THE UTIIIZATION OF SPACE TECHNOLOGY FOR DISASTER EARLY WARNING SYSTEM

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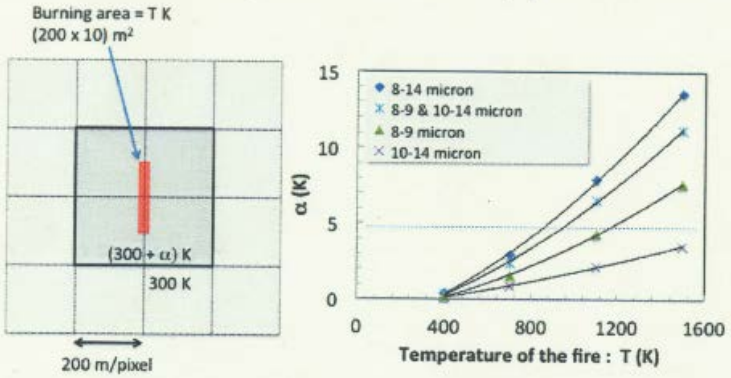
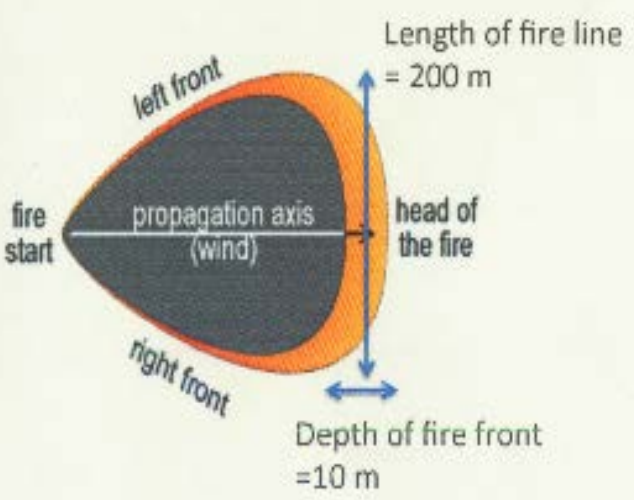
MICROBOLOMETER, (*WILDFIRE*) AND *LIQUID CRYSTAL TUNABLE FILTER* (LCTF)

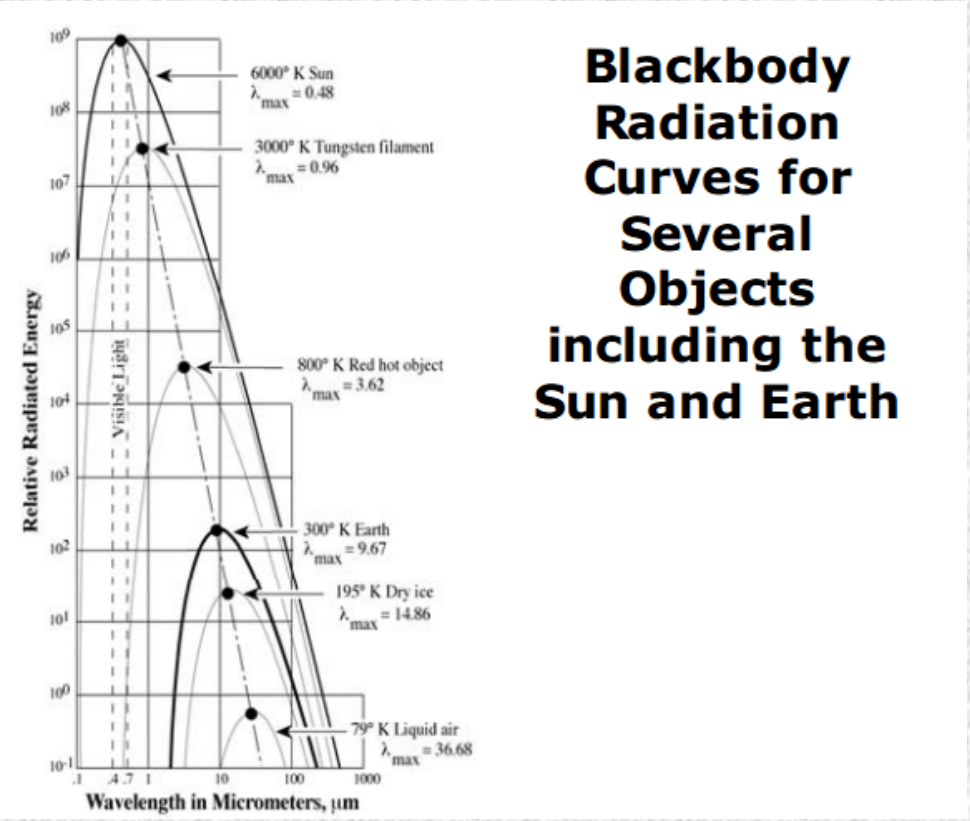
Can BOL detect the wildfire that fire fighters can suppress?



