



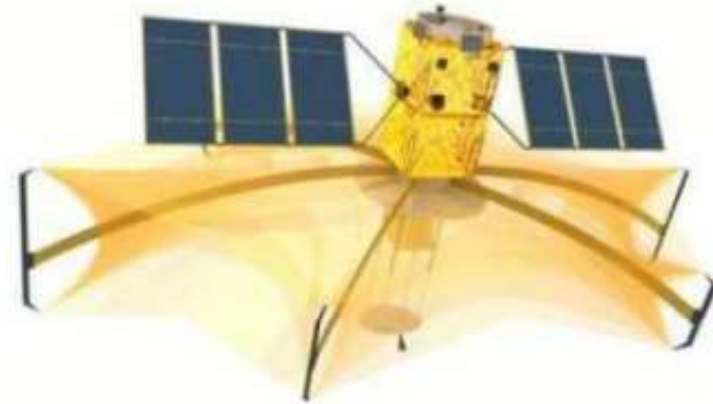
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÃO
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

Education and Research Activities Related to GNSS Performed in the Graduate Program in Engineering at INPE

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INPE (National Institute for Space Research, Brazil) - MISSION



- To promote and evaluate research, technological development and human capability in the field of space activities and their applications.
- To contribute towards the country's scientific, technological and industrial development, monitor its agricultural and environmental resources and help to promote sustainable development and improvements to the population's quality of life.
- To develop, build, launch and operate the Brazilian satellites.



Indroduction

- The Instituto Nacional de Pesquisas Espaciais - INPE (National Institute for Space Research) has a group of graduate schools, with the goal of educating people at a high level in order to be part of the Brazilian space activities;
- It gives important contributions to the scientific research performed at the Institute;
- The Institute receives scholarships from federal agencies (CAPES and CNPq) and also from the Sao Paulo state foundations FAPESP.



Indroduction

- It supports researches in all space-related fields that INPE is involved and it has been forming researchers for the whole country, helping to create new groups, in particular in satellite applications;
- Its programs is usually very well evaluated in the Brazilian ranking (made every four years by CAPES);
- It started working in 1968 and graduated around 3000 students.



Internationalization (PrInt Program)

CAPES Grant Call No. 041 / 2017

Main Objective:

Select proposals for internationalization actions from any Brazilian university or research institute with graduate courses

Overall Budget:

Up to R\$ 300 million / year

Duration of the Grant:

5 years (2019 - 2023)

<https://www.capes.gov.br/cooperacao-internacional/multinacional/programa-institucional-de-internacionalizacao-capes-print>



Internationalization

Specific Objectives

- Promote development, implementation and consolidation of a strategic plan for the internationalization of the Institute's graduate courses based on **seven priority thematic areas**;
- Maintain and expand the existing international research networks at INPE as well as foster the creation of novel networks to improve the academic production quality;
- Expand the internationalization actions, fostering research projects in cooperation to institutions abroad;
- Maintain and expand the academic training of human resources through the exchange of professors and students, with emphasis on doctoral students, postdoctoral students, from Brazil to abroad and vice-versa;
- Expand and consolidate INPE as an institute with an international environment;
- Integrate several actions of each graduate course to support INPE's internationalization effort.



Graduate Programs - INPE

- Astrophysics
- Applied Computation
- Earth's Science
- Space Engineering and Technology
 - ✓ Space Mechanics and Control
 - ✓ Combustion and Propulsion
 - ✓ Sciences and Tec. of Materials and Sensors
 - ✓ Eng. and Management of Space Systems
- Space Geophysics
- Meteorology
- Remote Sensing



General rules

- The usual requirements and duration are:
- 1) 2 years for the master program, with 8 months spend in classes and 16 months in research. A Thesis is required. It is necessary to complete the undergraduate course to start the program;
- 2) 4 years for the doctoral program, with 12 months spend in classes and 32 months in research. There is also a "qualifying examination", covering all aspects of the main courses. A Master degree is usually required to start the doctoral program.



Average Numbers along the Time

Professors:

- . Total: 270
- . Permanent: 200
- . Collaborators: 70

Regular students:

- . Total: 550
- . Brazilians: 500
- . Foreigners: 50

About 10% on international students, looking for increases for internationalization;

Several classes started to be in English.



