Focusing and MTF Compensation for KOMPSAT-3 Calibration and Validation

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Abstract

One of three big Cal/Val items in KOMPSAT-3 Cal/Val Phase I is the Focusing to get the optimal MTF. For the Focusing, KOMPSAT-3 have imaged the star, the night lamp and the edge target. Since the star imaging for the Focusing is higher reliability than the others, we have gotten the optimal Focusing value from the star image data, and additionally a little aberration has been found out from them.
MTF Compensation(MTFC) of the KOMPSAT-3 image data has been done in KOMPSAT-3 Cal/Val Phase II. For the MTFC of KOMPSAT-3, the PSF of KOMPSAT-3 has been generated from the star image data taken by KOMPSAT-3, and then the image data could be applied by Wiener filter with the PSF of KOMPPSAT-3. The MTFC image data of KOMPSAT-3 has been validated and complied with the quality requirement of it.

① Spatial Cal/Val Step for KOMPSAT-3

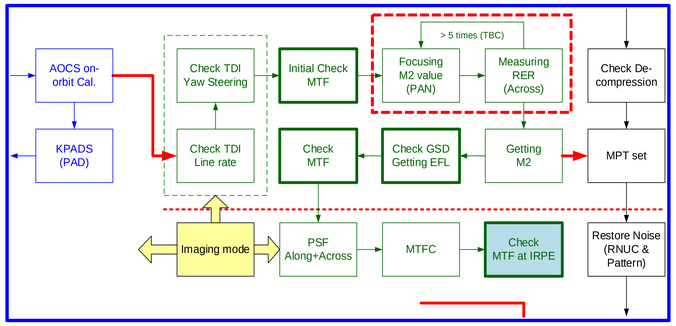
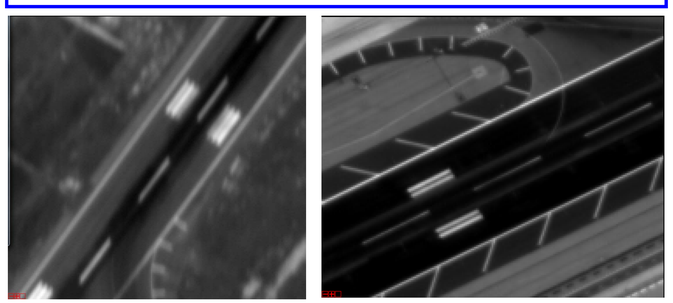


Figure 1. Spatial Cal/Val Work Flow for KOMPSAT-3 (Green)

② Initial MTF before Focusing

- Across MTF (Static MTF): > 8% (TDI 64)
- Along MTF (Dynamic MTF): 2~4% (TDI 64)
- Main parameter for Along MTF: Line rate (Line time)



• 2012.07.08, PAN_5, TDI 64 • Pitch/Roll: -30 / -5 deg • FMC Temp: -0.18 • Old Line rate: 7243	• 2012.07.27, PAN_3, TDI 64 • Pitch/Roll: +30 / -1 deg • FMC Temp: 0.0 • New Line rate: 6794

< With New Line rate >

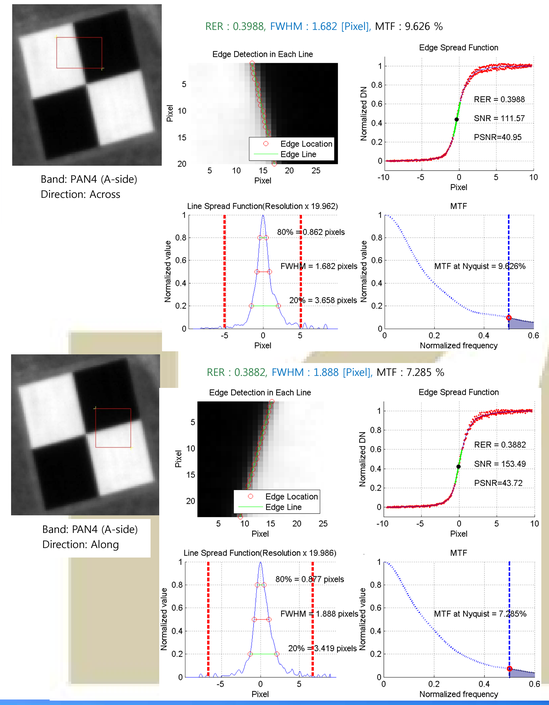
- Across MTF (Static MTF): 8~10% (TDI 64)
- Along MTF (Dynamic MTF): 6~8% (TDI 64)

③ Preparation and Step for Focusing

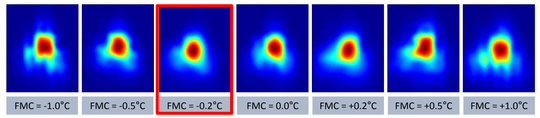
FMC Temperature (°C)	-1.0	-0.5	0	+0.5	+1.0
MTF (Estimated)	80%	90%	100%	90%	80%
FMC temp in Command	-1.0	-0.5	0	+0.5	+1.0

