QR Code
DO NOT REMOVE

SMARTSAT COOPERATIVE RESEARCH CENTRE

RMIT UNIVERSITY

Improvement of Satellite Images

Alvaro Valenzuela Quinteros[1,2], Karin Reinke[1] and Simon Jones[1]

Introduction

In satellite images a pixel detects radiance originating not only from the Earth's surface represented by the pixel but also from the surrounding area represented by adjacent pixels. This adjacency effect is highly undesirable because it degrades the quality of any satellite image. Restoration is a technique to improve the quality of satellite images by reducing the adjacency effect. Many restoration algorithms have been proposed but some of these algorithms actually degrade image quality. The usual way to find the optimum restoration algorithm is a cumbersome procedure that uses actual satellite images of much higher spatial resolution. We propose a simpler procedure to find the optimum algorithm by using synthetic images.

Aims

1.- Develop a new procedure (Synthetic Edge Images) to find the optimum restoration algorithm for a given satellite sensor's spatial response.
2.- Develop a new in-orbit technique (Three-Edge Quadratic Interpolation) to measure the sensor's spatial response using images of straight edges.
3.- Develop a new metric (Spatial Resolution Function) to compute the improvement in spatial resolution distance due to image restoration.
4.- Integrate previous aims into a single procedure that improves the spatial resolution and radiometric accuracy of any satellite image (Figure 1).

Methods

1.- Develop a new methodology to assess metrics, techniques and measurement procedures for satellite imagers, using the optical design parameters of a generic sensor as independent variables (Reference 2).
2.- Compute the system Optical Transfer Function (OTF) as the product of the individual OTF of all the satellite sensor's components.
3.- Compute the sensor's spatial response (Point Spread Function) as the two-dimensional inverse Fourier transform of the system OTF.

