GENERATING NUC TABLES BASED ON STATISTICAL DATA COLLECTION FOR KOMPSAT-2 WITHIN LEOP

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ABSTRACT

The algorithm of calculating NUC table, based on Image data collection, is based on two basic assumptions. These basic assumptions are as follow: one is the NUC is of a linear nature. The other is all pixel see the same statistical distribution for large number of lines.

We generated NUC tables for a radiometric calibration & validation of KOMPSAT-2 using a dark cal. Data.

KEY WORDS: KOMPSAT-2, Radiometric Calibration, NUC table

1. INTRODUCTION

1.1 NUC Table

The algorithm of calculating NUC table, based on Image data collection, is based on two basic assumptions:

- The NUC is of a linear nature.
- For large number of lines, all pixels see the same statistical distribution.

In this assumption, a different assumption can be taken. That implies a slightly different mathematical evaluation. The algorithm does not hold if imaging the same scenery all the time.

1.2 Initiated Updating NUC Table

After the bright and dark images are acquired, all the data in each image for each pixel should be summed by adding the image lines together.

This smoothes out shot noise and other fluctuations, and buries accidental light sources or sinks in the image. Had there been no non-uniformity, all the pixels' sums would have been equal.

1.3 Passive Updating Considerations

In this method, new NUC tables are produced, which may replace the ones that produce the stripe effect. The method itself yields corrections to the current NUC tables, from which the new tables are calculated. The method is based on collecting data from a large number of uncorrelated images. As the aim is to correct NUC tables for a given set spectral band, TDI level and temperature, it is necessary to collect data separately for each set of conditions.

The correction should be done when the images of a specific set of conditions display the characteristic stripes of insufficient non-uniformity correction.

Updating should be done separately for each NUC table such as for each TDI level, the different spectral bands etc.

2. GENERATING NUC TABLE

Let us use the following notations:

- x_{ij} the measured ("wrong") values of pixel j in line i
- i the line number, ranges from 1 to N (a very high number)
- N Number of sampled lines
- a_j the gain correction for pixel number j, to be found
- b_i the offset correction for pixel number j, to be found
- y_{ij} the actual ("true") value for that pixel, for which the correction aims
- X_j the average of xij
- $Var(X_j)$ the variance of xij

From the first basic assumption one gets:

$x_{ij} = a_j * y_{ij} + b_j$

$x_{ij}^2 = a_j^2 * y_{ij}^2 + 2 * a_j * b_j * y_{ij} + b_j^2$

Averaging those relations over all the lines (N), we obtain

[1] $X_j = a_j * Y_j + b_j$

{The means vector $X_j = \Sigma[(x_{ij})] / N$}

And

$(X^2)_j = a_j^2 * (Y^2)_j + 2 * a_j * b_j * Y_j + b_j^2$

{The means vector $(X^2)_j = \Sigma[(x_{ij})^2] / N$}

The squared values of the first means vector are:

$(X_j)^2 = a_j^2 * (Y_j)^2 + 2 * a_j * b_j * Y_j + b_j^2$

Thus the variance becomes:

[2] $Var(X_j) = (X^2)_j - (X_j)^2 = a_j^2 * [(Y^2)_j - (Y_j)^2] = a_j^2 * Var(Y_j)$

Note: Var(Yj) is the "true" variance.

Using the second basic assumption, the "true" mean and variance do not depend on the pixel. Thus:

$Y_j = Y$; $Var(Y_j) = Var(Y)$ for all j,

From this obtains:

[3] $X_j = a_j * Y + b_j$

And:

[4] $Var(X_j) = (X^2)_j - (X_j)^2 = a_j^2 * Var(Y)$

The goal variance Var(Y) can be approximated preferably by the largest variance.

Thus, the gain correction value for each pixel j is given by

[5] $GainCor[j] = (1/a_j) = SQRT(Var(Y) / Var(X_j))$.

All the gain correction values are larger than, or equal to 1.

Next, the values of bj are calculated by:

[6] $b_j = X_j - Y / GainCor[j]$, or

$Y = X_j * GainCor[j] - b_j * GainCor[j] = X_j * GainCor[j] + OffsetCor[j]$

The goal value Y can be approximated preferably by the largest value of all multiples

(Xj * GainCor[j]).

Thus, the correction to the offset is given by:

[7] $OffsetCor[j] = Y - X_j * GainCor[j]$.

