APPLIED COMPUTING

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

# AI and Meteorology/Remote Sensing Applications Research at PGCAP/INPE

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## Abstract

The Applied Computing Program (CAP) of the Brazilian National Institute for Space Research (INPE) is a MsC- and PhD-level graduate program which aim is to contribute to the national technological and scientific development and to respond to the current research and development needs in Space Sciences and Technologies, in line with INPE's institutional mission.

The program has a strong tradition in areas such as data modeling, representation, analysis and simulation, using techniques such as complex systems modeling, applied artificial intelligence, signal and image processing, HPC, geographic information science and others, always with applications to INPE's R&D fields. In particular, INPE has been developing research on AI application for weather forecasting and satellite data exploration, the key subjects of this workshop.

Recently, the Brazilian government has increased the funding to the internationalization process of some graduate programs, which will allow us to increase the cooperation with foreign institutions. In this way, INPE's participation in this event aims to share knowledge and its acquisition in regard to the state-of-the-art of AI applied to meteorology.

In this poster we will present the history and current activities of the program, with focus on interactions with other graduate programs and research centers at INPE (Meteorology, Remote Sensing, Astrophysics, Space Geophysics, Earth System Science, Engineering and Space Technologies). We will also present ongoing efforts and opportunities for collaboration between INPE and international universities, research centers and companies.

## About INPE

INPE (*Instituto Nacional de Pesquisas Espaciais*, the Brazilian National Space Research Institute) was created in 1961. Its mission is to produce science and technology in the space and terrestrial areas and offer singular products and services for the benefit of Brazil.

INPE is a federal R&D institution, part of the Brazilian Ministry of Science, Technology, Innovation and Communications.

As part of its mission INPE maintains seven graduate-level courses: Astrophysics, Earth System Science, Space Engineering and Technologies, Space Geophysics, Meteorology, Remote Sensing and Applied Computing.

## The Applied Computing Program (CAP)

The program was created in 1968 to meet INPE's need for researchers in applied CS, with emphasis on applications to INPE's areas of competence, and a strong focus on applied computing and mathematics.

Some of its research areas are Complex Systems, Modeling and Simulation, Software Engineering, Image Processing, Geographical Information Systems, Data Mining/Data Science and High-Performance Computing.

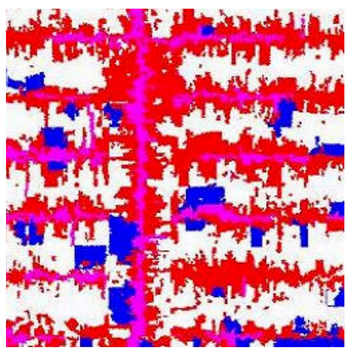
Several of its more than 500 graduates works on R&D at INPE, in other institutes and in tech companies, and many teach in colleges and universities.

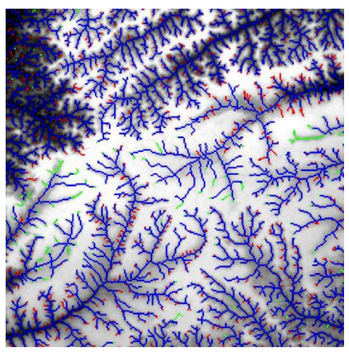
In 2019 we had 28 faculty members and 84 grad students.

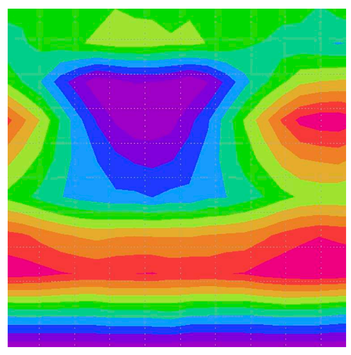
CAP was graded level 5 of 7 by the federal educational funding agency CAPES.

