



Estimation of Construction Year of Medium to Long Road Bridges in Zambia using Satellite Imagery

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Abstract

Using the age of the road bridges as one of the inputs, deterministic and probabilistic deterioration models are used to determine the deterioration rates and predict the future physical condition of these structures. This study attempts to estimate the year of construction of 27 road bridges in Zambia. The Technique assumes that the normalized difference water index 2 (NDWI₂) at the target bridge point (TBP) shows detectable differences before and after the construction of a road bridge. Landsat 5 Thematic Mapper in conjunction with Landsat 7 Enhanced Thematic Mapper Plus was used in the Google Earth Engine. Sequential t-test analysis of the regime shift method was applied with a cutoff length $l = 2$ to $l = 12$, and significance level $\alpha = 0,05$, to interpret the estimated year of construction from NDWI₂. The results confirm that it is possible to accurately estimate the year of construction of road bridges in Zambia using this method.

Keywords: satellite imagery; construction year; road bridges; normalized difference water index 2; regime shift; bridge management; bridge target point; Landsat.

1 Introduction

Using the year of construction of road bridges as one of the key parameters, deterministic and probabilistic deterioration models facilitate the calculation of deterioration rates and the prediction of the future physical condition of road bridges. This valuable information helps to prioritize bridges, formulate plans and budgets for future works, and develop strategies for routine maintenance and inspections [1, 2].

In the previous study [3], a Technique was developed to determine the estimated year of construction of the road bridges by correlating the regime shift of the normalized difference water index 2 (NDWI₂) with the actual year of construction of the road bridges in Nago City in Japan. The study yielded $R^2 = 0,33$ for 44 road bridges with an overall length < 100 m. The current

study attempts to apply the same Technique to assess and determine the estimated construction years of road bridges in Zambia. For over 90% of the road bridges in Zambia, the year of construction is not known, and, bridge's overall length < 100 m. The study examines 27 road bridges, of which 23 have an overall length > 100 m and 4 have an overall length < 100 m. The inclusion of bridges with an overall length > 100 m is motivated by the fact that they can only be detected to a limited extent by pixelated satellite images due to problems such as insufficient reflectance as well as absorption and scattering effects. In addition, bridges with an overall length > 100 m are classified as particularly critical.

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