

THE PIMAR PROJECT: REMOTE ENVIRONMENTAL MONITORING PROGRAM IN URBAN ATLANTIC FOREST OF RIO DE JANEIRO, BRAZIL

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Abstract

The PIMAR Project (Remote Environmental Monitoring Program) aims at the development of methodologies to support the analysis and classification of the land cover patterns in the urban landscape. PIMAR is focused on two important conservation units of Rio de Janeiro municipality, the Tijuca National Park and the north portion of the Pedra Branca State Park. For the monitoring process of the study site it will be acquired high resolution images (IKONOS stereoscopic) every six months during twelve months. From the first classified image (base map) onwards will be applied semiautomatic methods of classification on the subsequently acquired images, assessing the changes on land cover and land use. For the vertical urban expansion evaluation it will be developed digital elevation models (DEM) from IKONOS stereoscopic images. The land cover classification methods created within the PIMAR Project have already been validated in applied research projects, such as the current Geotechnical Risk Assessment Program for the State of Rio de Janeiro, in the context of the PRONEX Program (Support Program for Excellence Centers), and the Environmental and Urban Management Plan of the Municipality of Resende, in collaboration with Petrobras, the Brazilian oil and energy public company.

1. Introduction

The disordered and accelerated urban expansion in the Rio de Janeiro municipality has been putting pressure on the forest remnants areas in the last decades. The horizontal and vertical constructions growth tends to suppress the existing forest fragments. The lack of instruments to diagnose, with accuracy, the affected areas difficults the drawing of concrete actions of preservation and understanding and hinders the public organs performance.

The PIMAR Project (Remote Environmental Monitoring Program) is a pilot project for the continuous monitoring of the limits between urban and forest landscape through high resolution satellite images (IKONOS) coordinated by the LabGIS of the Geography Department and by the *Laboratório de Visão Computacional* (LVC) of the Electric Engineering Department of the *Pontifícia Universidade Católica do Rio de Janeiro* (PUC-Rio).

PIMAR is inserted in the policy established by the Rio de Janeiro State Environmental Office (SEA) to monitor and control the horizontal and vertical urban expansion on preserved areas of the State. The primary objective of PIMAR is to provide the fundamental subsidies to understand the social and environmental processes that model the landscape, supporting the definition and implementation of public policies within a sustainable perspective. The project aims at the development of methodologies to support the analysis and classification of the land cover patterns in the urban landscape. Other goals are:

a) to develop a software application in the Geographic Information System (GIS) for the semiautomatic updating of the information on vegetable covering and use of the soil, contributing with updated data to favor the performance and the integration of public entities;

b) to make available to the general public data and results from the monitoring process, therefore making the population aware of the environmental importance of this dynamics and encouraging its participation as agent of control of the environmental degradation and of the urban expansion;

c) to transfer the developed technology to SEA guaranteeing its autonomy for the continuation of the monitoring process, also making possible the further expansion of the project to other areas of the State.

2. Methodology

2.1. Study site

PIMAR is focused on two important conservation units of Rio de Janeiro municipality, the Tijuca National Park (Figure 1A) and the north portion of the Pedra Branca State Park (Figure 1B). The main arguments to select these areas as object of study for this project was the pressure put on it, mainly by the informal urbanization of the city, which grows disordered over natural legally protected areas. Moreover, the two areas concentrate a very representative mosaic of fragments of Atlantic forest of the State. It was also taken in consideration on the decision process the presence of governmental programs and projects of social interest in these areas.