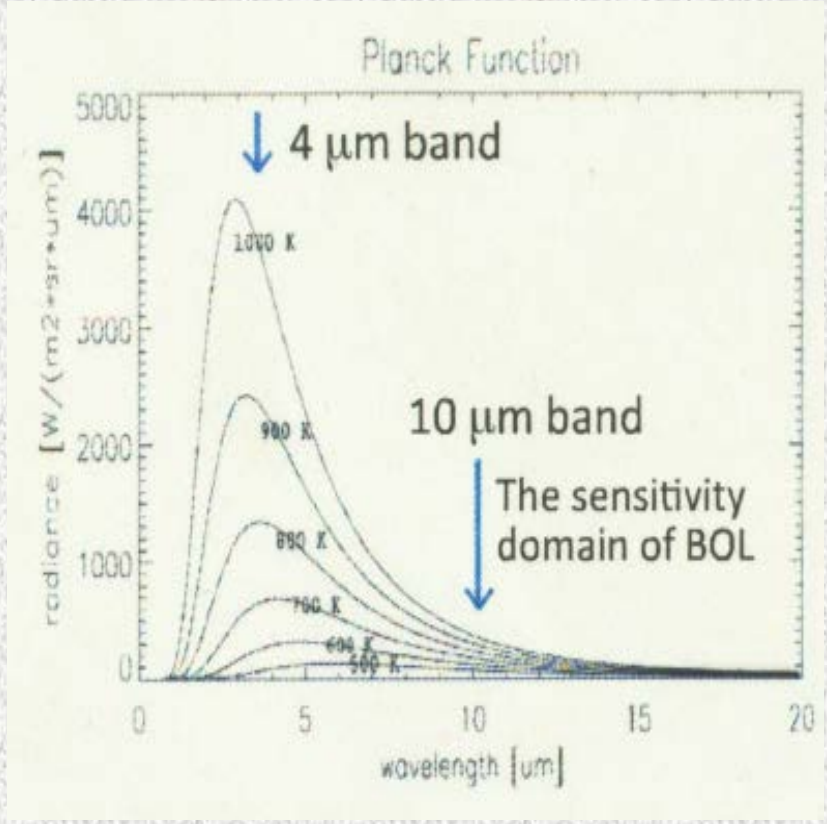
10μm infrared band is effective for fire detection when the spatial resolution of 200 m