Best FMC value at Lab

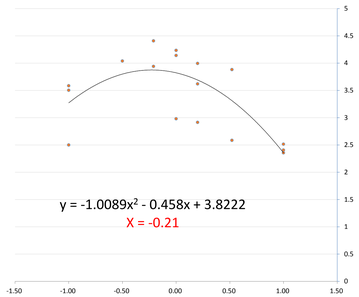
	Imaging & FMC value	Period
Step 1 (Focusing)	Star imaging (TDI 64 / TDI 32) FMC temp (-2, -1, -0.5, +0.2, 0, +0.2, +0.5, +1, +2)	2012.07.17~30 (FWHM, MTF)
Step 2 (Checking)	Imaging Edge target & Night lamp (TDI 64 / TDI 32) FMC temp (-0.2, 0, +0.2)	2012.07.17~08.03 (RER, FWHM, MTF)
Step 3	Measuring & Decision of FMC temp Effective Focal Length & MTF w/o MTFC (Along & Across)	2012.07.27~08.10

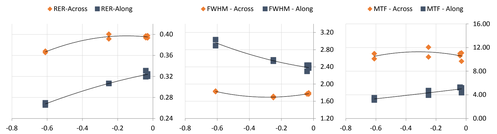


④ Focusing with Star imaging



FMC Temperature(°C)		FWHM - Across			FWHM-Along			MTF(%)	
at Star	at Ground	20%	50%	80%	20%	50%	80%	Across	Along
-1.46	-1.00	2.881	1.666	0.997	2.816	1.803	1.115	12.52	7.85
-0.96	-0.50	2.750	1.665	0.957	2.644	1.745	1.082	11.41	9.13
-0.67	-0.21	2.834	1.580	0.926	2.765	1.789	1.065	13.22	7.37
-0.46	0.00	2.907	1.650	1.000	2.458	1.587	0.901	12.44	12.69
-0.26	0.20	2.612	1.650	0.997	2.994	1.813	1.072	12.14	8.02
0.04	0.50	3.207	1.747	1.011	2.896	1.808	1.124	10.54	7.67
0.54	1.00	3.122	1.773	1.065	2.929	1.801	1.019	10.76	7.82





- Any difference of the result may be between Along and Across.
- FMC temp from Star imaging (with only Across): '-0.2'
- FMC temp from imaging Edge target
  - Only in Along: '+0.2'
- Final FMC temp for KOMPSAT-3: '0'

2012	TDI	FMC Temp	Roll		RER	FWHM	MTF
07.28	64	+0.17	+16.13	Across	0.40	1.68	8.90
				Along	0.38	1.97	6.46
07.31	64	-0.24	-11.83	Across	0.41	1.66	10.06
				Along	0.36	2.00	5.54
08.07	64	+0.23	24.87	Across	0.40	1.67	9.43
				Along	0.39	1.86	7.16
08.10	64	+0.02	-1.57	Across	0.39	1.69	10.05
				Along	0.38	1.96	7.44
08.02	32	-0.24	20.62	Across	0.41	1.65	10.05
				Along	0.39	1.86	7.98
08.13	32	+0.17	+25.67	Across	0.41	1.58	11.02
				Along	0.39	1.86	7.99
08.15	32	-0.03	+3.26	Across	0.40	1.65	9.09
				Along	0.39	1.99	6.27

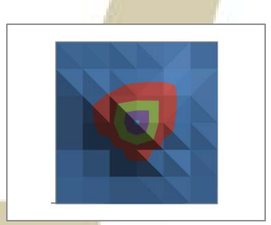
- MTF at Nyquist fr. (without MTFC)
  - Across: 9~11%
  - Along: 6~8%

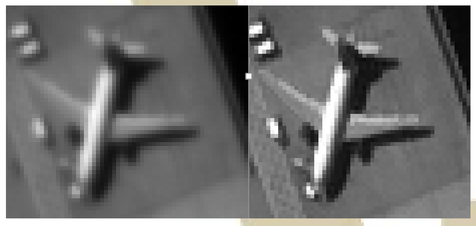
Summary

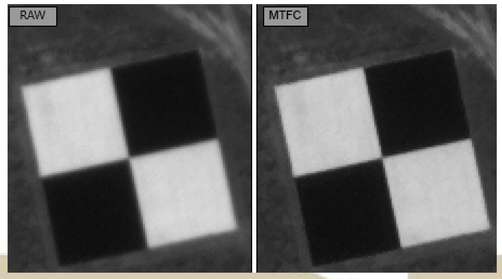
- Optimal Focusing Cal/Val for KOMPSAT-3
- Final FMC temp is '0'.
- Updated Algorithm for Calculating the optimal Line rate value
- Best optimal PSF of K3 from Star imaging
- May be a little aberration in Star image.
- Optimal Image data Quality for KOMPSAT-3

⑤MTF Compensation

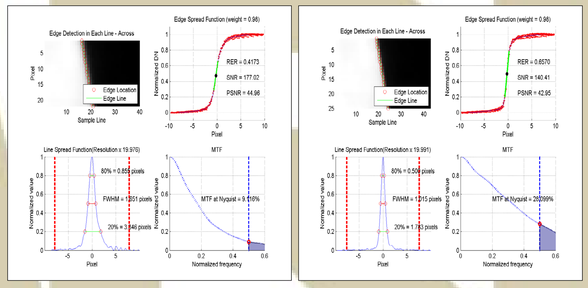
- Wiener filter with 7x7 kernel







Edge idx	RAW image			MTFC image		
	RER	FWHM	MTF (%)	RER	FWHM	MTF (%)
Across-1	0.417	1.65	9.12	0.657	1.02	28.10
Across-2	0.424	1.55	10.53	0.668	1.00	31.16
Along-1	0.369	2.00	6.03	0.563	1.17	20.24
Along-2	0.371	1.99	5.46	0.567	1.08	18.35



Summary

The KOMPSAT-3 image data with MTFC may have been complied and acceptable by Users.