Graduate Program in Applied Computing - CAP

- Research in Applied Computing for applications in Space Geophysics, Astrophysics, Remote Sensing, Meteorology, Earth Science System.
- Evaluated by CAPES with grade 5 (from 1-7) as an interdisciplinary program.
- 21 faculty, 70+ students, 620+ graduates.



Areas of expertise

- Modeling and Simulation of Complex Systems.
 - Image Processing and Geographical Information Systems.
 - Data Science/Applied Artificial Intelligence.
 - High-Performance Computing.
 - Applied Mathematics.
- Related to INPE's missions and projects.
- Students can be co-advised by other areas' researchers).



Postgraduate studies in Astrophysics at INPE



<http://www.inpe.br/posgraduacao/ast/en/>

[Online application](#)



[High quality publications](#)



Research areas



Cosmology



Gravitational waves



High energy astrophysics



Optical and infrared astrophysics



Earth & Space Data Modeling and Analysis

Graduate Courses: CAP, ETE, MET, SER, CST, GES, AST

Countries: South Africa; Germany; Argentina; Canada; Chile; China; Cuba; Spain; U.S; France; Netherlands; India; Ireland; Italy; Japan; Mexico; Portugal; UK; Russia and Sweden.

Description: Space & Earth data allow the understanding of Earth and Space as dynamic systems composed of subsystems (such as the atmosphere, forests and urban areas, geosphere, oceans, interplanetary environment, etc) that interact at different spatial and temporal scales. **These data are used in applications for the systematic monitoring of environmental resources with impact on health, urban development, food security and to monitor impacts and changes in climate and the environment.** These data are collected by sensors of different types and characteristics, which are created and deployed to help understand the measured systems through the application of scientific knowledge.



Heliophysics

Graduate Courses: GES, AST, CAP, ETE, MET, SER

Countries: South Africa; Germany; Argentina; Australia; Austria; Belgium; Canada; Chile; China; Cuba; Spain; U.S; France; India; Italy; Japan; Mexico; Nepal; Nigeria; United Kingdom and Sweden.

Description: Heliophysics can be understood as an extension of Geophysics. It focuses on the interconnections between the Sun, interplanetary space and the planets. It aims to qualify, in an international standard, personnel from engineering and exact sciences to work on research, development and teaching at Universities and research institutes, as well as R&D in private companies. Of special interest are the disciplines related to solar physics, planetary physics, interplanetary medium, magnetosphere, ionosphere, atmosphere and planetary magnetic fields of Earth and other bodies.



Tropical Meteorology

Graduate Courses: MET, SER, CST, CAP, GES

Countries: Germany; Argentina; Australia; Bolivia; Cape Verde; Canada; Chile; Colombia; Cuba; Spain; U.S; France; Netherlands; India; Israel; Italy; Japan; Mexico; Paraguay; Peru; UK; Sweden and Switzerland.

Description: The region of South America is located mostly in the tropical region, where meteorological systems that interact with the Amazon rainforest, the largest tropical forest in the world, prevail. The interaction between tropical and mid-latitude systems makes the theme unique and with great internationalization potential. Brazil has one of the largest collections of observational data from the tropical region, mainly from field experiments, with emphasis on the Amazon. Research using this datasets jointly with parametrization of numerical models by the best specialists allows INPE to be a pole of research in the area of tropical modeling.



Satellite Applications for Sustainable Development

Graduate Courses: SER, ETE, CAP, MET, CST

Countries: South Africa; Germany; Argentina; Australia; Austria; Belgium; Canada; Chile; China; Colombia; Denmark; Spain; U.S; Finland; France; Netherlands; India; Ireland; Italy; Japan; Mexico; Norway; New Zealand; Peru; Poland; Portugal; UK; Russia; Sweden and Switzerland.

Description: In the global discussions of environmental change, sustainable development, health and food security, Brazil has a leading position in the development of satellite monitoring of natural resources and associated geoprocessing techniques, development of technologies for image processing, analysis of satellite data and derivative services. **The competent acting of the leaderships in this thematic line, through the development of state-of-the-art knowledge, will strategically assists Brazil to fulfill its international targets that includes identifying and implementing actions on mitigation; impacts, vulnerabilities and adaptation; research and development; as well as education, training and communication.** These actions will also have a direct impact on the National Strategy for REDD+ in Brazil (ENREDD+), which formalizes actions to prevent and control deforestation, forest degradation, and to promote sustainable development.