Maximum fire size that fire fighter can suppress

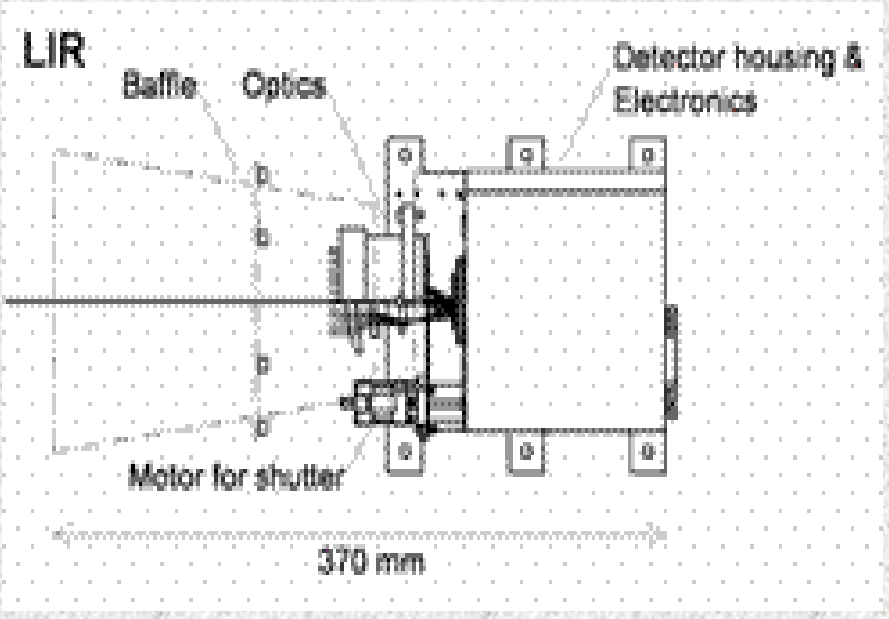




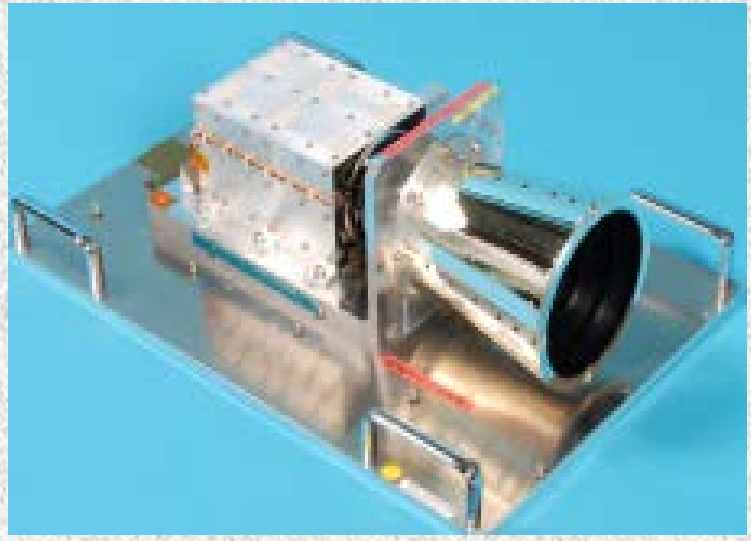
Blackbody Radiation Curves for Several Objects including the Sun and Earth



MICROBOLOMETER

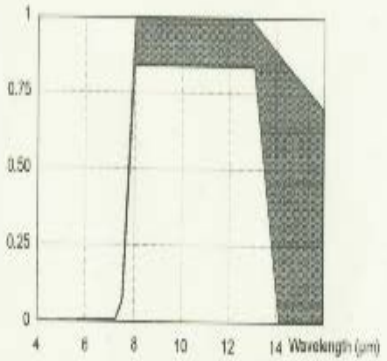


AKATSUKI (PLANET-C) SPACECRAFT



> UNIFORM SATELLITE

Specification	
Detector	UL04171 (ULIS France)
Wave length	8-14 μm
Active pixels	640 (H) × 480 (V)
Pixel size	25.0 μm
Detector size	16.0 × 12.0 mm
Data size	614.4 Kbyte
Frame rate	60 Hz
NETD	0.12 K @ 300 K, f/1
Absolute Temperature Accuracy	±3 K
Spatial resolution	0.0143 deg/pixel (157.0 m/pixel @628 km)
FOV	9.17 deg(H) ×6.88 deg(V) (100.5 x 75.4 km)
Power	7.0 V 1.8 A
Size	100.0 × 100.0 × 123.0 mm
Weight	800 g
Ge Lens	Ophir65148 f=100 mm F/1.4



> RISING-2 Satellite

Wave length	8-14μm
FOV	18.64°x36.48°(0.05°/pixel)
Active Pixels	640×480 (23.5 μm /pixel)
NETD	0.5 K @ 230 K
Size	90×90×109 m
Weight	~0.54 kg
Power	~7 W

> Modul Microbolometer NEC

Uncooled IR DETECTOR MODULE

HX0830M1

Basic characteristics

Detector	Uncooled microbolometer
Wavelength	8 to 14 μm
Array Format (HxV)	320 x 240 pixels
Pixel Size (HxV)	23.5μm x 23.5μm
NETD	<75mK (L range F/1,60Hz)
Dynamic Range	L range : 150℃ (Typ. F/1)
	H range : 540℃ (Typ. F/1)
Video Output	NTSC/PAL
Digital Output	ITU-R.BT656 video data or RAW data
Serial Interface	RS-232C
Input Voltage	5 to 15VDC
Power Consumption	<5W (25℃)
Size	38(W)x38(H)x65(D) mm (Including shutter)
Weight	150g
Functions	Contrast : Auto or Manual
	Brightness : Auto or Manual
	Polarity : White-hot or Black-hot
	Digital zoom : x2 or x4
	FPN Correction (NUC): Auto or Manual
	Dynamic Range Select (L/H/Auto)
	Video Format Select
	Configuration Save
	Control : RS-232C

