INPE Space News

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CHINA AND BRAZIL INTENSIFY COOPERATION IN SPACE

At the end of 1993, the construction of two earth resources satellites by Brazil and China received a new and definitive impulse that will guarantee the successful conclusion of the joint program. The signing of the contract for the launch of the satellites; the visit of the president of the People's Republic of China, Jiang Zemin, to Brazil, in November 25, 1993; and seven new contracts with Brazilian industries, were the visible signs of the vitality of the program which goes under the name of the China-Brazil Earth Resources Satellites (CBERS).

The agreement for the construction of the two CBERS satellites was signed in July 1988. Brazilian participation in the construction of the satellites corresponds to 30% of the whole program, and INPE is in managing the project on the Brazilian side. The Chinese Academy of Space Technology (CAST) is responsible for 70% of the CBERS program. The total cost for the construction of the two satellites is estimated at US$ 150 million, including launching services.

The first CBERS satellite is scheduled to fly in October 1996. It will be launched from the Shanxi Launch Base by a Chinese Long March rocket, capable of carrying up to 3,000 kilograms - the CBERS satellite weighs 1,400 kg. The contract for the two CBERS launches was signed in November 1993, in Beijing, between the Brazilian Ministry of Science and Technology and the Chinese Great Wall Co. Brazil will pay US$ 15 million for the launches and, according to the contract, China will guarantee a 100% commercial counterpart to the Brazilian side. This will include the commercialization of high-tech products from Brazil to China, such as aerospace items, through a trade agreement that will be coordinated by FINEP (Financiadora de Estudos e Projetos), the financial agency of the Ministry of Science and Technology.

The contract mentioned above also allows INPE to include 60 kilos of extra payload on the rocket that will place CBERS in its 778 kilometer orbit. As a piggy back payload INPE will launch a scientific micro-satellite that will be developed in conjunction with other Brazilian scientific organizations.

Between December 1993 and January 1994, INPE celebrated the signature of seven new contracts with Brazilian industries for the fabrication of CBERS equipment. These include the spacecraft antennas; the UHF transmitter and duplexers; the environmental data collection transponder; the regulators and converters for the power supply subsystem; the solid state power amplifier-SSPA (for image transmissions); and the satellite mechanical structure. Brazilian industries are already working on the following CBERS equipment: solar panels; on-board computers; service telecommunication transponders; and a 200-meter resolution wide-field of view (WFI) camera to cover areas 900 km wide. In the case of Brazil, this camera will cover the whole country every four days.

The Chinese are responsible for the development and fabrication of the following CBERS devices and subsystems: hydrazine thrusters, gyroscopes, reaction wheels, horizon and solar sensors for the attitude and orbit control subsystem - which will assure a pointing accuracy of 0.5^{o}; a high resolution CCD multispectral camera (20 m, 5 bands); an infrared multispectral scanner with a resolution of 180 m and 22 days repeat cycle; tape recorders to store imagery onboard; thermal control subsystem; and service telecommunications.

In 1993, INPE's budget for the CBERS program was US$ 21 million. This year, CBERS will take US$ 10 million of INPE's total budget (not including personnel costs), which is of the order of US$ 40 million.

MESSAGE FROM THE DIRECTOR

Just about one year ago we experienced at INPE one of the most important moments that an organization dedicated to space research can expect - the launch of the first satellite developed by the Institute. Although this has already become routine for many nations, this is certainly not the case for developing countries like Brazil. If we also consider that the most active space fairing countries are presently going through difficult times, with severe economical restrictions forcing them to shrink some initially ambitious space programs, then our struggle to continue the Brazilian space program can be well understood. Although progress is not as fast as we would like, the program is certainly growing on a persistent and continuous basis. The MECB and the CBERS satellite programs, as detailed in this newsletter, are the most relevant examples that it is possible to achieve a considerable level of advancement in the space field, compatible with our country's social and economical needs and, most important, that two countries so far apart, both geographically and culturally, can develop a mutually gratifying program in space.

We start the year of 1994 with great expectations for the Brazilian space program. Our industry is beginning to respond positively to the manufacturing requirements of the space sector. We are quite sure that during this decade, Brazil will start to be looked upon as a very viable partner for space technology initiatives, especially those that involve the development of small spacecraft, which is a must for the space sector at this time. The ECO-8 project (Equatorial Low Orbit Communication System), that we are just beginning to develop, has already caught the attention of many Brazilian and foreign potential partners, which shows that we are on the right track. We understand that nowadays there is no way to undertake any of these activities alone, and this is true for all countries active in space. International cooperation, we believe, must be the basis for space activities today.

