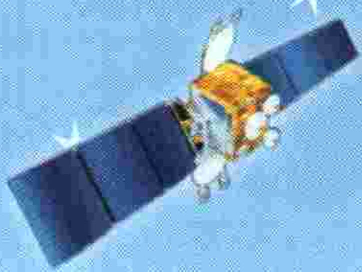

Space Applications Centre - A perspective

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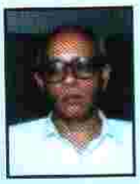


Introduction

The Space Applications Centre of Ahmedabad, one of the major centres of Indian Space Research Organisation, Department of Space, was established in 1972 with a view to carry out research and development in the field of space applications. As the lead centre for harnessing space technology for national development, Space Applications Centre (SAC) has been conceiving and demonstrating new applications using space technology and helping to operationalise these. The centre is also engaged in the areas of development of sensors in optical, IR and microwave regions for remote sensing of earth resource survey, meteorology and oceanography; transponders for telecommunications and TV broadcasting, ground hardware/software and application methodologies in close interaction with user community in the country. For successfully carrying out these activities, the centre has developed necessary infrastructure in a campus spread over 95 acres of land with a staff of about 2200 including technical/ scientific and administrative manpower.

To effectively discharge the above responsibilities SAC is organized into various areas and groups. The areas and groups are also periodically reorganized to cater to the new projects and activities.

Satellite Communication

Recognising the important role of space communications in nation building, an Experimental Satellite Communication Earth Station (ESCES) was established in 1967 at Ahmedabad (now part of SAC). It was an experimental Earth Station and training centre where scientists and engineers of India and other developing countries could receive training and first hand experience in the design, development and operations of an earth station for communications and broadcasting. A large number of international training courses have been conducted since then.

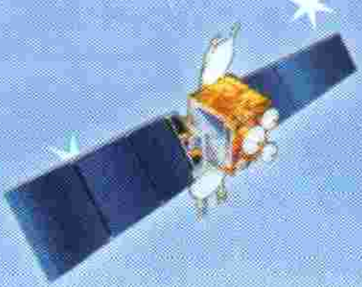
One of the earliest projects carried out at SAC was a unique experiment called the Satellite Instructional Television Experiment (SITE), conducted during 1975–76 utilising the American ATS-6 satellite. It involved telecasting educational programmes aimed at socio-economic upliftment of rural India, to 2400 villages - spread over six states - through experimental Direct Reception Sets. SAC handled total responsibility of the project including deployment/maintenance of sets, programme production, telecast and social research to evaluate the impact of the programme.

With a view to developing new satellite communications techniques a project called Satellite Telecommunications Experiments Projects (STEP) was carried out with the Frenco-German satellite, Symphony. As part of STEP, SAC delivered in 1977-79 the first Transportable Remote Area Communications Terminal (TRACT) for establishing a direct link with satellite at locations where no earth station was available nearby and an Emergency Communications Terminal (ECT), to be deployed to establish communication link during a disaster.

The first experimental communication satellite APPLE was designed, fabricated and qualified at SAC. It was launched onboard the first experimental flight of the Arianne. An exhaustive communications application programme called the APPLE Utilisation Programme (AUP) was also conceived and carried out simultaneously.

The INSAT-1 series of satellites was custom designed and made as per the unique requirements of the country by a US company. The INSAT –2A, 2B, 2C, 2D and 2E, launched in the years 1992, 1993, 1995, 1997 and 1999 respectively, were designed, fabricated and qualified in house. The INSAT –2A and 2B satellites carried 12 C band communication transponders, 6 ext. C band transponders, 2 high power TV broadcast transponders in C (Uplink)/S (downlink) bands, a VHRR in visible and IR bands, a data relay transponder and a search and rescue distress alert transponder. The INSAT 2C and 2D satellites had 12 C band transponders comprising of 2 transponders with expanded coverage, 7 transponders with higher eirp and 2 with eirp equivalent to INSAT 2A, C-band transponders. These also have 6 ext. C band 3 Ku band transponders, one Ku band beacon, one transponder each in S band (Broadcast Satellite Service) CxS band (Mobile Satellite Service) and SxC (return). It is worth noting here that eleven transponders onboard the INSAT –2E were leased to the international INTELSAT group even before its launch.