HX0830M1 Infrared Detector Module consists of an Uncooled IR detector to detect LWIR and Circuit Board for Imaging Processing etc.,which can be used for core device for IR cameras. It can provide high quality IR images by detecting IR radiation of 8-14μm from objects and its ambience.

> LENSA OPHIR 65148

SupIR 100mm f/1.4, Fixed Focus 65148

HFOV[deg]	160x120	320x240	384x288	640x480	1024x768
50μ	4.6	9.1			
38μ	3.5	6.9			
30μ	2.7	5.5			
28μ	2.6	5.1		10.1	
25μ	2.3	4.6	5.5	9.1	
17μ	1.6	3.1		6.2	9.8

Property	Value
Optical	
Focal Length	100mm
F/#	1.4
Average Transmission (8-12μm)	88% (HC)
Horizontal Field of View (FOV)	4.6° (8mm)
Spurious Reflection	No spurious reflections
Back Focal Length	30.3mm in air
Mechanical	
Focus Mechanism	Fixed focus (cell only)
Focus Range	300m to infinity
Weight	360gr
Dimensions	Length 85 mm, Ø93 mm
Environmental	
Operating Temperature	-30°C to +85°C
Storage Temperature	-40°C to +85°C
Sealing	IP 67
External Coating	Hard Carbon
Solar Radiation (Operating)	1120W/m² at 49°C in still air
Mechanical Shock	MIL-E-5400, Para.3.2.24.6.3
Vibration	MIL-STD-810E
Configurations	
65148-02	

> Sensor NEC

Uncooled IR DETECTOR UNIT

HX3100

Array format

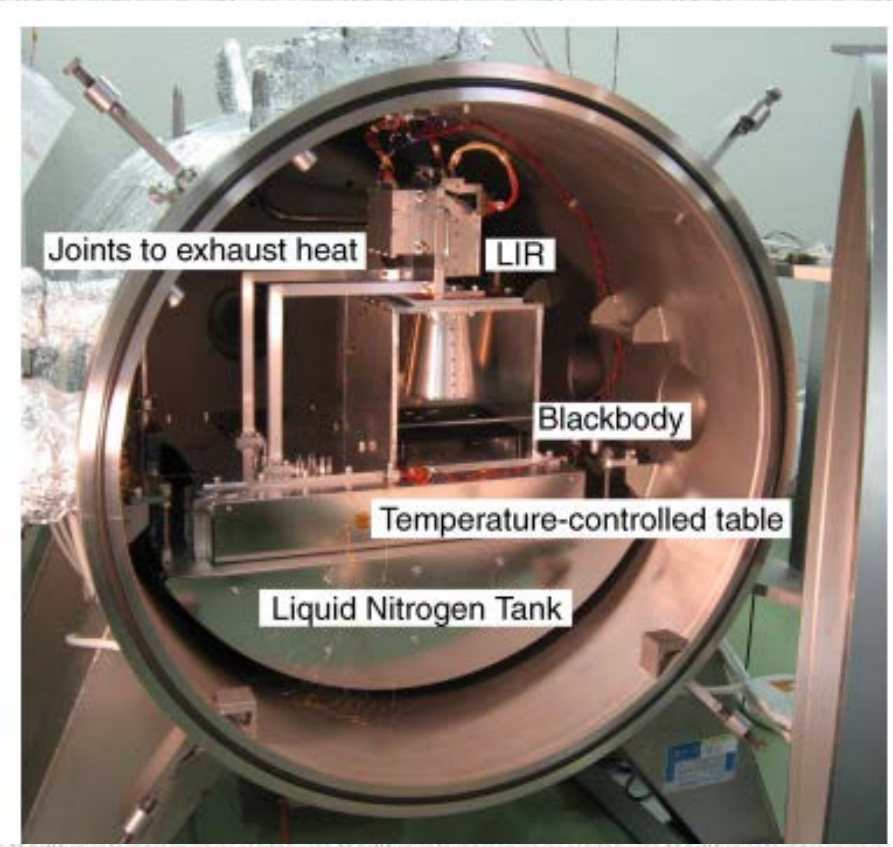
640x480 pixels

Basic characteristics

Detector type	Uncooled microbolometer
Array format (HxV)	640x480 pixels
Operability	>98%
Pixel size (HxV)	23.5μmx23.5μm
Fill factor	92%
Thermal time constant	16msec
Frame rate	30Hz
Wavelength	8~14μm
NETD	<75mK (F/1, 30Hz)
Weight	75g