Marcio Nogueira Barbosa
Director

SCD1 COMPLETES ONE YEAR IN ORBIT

In February 9, 1994 - after 5250 revolutions around the Earth - the Satélite de Coleta de Dados 1 (SCD1), the first Brazilian made satellite, completed its first year in orbit. Since its launching from Kennedy Space Center (Florida, U.S.A.) by a Pegasus rocket in 1993, the SCD1 has presented an excellent performance in orbit. The SCD1 is a data relay satellite and the first of a series of four included in the Missão Espacial Completa Brasileira - MECB (Brazilian Complete Space Mission).

INPE's Data Collection Mission Center, located in Cachoeira Paulista, in the state of São Paulo (100 km from São José dos Campos, on the way to Rio de Janeiro), has been receiving daily data from its pilot network of data collection platforms (DCPs). INPE's network includes 30 DCPs that are being used for experiments in the areas of meteorology, oceanography (tides and maritime currents), atmosphere chemistry and tropical forests. There are 10 DCPs being used for the monitoring of reservoir water level in Ceará, which is one of the states in the northeast of Brazil that has frequent droughts. The present number of DCPs relaying data to the SCD1 satellite will increase considerably this year with the installation of around 250 new DCPs, which will be used mainly for the monitoring of Brazilian hydrographic basins and in flood control.

The MECB Ground Segment is responsible for the control of the SCD1 in orbit, and for the reception and dissemination of DCP data. This service includes the ground stations of Cuiabá (in the state of Mato Grosso, geographic center of the country) and Alcântara (in the state of Maranhão, north of Brazil); the Data Communication Network; the Satellite Control Center, in São José dos Campos; and the Mission Center, in Cachoeira Paulista. The monitoring of the SCD1 operation in orbit shows a performance much better than expected. Reduction in spin rate is less than expected, and the degradation of the solar panels is also slow, resulting in a more than adequate power supply for the satellite's electronics. As yet the satellite's batteries show no significant drop in performance . The predicted lifetime for the SCD1 was one year but, as a result of the excellent performance of the satellite in space, INPE's engineers predict one more year of operation for the SCD1 in orbit. The second MECB satellite, the SCD2, is now in its integration phase and it will be ready for launch by the end of 1994.

The successful completion of the SCD1's first year in orbit was celebrated during the "International Symposium on Spacecraft Ground Control and Flight Dynamics", which took place in São José dos Campos, between the 7th and 11th of February, 1994. The event, organized by INPE, brought together specialists from various countries and organizations such as ESA, CNES (France), DLR (Germany), ISRO (India), Matra (France), NASDA (Japan), the Russian Academy of Sciences, the Chinese Academy of Space Technology, APL (U.S.A.), and other Brazilian and foreign organizations and universities.

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REMOTE SENSING USED TO STUDY ONE OF BRAZIL'S MOST IMPORTANT ENVIRONMENTAL RESERVES

Since the second semester of 1993, INPE and the Brazilian Company for Agriculture and Cattle Raising Research (EMBRAPA) are working together to evaluate the use of remote sensing techniques to study the natural resources of the Pantanal, the Brazilian swampy central region that is considered one of the world's main ecological reserves and an area with exceptional biodiversity. The project will be concluded in the second semester of 1994, when the researchers from the two organizations will present the results of their work. It is expected that these will include important tools for use by both research institutions and private companies, to undertake reliable environmental studies on the Pantanal, a region of difficult access which is still poorly known.

For the Pantanal study INPE is using aerial photography, airborne radar and orbital data from the Landsat 5, SPOT, NOAA, and ERS-1 satellites. Three areas have been chosen for study from a region that is characterized by a great number of lakes, covering a total of 90 km^2. The researchers are evaluating the response that the sensors obtain from parameters such as green vegetation cover, land use, geology, geomorphology, urban usage, and humidity variation. They are also undertaking studies of climatology in the region. The best months for field work are September and October, since this is the driest period in the Pantanal. During the rest of the year the lower part of the region remains flooded. Cattle raising is the only economic activity in the lower part of the Pantanal.