Several new technologies, such as thin wall invar multiplexers, Solid State Power Amplifiers, integrated receivers, etc have been developed. New design capabilities have



also been developed both in hardware and software for improved antenna coverage, cross polarisation and better beam shaping, onboard regenerative payload, etc. Work on definition of future generation communication satellites in INSAT-4 series and for realising satellite payloads to be launched on board experimental flights of Geosychronous Satellite Launch Vehicle (GSLV) has been in full swing. Many of the INSAT-3 series satellites have been launched and a few are in the pipeline..

Under the SATCOM and IT applications programme, the development of all hardware and software like DSDB receiver for digital sound and data broadcast and hybrid internet, envisaged under GAP-1, has been successfully completed and demonstrations carried out using INSAT. A number of spin-off applications of DSDB for information dissemination were also developed and demonstrated. Users like the All India Radio (AIR) and India Meteorology Department (IMD) have evinced keen interest in the use of DSDB for their programmes. In the area of Mobile Communication, the handheld MSS was integrated with GPS and demonstrated for fleet management applications. MSS was also interfaced with DCP and tested successfully with INSAT. SAC also provides technology development and operations support for the successful conduct of JDCP and TDCC.

Remote Sensing Activities

The remote sensing activities in the country were initiated through utilisation of aerial and Landsat imagery for resources application in early 70s. Activities were also carried in the field of meteorology with available data from foreign satellites and from indigenously developed airborne thermal Scanner. All the remote sensing activities so far can be divided into three Phases, viz. Experimental Phase, Semi-Operational and Operational Phase.

The first phase saw the development of airborne thermal sensors such as Infrared (IR) scanner, multispectral scanner, linear Charge Coupled Device (CCD) camera, Side Looking Radar, Colour Infrared (CIR) based photographic systems and a number of photo interpretation and ground truth equipment which were later productionised through technology transfer. Landsat data were fully utilised since 1973 to learn space based Remote Sensing applications. For all these sensors, efforts were made to also define and develop data products systems.

A strong applications programme was evolved around these instruments. Foundations for space borne sensors were laid during this period. Under Satellite for Earth Observation (SEO) programme, 2 satellites called Bhaskara satellites after their Launch onboard

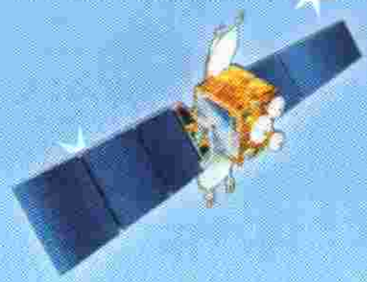
Russian launch Vehicle, carried a 1 km resolution 2 band TV camera system and a three channel microwave radiometer. These were designed, developed and successfully qualified inhouse. The programme was a resounding success and formed the basis for the advanced sensor development leading to operational applications. Users were also activated for utilising remote sensing data from satellite based sensors.

During the second phase the IRS –1A programme was successfully launched and the users started receiving multispectral imagery with 36m resolution. Professionalism was brought into the design of sensors, data products and applications projects. Major applications in agriculture, hydrology, geology and other areas were defined in close interaction with user agencies and the IRS utilisation programme was carried out successfully. These efforts led to semi-operational applications of IRS – 1A data.

Over these years, groups had acquired adequate expertise in high resolution sensor design, digital image handling and analysis, design of applications missions and execution of the same in close interaction with user agencies and in coordination with other ISRO/DOS centres and units. Strong foundation was also laid for airborne SAR system development, its data processing and applications. Meteorology and Oceanographic studies were carried out with data in optical and microwave region from foreign satellites.