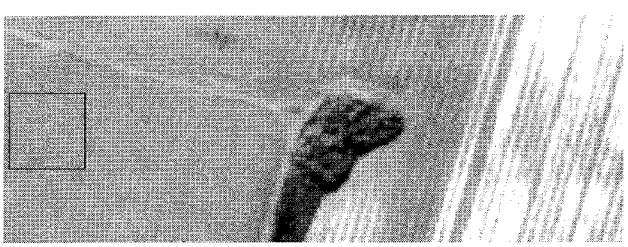
All the offset values are non-negative.

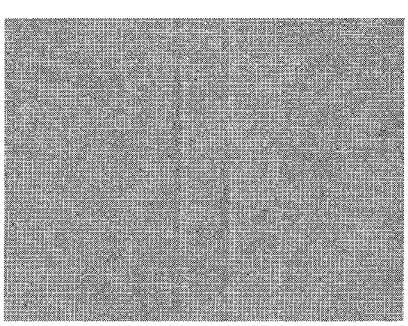
3. RESULT AND ANALYSIS

3.1 Before & After NUC Correction

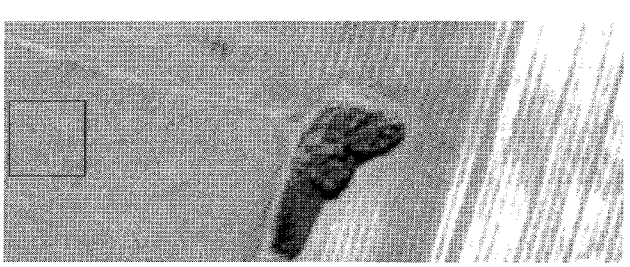
Sample Image 1
(KOMPSAT-2, PAN1, LA, 20060916)

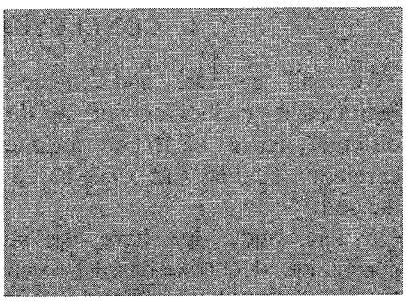
(1) Before NUC Image





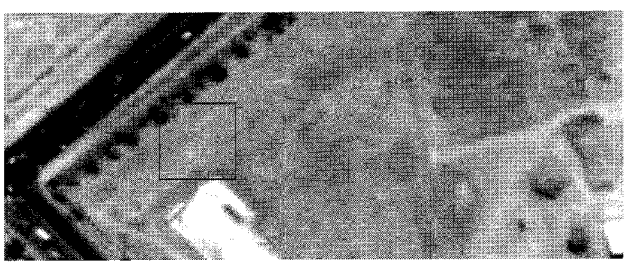
(2) After NUC Image

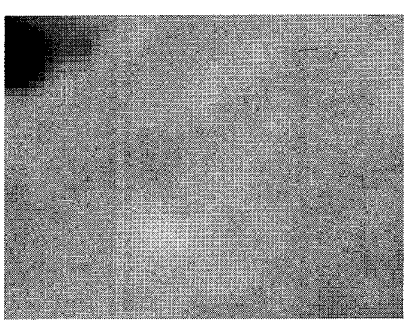




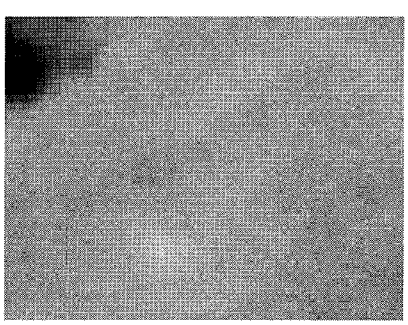
Sample Image 2
(KOMPSAT-2, PAN2, LA, 20060916)

(1) Before NUC Image





(2) After NUC Image



4. CONCLUSION

We will generate and update a NUC table for radiometric calibration of KOMPSAT-2 with two different types of NUC techniques that two-point correction method and scene-based statistical correction method.

In this study, we have presented the method of generating NUC table based by statistical data collection for KOMPSAT-2 and applied NUC correction to KOMPSAT-2 images within LEOP phase I.

The method is based on collecting data from a large number of uncorrelated images. In order to obtain the desired accuracy it is estimated that many images of different locations are necessary. Therefore we will update a NUC table continually and apply the better one to KOMPSAT-2 imaging system by comparing statistical method with two-point method.