EMBRAPA is responsible for providing support for a number of important economic activities in the Pantanal, including agriculture and cattle raising, besides the preservation of the environment of an area that covers approximately 140,000 km^2. The success of Pantanal entrepreneurs depends on an adequate understanding and management of natural resources in a region where human activities must be adapted to the annual flood cycle.

The Pantanal region is an environment that is fragile and difficult to recover when damaged. For this reason it is very important to gather as much environmental data as possible, data which will contribute to the achievement of a balance between preservation and the economic development of the region. The difficult access by land makes field work very slow and expensive. Aerial photography and satellite imagery provide data at lower cost and with a much shorter lead time than in situ studies.

UNEP LATIN AMERICA ENVIRONMENTAL INFORMATION AVAILABLE AT INPE

All the information on the Latin America and the Caribbean environment stored at the Global Resources Information Database (GRID) from the United Nations Environmental Program (UNEP), are now available at the GRID installed at INPE, in São José dos Campos, SP, Brazil. Until last year, these magnetic tape data could only be requested directly from UNEP's headquarters, in Nairobi, Kenya.

The GRID/INPE database was inaugurated in May 1993, and already has the following data available to users: 1) INPE's file with all the images from the meteorological satellite METEOSAT-3 on Brazil; 2) weekly reports of burning areas in Brazil since July 1993, using data from the NOAA environmental satellite; 3) the MetaDataBase, with localization pointers for technical-scientific data on the global environment.

The GRID-INPE database can be accessed through Internet. The user must have a computer which can access Internet, and should use anonymous FTP (file transfer protocol) with "grid.inpe.br.". Requests for GRID-INPE or MetaDataBase data sets can be made by fax (+55 123 21 8743), mail (INPE, GRID, C.P. 515, São José dos Campos, SP, 12227-010, Brazil), or by electronic mail (grid@dpi.inpe.br.). The person responsible for GRID-INPE is the engineer Danton Nunes.

MASCO TELESCOPE WILL STUDY RAYS FROM COSMIC SOURCES

INPE's Astrophysics and Mechanics divisions are developing a telescope for the observation of X and Gamma rays in our galaxy. The telescope named MASCO, weighing 1.5 tons, and with a height of 5 meters, will be carried to a height of 40 km by a stratospheric balloon. The project will be concluded in about one year and its estimated cost is US$ 300,000.

One of the major obstacles for research in this area is the difficulty of obtaining X and Gamma rays images from cosmic sources. Last year INPE researchers carried out successful tests of the X Ray Imaging Telescope (TIMAX), also developed at INPE. TIMAX served as a prototype for MASCO, which will have 10 times the imaging resolution of its predecessor.

The X rays to be observed, at energies up to 100 keV, result from transitions between electronic energy levels. The Gamma rays in question, with energies greater than 100 keV, result from reactions that take place within the atomic nucleus. The main purpose of the research is to study the regions of the Universe and the objects where these processes take place.

It is fortunate that the opacity of the atmosphere prevents X and Gamma rays from reaching the Earth's surface, where they would be harmful to living organisms. As a result of this atmospheric absorption, X and Gamma ray research must be carried out with the use of satellites, balloons or rockets that can carry instruments above most of the earth's atmosphere. These rays occupy a considerable portion of the electromagnetic spectrum and they can reveal more about the physics of an object than does the optical spectrum. The radiation in question is basically the same as that used for medical X-ray imaging and in industrial applications, such as the identification of defects in solid materials - bubbles in steel plates for example.

Brazil, and especially its southern region, offers a privileged geographic location for these studies. The country is right below the Milky Way and thus provides an ideal viewing point for studies of the galactic center, where the concentration of X and Gamma ray sources is a maximum.

INPE DEVELOPS NEW SATELLITE SYSTEM

The consolidation of the MECB and the CBERS satellite programs, dedicated to environmental data collection and monitoring of earth resources, has served as the basis for the planning of a new satellite system being developed by INPE, for use in mobile remote communications and earth observation systems, relevant to the sustainable development of remote regions of Brazil. The Equatorial Low Orbit Communication System, or ECO-8 as it is already being called, will include eight light satellites in an equatorial constellation at 2000 km.