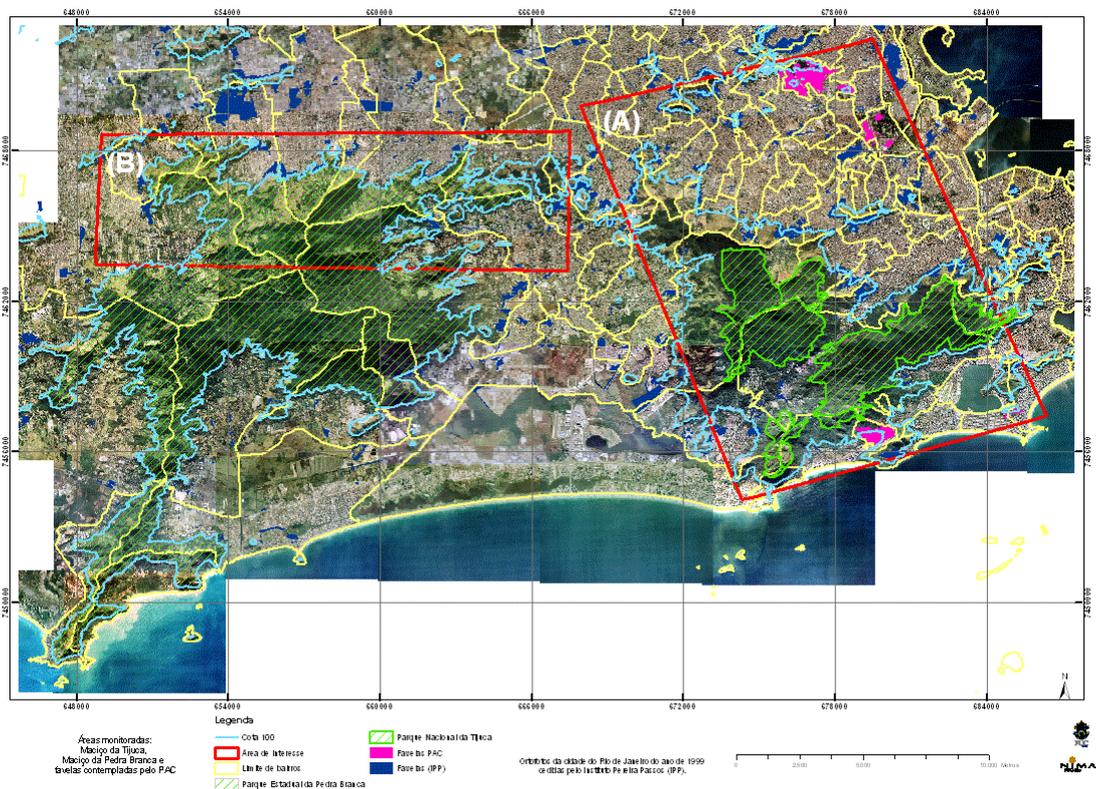


Figure 1: (A) Tijuca National Park. (B) North portion of the Pedra Branca State Park.

2.2. Material and Methods

The continuous manual or (semi)automatic classification of the land cover urban patterns from data produced by the available orbital sensor systems depends on several different aspects, such as the specific characteristics of the sensors, the target land cover classes, the ancillary information available, and the knowledge used by the interpretation system, regardless of it being a human or a computational system. Those different issues determine the research initiatives within the PIMAR Project, for instance: development of methodologies to support object based image analysis (Dart, 2006; Jorge, 2006; Cintra et al., 2007; Almeida et al, 2008); semantic and temporal knowledge modeling and processing (Mota et al., 2007; Campos et al., 2005; Cazes et al., 2007; Costa et al., 2007a); development of methods based on computational intelligence tools (Santos et al., 2007; Feitosa et al., 2006); and multisource image interpretation (Costa et al., 2007b).

For the monitoring of the study site high resolution images (IKONOS stereoscopic) will be acquired every six months during twelve months. These images will be first orthorectified and then classified by visual interpretation in order to verify land cover changes, specially the horizontal urban growth on the forest remnant edges of Tijuca National Park (Figure 1A) and the north portion of the Pedra Branca State Park (Figure 1B). Thereby, it will be generated the reference data (base map). From the first classified image (base map) onwards will be applied semiautomatic methods of classification on the subsequently acquired images assessing the changes on land cover and land use. At that time, it will be possible to analyse and compare the images visual interpretation and the semiautomatic methods of classification arriving to conclusive and useful results. For the vertical urban expansion evaluation it will be developed digital elevation models (DEM) from IKONOS stereoscopic images. DEM makes possible the altimetry measurement and vertical classification of forests and urban growth.

3. Expected Results

With the PIMAR project we expect:

- a) to develop a simple and replicable methodology for the continuous monitoring of the land cover and land use changes based on multitemporal classification of high resolution satellite images (IKONOS stereoscopic) applicable to the study site and other areas.
- b) to generate data about the urban pressure over forest remnants;
- c) to assess the horizontal and vertical expansion of the forest and reforested areas and on the horizontal and vertical expansion of the demarcated urban areas;
- d) to develop a software application in the Geographic Information System (GIS) for the semiautomatic updating of the information on vegetable covering and use of the soil, contributing with updated data to favor the performance and the integration of public entities;
- e) to transfer the developed technology to SEA guaranteeing its autonomy for the continuation of the monitoring process, also making possible the further expansion of the project to other areas of the State.

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