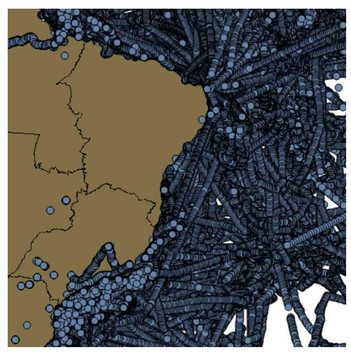
INPE | CAP | PrInt | Rafael Santos

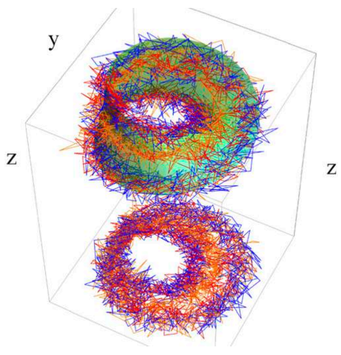
## Theses' Sampler


Mining Patterns of Change in Remote Sensing Images

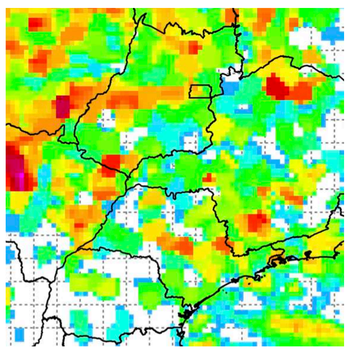

Decision Trees for Automatic Extraction of Drainage Networks


Neural Networks for Data Assimilation in a Oceanic Circulation Model


A Framework for Trajectory Data Mining



Networks of Phase Oscillators: Synchronization and Applications


Rainfall Estimation from Cloud-to-Ground Lightning Data

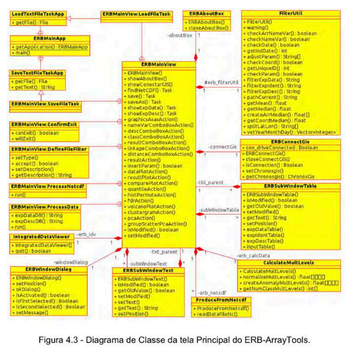
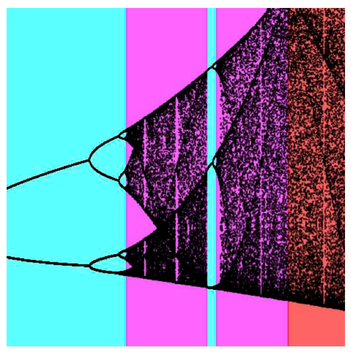
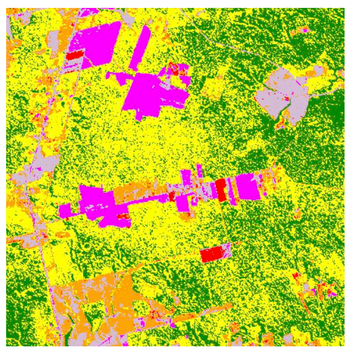
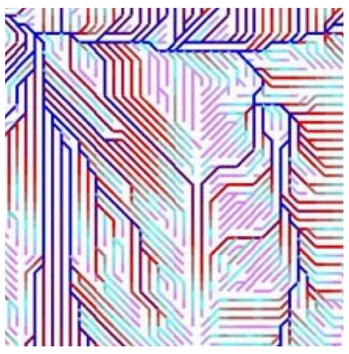
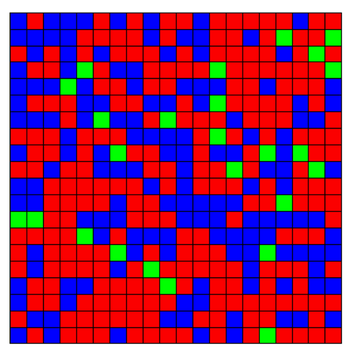


Figura 4.3 - Diagrama de Classe da tela Principal do ERB-ArrayTools.
Tool to automate knowledge Discovery in NOAA Databases