GNSS Activities

The course in Space Engineering and Technology has been working in activities related to GNSS for many years.

Among these activities, some are related to the space system itself, like orbit determination of satellites, orbital maneuvers, attitude and orbit control, etc.

There are also studies related to applications, like the use of a space qualified receiver of one of the GNSS systems inside a user satellite, to make a more accurate orbit determination of this satellite.



GNSS Activities

Thesis and Dissertations about those topics have been developed in the Institute for a long time.

In more recent years, studies related to the discard of the satellites belonging to a GNSS system, at the end of their lifetimes, are under way.

Some proposals using the solar radiation pressure to de-orbit a GNSS satellite have been made, with interesting academic and practical results.



GNSS Activities

Collaboration with INPE Academic:

There are no tuitions fees;

It is possible to have students from abroad for full or partial programs;

Students of full programs can have scholarships;

It is possible to pay for Brazilian students to make full or partial programs abroad;

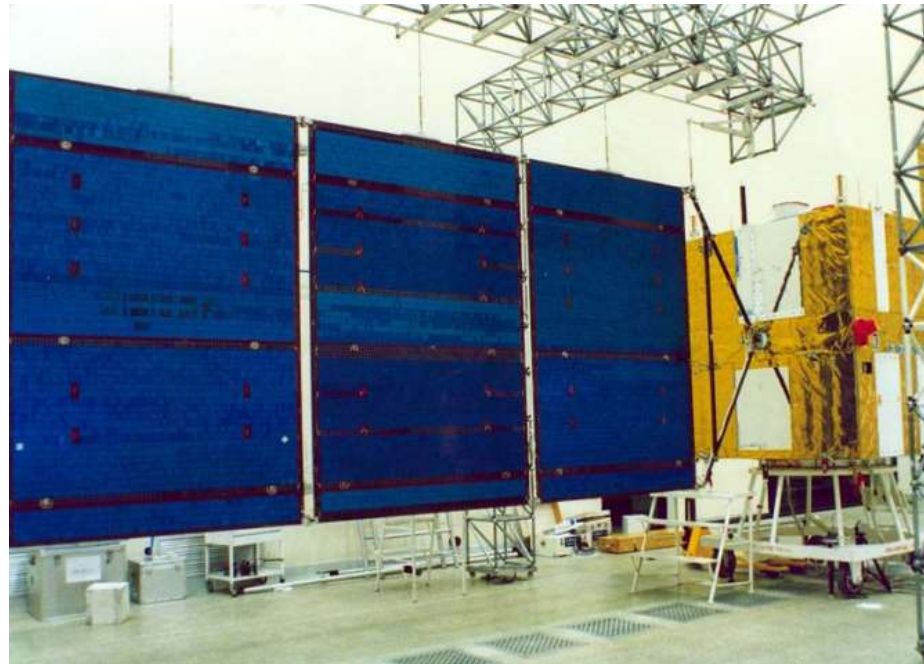
It is possible to pay exchange of professors in both directions (send and receive).



International Projects

It is possible to have international projects for basic and applied research, as well as development of large structures like satellites;

Example: There is a long project with China for the CBERS satellite series;





International Projects

CBERS: China Brazilian Earth Resource Satellite

The CBERS program was born from a unique partnership between Brazil and China in the space technical scientific sector.

It is a powerful tool to monitor the huge territories with remote sensing satellites.

The CBERS program looked at first for only two remote sensing satellites, CBERS-1 and 2.



Final Remarks

The Graduate Studies Program at INPE pervades every area in INPE.

It gives support to research in space-related fields of knowledge in INPE and has been forming researchers for the whole country.

It is very well-positioned in the Brazilian rank (CAPES), usually in the top 5 institution of the country.



Final Remarks

Conclusions INPE is an Institute devoted to space research;

It has engineering and academic activities;

There are possibilities of collaborations in both aspects;

Contact: www.inpe.br.