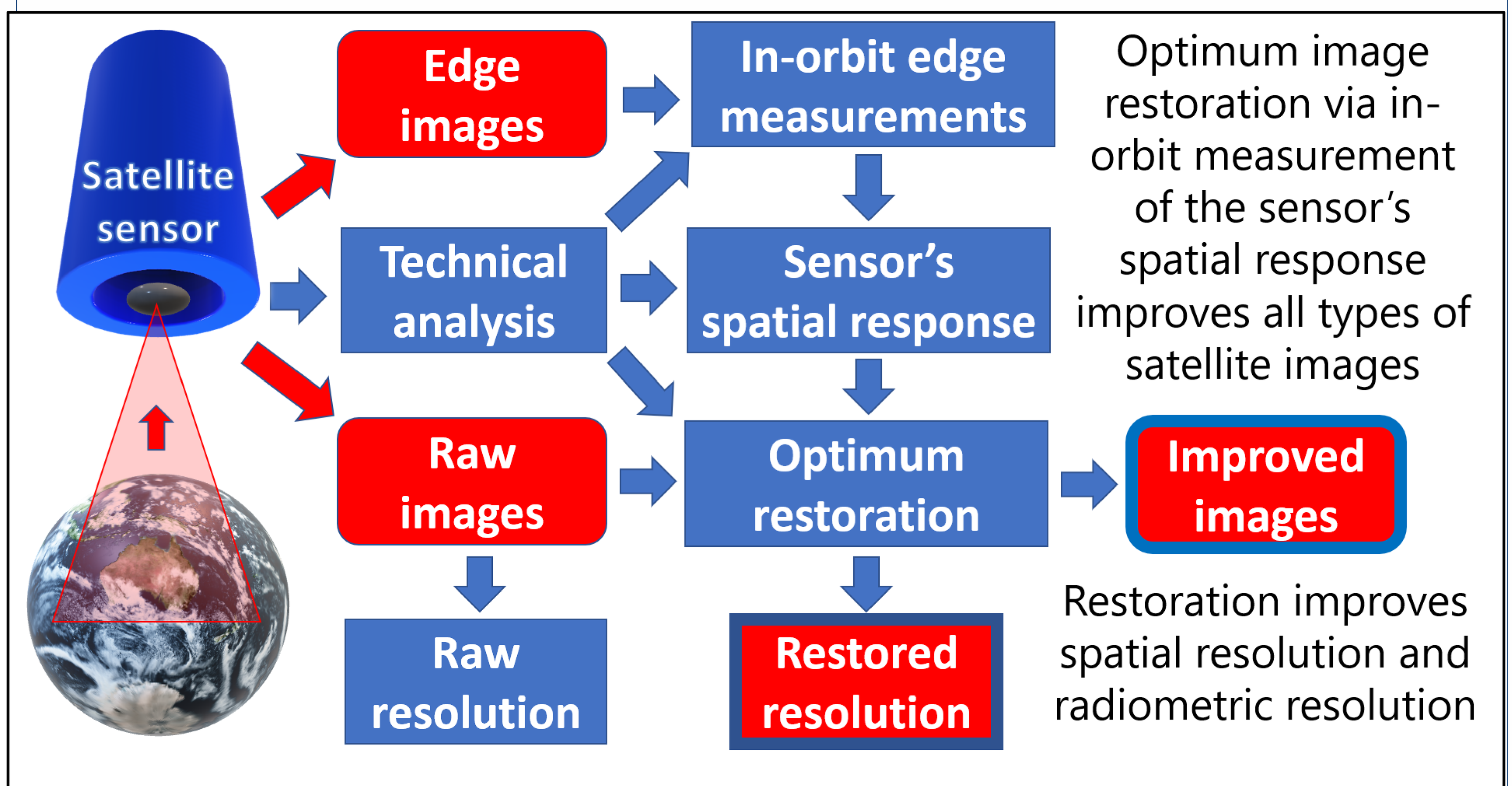


Figure 1: Procedure to improve the quality of satellite images

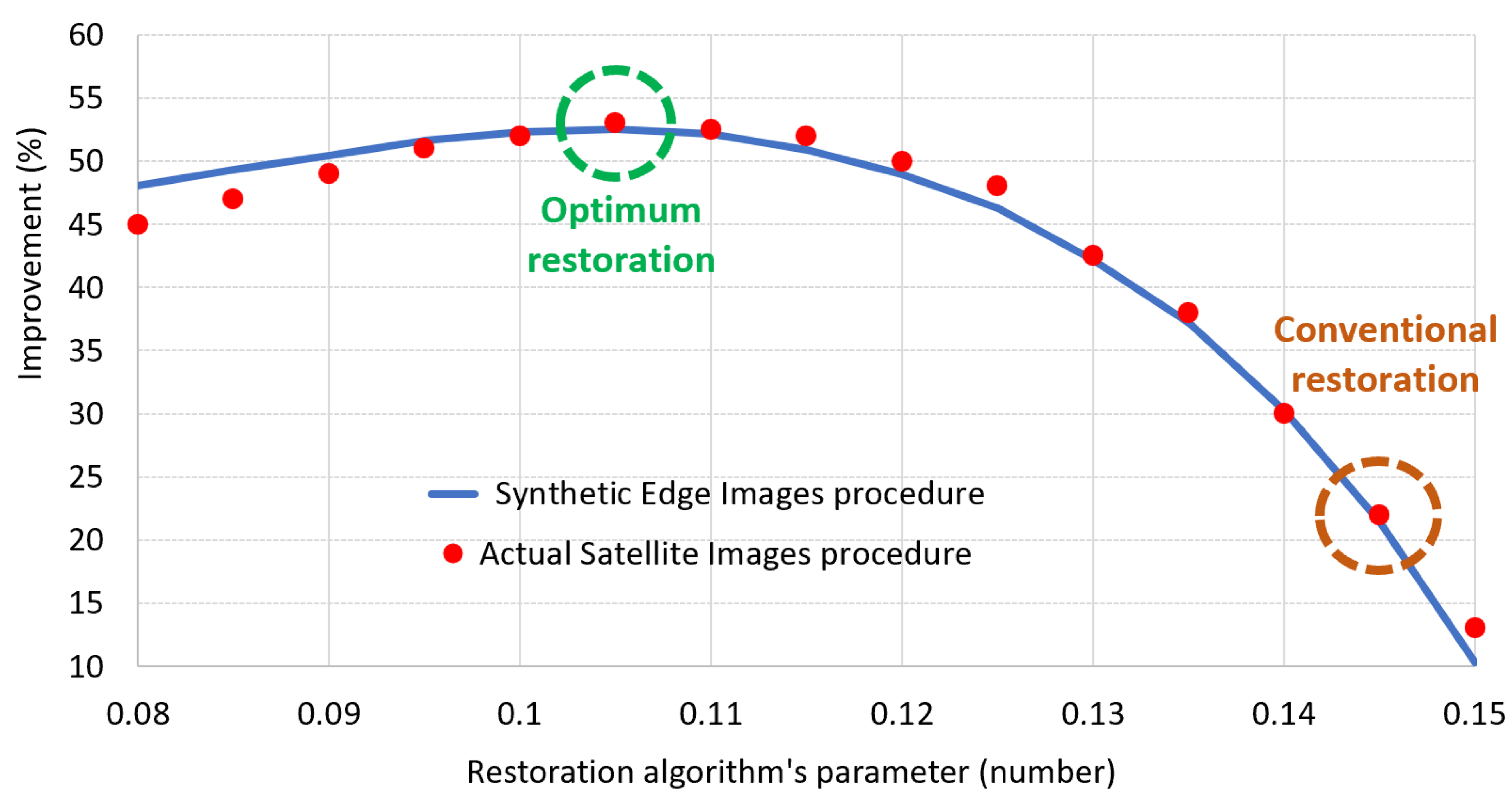
Results

1.- A new procedure to find the optimum algorithm to restore satellite images was validated by replicating the MODIS' results found by other authors that used the Actual Satellite Images procedure (Figure 2).
2.- A new Three-Edge Quadratic Interpolation technique to measure the sensor's spatial response was validated using the method of Reference 2. A publication is under review in the *Trans. Geosci. Remote Sens.*
3.- A new Spatial Resolution Function metric was developed (Reference 1) and used to show that the average spatial resolution distance of Planet's CubeSats is five times their ground pixel size, in agreement with NASA and ESA findings. A publication is under review in the *Int. J. Remote Sens.*

Impacts

1.- Optimum restoration improves the spatial resolution and radiometric accuracy of any satellite image application based on the pixels' digital number. For example: fire detection, agriculture and water quality.
2.- The new three-edge method characterizes the spatial response of the newer types of satellite sensors for which the two-edge method fails.
3.- Spatial Resolution Function metric shows that the Ground Sampling Distance (GSD) is not a valid resolution metric and allows the computation of the true spatial resolution distance of any type of satellite sensor.

Figure 2: Improvement of MODIS' images by using two different procedures versus the restoration algorithm's parameter



References

1.- A. Valenzuela, K. Reinke, S. Jones, "A new metric for the assessment of spatial resolution in satellite imagers", *Int. J. Appl. Earth Obs. Geoinf.*, Vol. 114, pp. 1-19, Oct. 2022.
2.- A. Valenzuela, K. Reinke, S. Jones, "A new methodology to assess spatial response models for satellite imagers using the optical design parameters of a generic sensor as independent variables", *IEEE Trans. Geosci. Remote Sens.*, Vol. 61, pp. 1-10, Apr. 2023.

[1]Royal Melbourne Institute of Technology University [2] +61477533567 alvvalq@gmail.com

Australian Government Department of Industry, Science, Energy and Resources
AusIndustry Cooperative Research Centres Program