> Modul Skala LAB

CALIBRATION

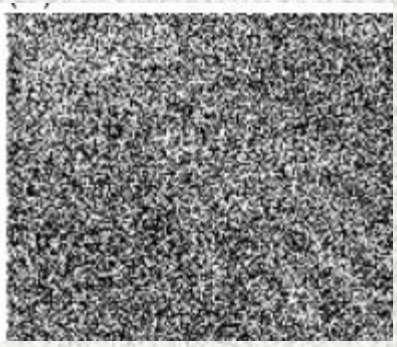


- Sensitivity is most often measured by a parameter called Noise Equivalent Temperature Difference or NETD

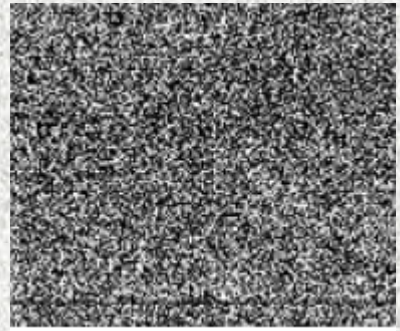
$$NETD = dT/(S/N)$$

dT is the actual temperature difference between the warmer and colder blackbodies,

SAMPEL INFRARED IMAGES



raw target image



raw shutter image for calibration

resultant image produced by subtracting the shutter image from the target image

FACILITY

SPACE MISSION CENTER

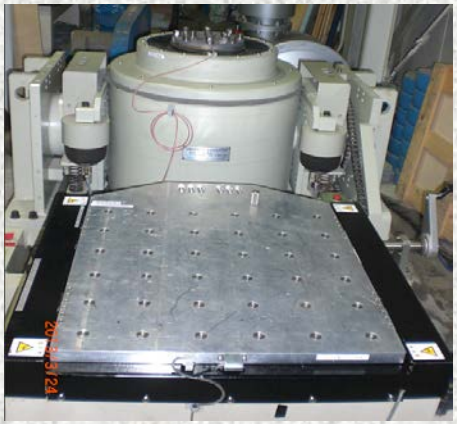
Hokkaido Research Organization

> Vacuum Chamber

>Thermal Chamber

> Clean Room

>Anechoic Chamber
(150Mhz-1Ghz)



>Vibration test
(up to 200Kg)

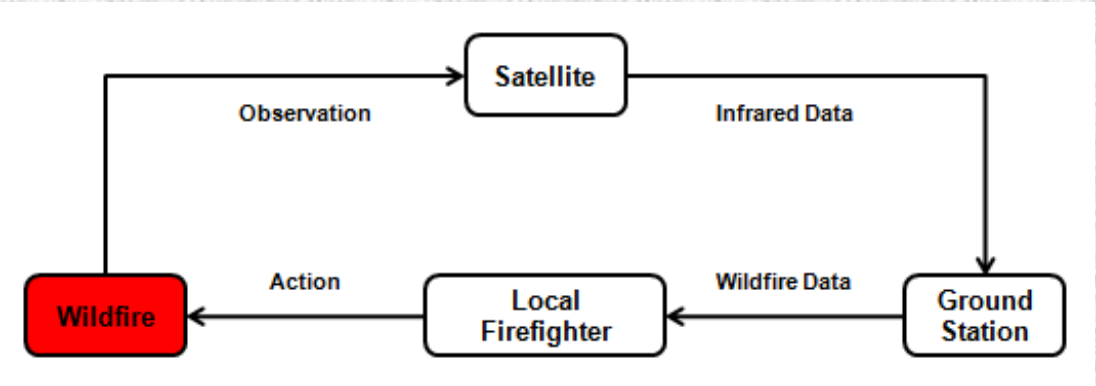
>Shock Test (up to 3000G)