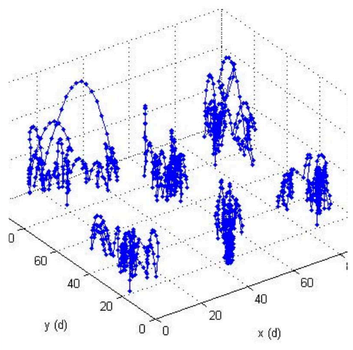

Identifying Low-Dimensional Complex Systems by Recurrence Plot and Complex Network


HSMI: Hierarchical Classification Method Based on Multi-Kernel SVM with Meta-Heuristic Optimization

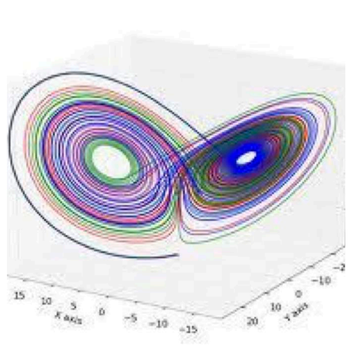

Graph Based Structure for Unifying Representation of Local Flows in GIS Distributed Hydrological Modeling

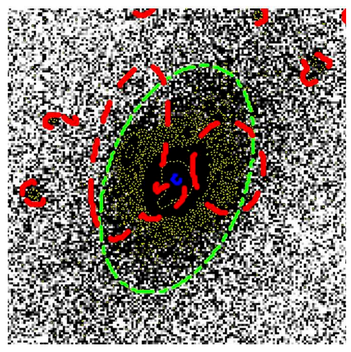

Game Theory and Agent-Based Modeling for the Simulation of Spatial Phenomena

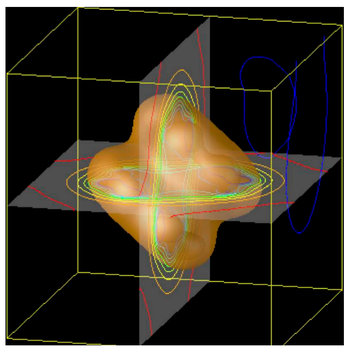

Analysis of Samples' Selection Methods for Reducing the Training Time of the SVM Classifier



Simulation and Analysis of Granular Fluid Dynamics

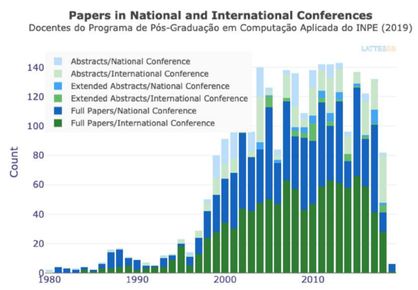

Predictability in Chaotic Systems using Neuro-Fuzzy Systems

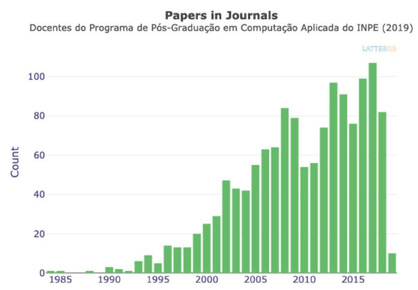

Applied Computing to Study Structural and Environmental Properties of SDSS's Galaxies

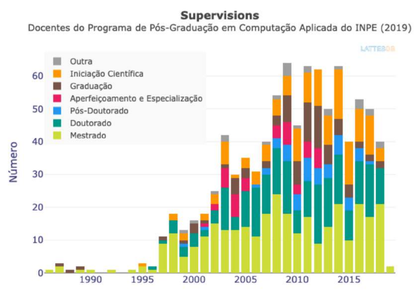

High Order Method for Local Time Step Adjustment in the Numerical Resolution of Evolutive Differential Equations using Adaptative Multiresolution Analysis

All theses are online at http://www.inpe.br/biblioteca/, some are in Portuguese.

## CAP in Numbers




## Opportunities

**Research:** collaboration with INPE (CAP and CPTEC, Center for Weather Forecasting and Climate Research), opportunities at the Internationalization Project (http://print.dpi.inpe.br/en)

**Studying**: there are no fees or tuitions. Most eligible MsC and PhD candidates can get grants from Brazilian funding agencies.