondary targets	Three (difference in pinhole size and distance between pinholes as in Fig. 4)
Sizes and distances between pinholes of secondary targets	see Table 2 (basic version)
Relative speed of simulated secondary targets	1) 0.5 [deg/s]; 2) 1 [deg/s] (basic version)
Temporal intervals between simulated secondary targets	see Table 2 (basic version)
Time for simulated secondary targets coming back to start position	1.5 s
Radiation source that irradiates secondary target	HIR1920 infrared lamp
Color temperature of the radiation source	1900 K
Radiation modulation	no (option: can be optionally modulated)
Rise time	constant (option: regulated)

Boresight parameters	
Aligning error of centers of images projected by both channels	not worse than 0.3 [mrad]
Linear deviation of optical axis of channel 1 and mechanical axis of the simulator	< 2.5 [mm] at the plane located 250 [mm] from exit of the simulator
Environmental parameters	
Working ambient temperature	+5ºC to +35ºC
Storage ambient temperature	–5ºC to +55ºC
Maximal acceptable humidity	Up to 90% (non condensing)
Geometric parameters	
Dimension	WxHxL (1315x448x1000 mm)
Mass	< 80 kg

Fig. 4. Three types of the secondary multi pinhole target

Table 2. Data on simulated secondary target (pinhole diameter and distance between pinholes)

Pattern No	Number of simulated secondary targets	size [minutes]	size [mrad]	distance [minutes]	distance [mrad]
1	4	8	2,33	18	5,24
2	4	2	0,58	9	2,62
3	4	2	0,58	18	5,24

Table 3. Temporal intervals when the simulated secondary targets are visible

Pattern No	Time duration [s] (at speed 0.5 [deg/s])	Time duration [s] (at speed 1 [deg/s])
1	0.6	0.3
2	0.3	0.15
3	0.6	0.3

4 Options

Inframet can optionally deliver also Simit simulator of expanded simulation capabilities:

1. Maximal irradiance at channel 1 can increased at least up to to 20000 10^{-10} W/cm^{-2} at system output at blackbody temperature 300C (basic version 4000 10^{-10} W/cm^{-2}).
2. Temperature of the primary target can be regulated up to at least 600ºC (basic version - fixed to 300ºC).
3. Maximal irradiance at channel 2 can increased at least up to to 16000.10^{-10} [W.cm^{-2}] at system output (basic version 3300 10^{-10} [W.cm^{-2}]).
4. Modulated light source at frequency at secondary channel can be added
5. Color ratio SWIR/MWIR of simulated secondary targets can be regulated in range from about 0.25 up to about 2.5 (at present this ration is fixed about 0.7).
6. Rise time of simulated secondary targets can be regulated. For basic version this time cannot be regulated.
7. Simulated scenarios can be more sophisticated. At present only secondary targets in form of four pinholes traveling in the same direction can be simulated. Option : large groups of secondary targets traveling into different directions.

Version 2.2

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