WILDFIRE

- *Wildfire* susceptible happen in Indonesian because dry air characteristic that trees flammable and fire pervasiveness
- *Railbelt Complex* happen in June 21 2009 caused lighting flash and caused area 2574 km^2 fired
- Every year *wildfire* result emission CO_2 6-15 Giga Ton or the same with 25-50% emission fuel

EARLY WARNING SYSTEM

- Research *wildfire* in Palangkaraya to set up early detection system terhadap about forest fire
- Data processing that result form satellite to determine forest fire location exactl and inform official as soon as possible



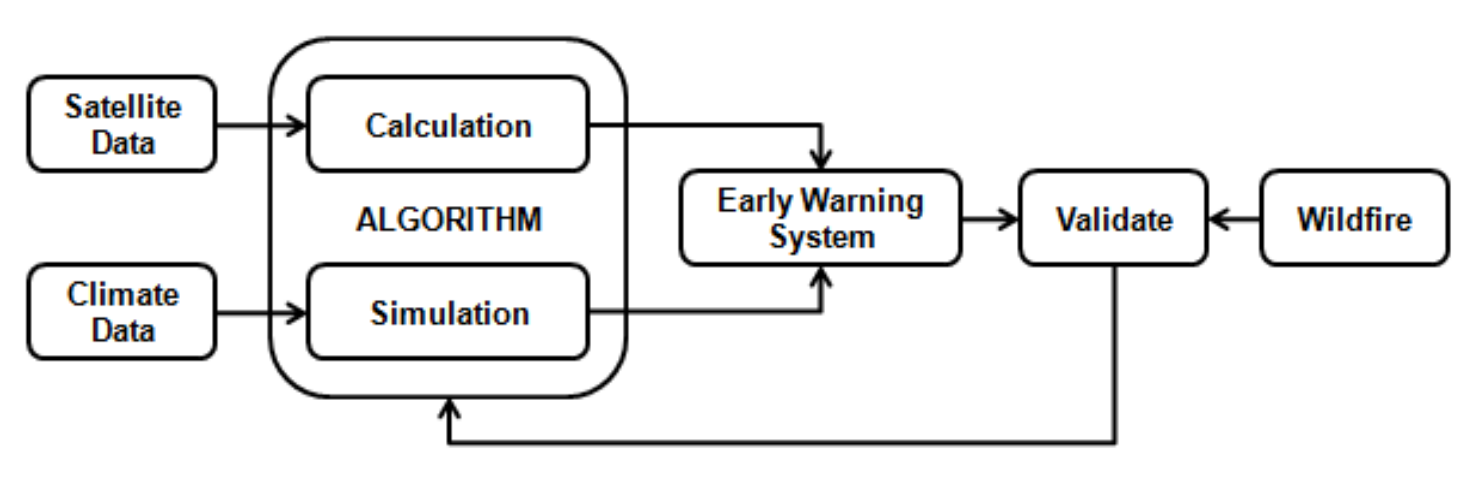
SATELLITE FOR DETECTION *WILDFIRE*

- Some satellite that result data *infrared* that used to detect forest fire
- There is problem in resolution spatial dengan time repetision monitoring
- Terra dan Aqua satellite have time repetision under 1 day but have resolution spatial 1km
- Landsat satellite 7 have resolution spatial 30 meter but have time repetision 16 day
- UNIFORM satellite have resolution spatial 200 meter and time repetision about 1 time a day

ALGORITMA DETECTION CONCEPT

- Result algoritma that detect *hotspot* as many as possible and minimalized (*false alarm*)
- *False alarm* in common result in area that have high temperature like area industry
- Algoritma based anomali spatial that different light intensity temperature surface
- Algoritma detect forest fire identical with algoritma detection edge in data processing

ALGORITMA



- Match simulasi result algoritma that use data climate with result algoritma in data satellite
- Implementation algoritma detection in early system detection and validate algoritma based result