The advanced activities carried out during the third phase in 1990s saw India at par with many other advanced nations through the design of high resolution sensors in the optical and microwave regions including a successfully flown airborne SAR system and a very sophisticated application programme tuned to our country's needs. The 5.8 m resolution Pan Camera of IRC –1C & 1D revolutionised the applications concept in the country. Being the best resolution civilian sensor in the world at that time, it attracted the attention of foreign users which resulted in the global reception of IRS data through the agreement with the American Company, Space Imaging/EOSAT. A variety of data products to meet the needs of user community were defined and developed. These are being used worldwide. The design and launch of the IRS-TES with 1 m resolution has gone a long way in redefining remote sensing with several new applications. Several new remote sensing satellites like Cartosat, METSAT, etc. are also getting ready for launch.

The applications programme got a fillip under several of the ISRO's innovative programmes like Integrated Mission for Sustainable Development (IMSD) in which SAC



played a significant role. Applications in Agriculture like Crop Acreage and Production Estimation CAPE) were operationalised which was accepted by the Agriculture Ministry as a major component in their scheme of crop production estimation. The latest collaborative programme with the user agencies, FASAL is another achievement in this direction. Numerous applications were demonstrated to utilise the sensor combination of medium resolution LISS-III sensor; high resolution Pan Camera and coarse resolution but highly repetitive WiFS imagery. Such a combination of sensors does not exist in any other operational remote sensing programme. Further, SAC scientists trained a number of scientists in user departments on advanced concepts in RS applications.

These successful ventures enabled ISRO to evolve an ambitious Remote Sensing programme for the country to have a unique constellation of satellites for resources and environmental applications. SAC has already launched the Oceansat-I which has an Ocean Colour Monitor (OCM), an optical sensor with 8 narrow spectral bands with high resolution and higher dynamic range and Multi frequency Microwave Scanning Radiometer (MSMR). These sensors have high repetivity of 2 days and hence are most suited for dynamic events in coastal and mid ocean regions. Oceanographic applications including improved techniques for delineating primary fishing zones and monitoring ocean parameters like Sea Surface Temperature (SST), wind speed etc. are planned. Another major activity underway is the development of a stereo camera with 2.5 m resolution to be flown onboard IRS-P5. Laboratory models of advanced microwave sensors such as Scatterometer and Altimeter have already been developed and the space qualified models will be developed for Oceansat-II programme. A major application programme is defined under DOD's funding at SAC for development of applications packages to derive oceanographic and atmospheric parameters using space borne sensors.

Support Groups

The success story of above programmes is written in the very active and efficient Electronics and Mechanical Support Services Groups in the Centre. These Groups provide support in almost all the fields such as fabrication facilities, Microwave Integrated Circuits, Chemical facilities and Quality Control. These are also responsible for the operation, maintenance and establishment of the electronic test, mechanical vibration test and thermovacuum test facilities. A separate group is responsible for the maintenance and calibration of the equipment.

There is an independent Systems Reliability Group at SAC that ensures that the required quality objectives are met by examining all the work in terms of electronic design, mechanical design, component selections, component applications, material selection, material applications, process selection, process qualification, software, etc. For this purpose there are well equipped laboratories and facilities that carry all the necessary tests including destructive physical and chemical analysis and X-ray tests.

Some new major facilities are scheduled to be operationalised soon including the 5.5 m Thermovacum Test facility, Integration facility for IRS P5/CARTOSAT-2, High Power Test Facility for INSAT and the Compact Antenna Test Facility (CATF). A new campus for SAC is also getting ready which would be mainly used for training facilities including those related with the CSSTEAP programs. The Meteorology and Oceanographic activities and projects would also be carried out from there.

SAC has now grown into a unique centre of space technology and applications with multidisciplinary teams consisting of experts in the fields of state of the art satellite payload design, fabrication and qualification, Earth station technology and various applications in communications and remote sensing.