The system was conceived to provide communications for equatorial countries. It will cover an equatorial belt between the latitudes of 30° south and 30° north, an area which includes all the remote regions near the equator, where low orbit communications can play an important role. With ECO-8, low cost handheld equipment and real time communications, will allow flexibility for communications in remote areas. Equatorial countries are in a privileged geographical position for low orbit communications. In the case of ECO-8, the 8 spacecraft will cover the whole equatorial band in real time, while similar systems elsewhere need up to 80 satellites to cover the whole globe. The system will benefit around 1 million intermittent users, give logistical support to forestry, medical and scientific missions, and could even be used for logistical support for drug enforcement agencies in remote areas of Latin America.

The cost of the whole system is estimated at US$ 250 million. During the past two years, INPE's Division for the Development of New Satellites worked on viability studies for the ECO-8 system, with the aim of confirming its technological and economical feasibility. At the moment, the program is being analyzed by the Brazilian Commission for Space Activities (COBAE) and by Telebrás (a state-owned telecommunications company). The launch of the first satellite of the ECO-8 system could take place as early as 1996.

DEVELOPMENT OF DIAMOND FILMS FOR SPACE AND INDUSTRY

In cooperation with universities and Brazilian industries, INPE is developing a project denominated "Growth of Diamond Films", for the fabrication of synthetic diamonds for multiple industrial and space applications. The project started during the first semester of 1990, when INPE and the State University of Campinas (UNICAMP) created a group for research into diamond growth. This is still the only research group in Brazil dedicated to the growth of diamonds by the method known as "chemical vapor deposition - CVD". This method produces diamond films from a mixture of hydrogen and methane passed through a reactor under controlled conditions. The diamond begins to appear on a surface that starts 5 mm from the region activated by the reactor. The fabrication of artificial diamonds can also be obtained at high pressures and temperatures, but the best properties can only be obtained by the CVD method, currently in use in a number of countries, especially Japan and the U.S.A.

Diamond, the hardest substance found in nature, started to be produced synthetically around the middle of this century. Its main properties include a thermal conductivity 5 times better than copper, leading to its use in semiconductor fabrication, optical transparency from the ultra-violet to the infra-red, and chemical inertness. With these qualities diamond becomes an excellent material for use in various applications such as a heat sinks in semi-conductor lasers and microelectronic circuits, and protective layers on optical components (such as spacecraft solar cells), and infrared detectors.

At the moment, the joint research group at INPE and UNICAMP is studying the use of CVD diamonds for dentist's drills. The group is also working in cooperation with three other Brazilian universities, and a number of industries interested in the use of synthetic diamonds.

GEODETIC VLBI TERMINAL OPERATING IN THE NORTH-EAST OF THE COUNTRY

INPE and other Brazilian organizations are operating a space radio-observatory that consists of a geodetic VLBI (Very Long Base Interferometry) terminal, forming part of a worldwide network. This terminal, installed in 1993, at Eusébio in the northeast of Brazil (state of Ceará), can be considered as one of the most important of its type, since it serves as a geodetic link between the continents of North America, Europe, Africa and the Antarctic. The Brazilian geodetic VLBI terminal is part of the International Radio Interferometry Survey (IRIS), coordinated by the International Earth Rotation Service (IERS). The space geodesy global program, making use of VLBI, is essential for many applications such as in cartography, precision navigation and geodesy, as well as for research programs that involve irregularities in the Earth's rotation, geodynamics, plate tectonics and seismology, and quantitative evaluation of global changes.

The terminal consists of a complete VLBI system including a 14.2 m (diameter) antenna; a hydrogen maser standard; a VLBI MK III processor; and a cryogenic receiver for S and X bands. The system also has a complete GPS (Global Positioning system) station, making possible the intercomparison of parameters derived from VLBI and GPS.

The Eusébio space radio-observatory is the result of a joint effort started in 1988-1989. The organizations involved on the US side are the National Geodetic Survey, currently the Geoscience Laboratory (U.S.A.), and the National Ocean Services, a branch of NOAA (U.S.A.). On the Brazilian side are the Polytechnic School of the University of São Paulo, the Radio-Astronomy Center for Space Applications (CRAAE), coordinated by three universities - USP, UNICAMP, and Mackenzie - and INPE. CRAAE was responsible for the installation of the radio-observatory at the Eusébio station belonging to INPE.