SOME ALGORITMA

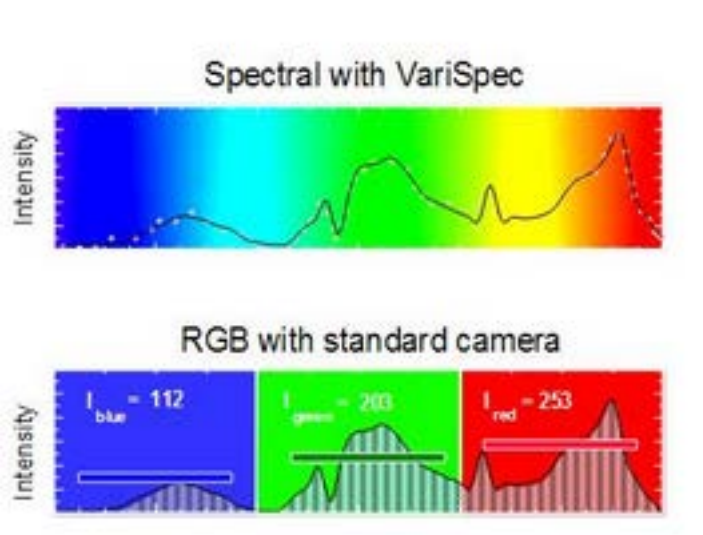
- Algoritma MOD14 is algoritma that used in common to detect forest fire *hotspot*
- More high sensitivity more many hot spot detected but reduce accurate in *false alarm*

Algoritma	Hotspot	True	False
MOD14	34647	34599	48
Nakau 2008	40143	40089	54
Proposed	63117	63074	43

LIQUID CRYSTAL TUNABLE FILTER (LCTF)

LCTF

Specifications				
	VariSpec VIS / VISR	VariSpec SNIR / NIRR	VariSpec LNIR	VariSpec XNIR
Spectral range	400-720 nm (VIS) 480-720 nm (VISR)	650-1100 nm	850-1800 nm	1200-2450 nm
Bandwidth	7, 10, or 20 nm (VIS) 0.25 nm (VISR)	7 or 10 nm (SNIR) 0.75 nm (NIRR)	6 or 20 nm	9 nm
Aperture	20 or 35 mm	20 mm	20 mm	20 mm
Angle-of-acceptance	7.5 ° half-angle (VIS) 3.5 ° half-angle (VISR)	7.5 ° half-angle (SNIR) 3.5 ° half-angle (NIRR)	3.5 ° half-angle	3.5 ° half-angle
Response time (room temp)	50 ms (VIS) 150 ms (VISR)	150 ms	150 ms	150 ms
Wavelength accuracy	Bandwidth/8 +/- 0.5 nm	Bandwidth/8 +/- 0.5 nm	Bandwidth/8 +/- 0.5 nm	Bandwidth/8 +/- 0.5 nm
Maximum optical throughput	500 mW/cm²	500 mW/cm²	500 mW/cm²	500 mW/cm²
Operating temp	10 to 40 °C	10 to 40 °C	10 to 40 °C	10 to 40 °C
Storage temp	-15 to 55 °C	-15 to 55 °C	-15 to 55 °C	-15 to 55 °C
Computer interface	USB 1.1	USB 1.1	USB 1.1	USB 1.1
Power supply	USB bus-powered	USB bus-powered	USB bus-powered	USB bus-powered
Software	Free SDK, demo program	Free SDK, demo program	Free SDK, demo program	Free SDK, demo program



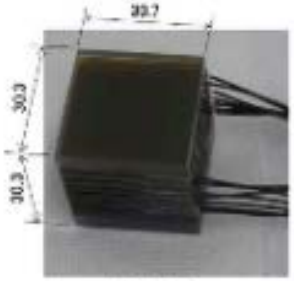
Airborne Multicolor Imager (AMI)

Multispectral Camera

- Wide FOV lens
- High-sensitive CCD
- Liquid Crystal Tunable Filter (LCTF) for Visible
- 190 x 100 x 100 mm
- 1.3 kg

Camera controller

- 100-240 V AC input
- USB 2.0 interface
- 300 x 200 x 60 mm
- 2.0 kg



LCTF

Specifications	
Wavelength range	420 - 700 nm
Band width (FWHM)	8 - 25 nm
Response time	< 0.3 sec
Frame rate	> 1 frame /sec
Number of pixels	659 x 494
Field of view	92 degree

CONCLUSION

- Microbolometer that used in microsatellite to detect wildfire
- Early System detection wildfire have to build with sensor aspect and algotritma detection
- LCTF that used in microsatellite with mission hyperspectral remote sensing

THANK YOU