अंतरिक्ष उपयोग केंद्र (इसरो)
Space Applications Centre (ISRO)

Harnessing Space Technology for Societal Benefits

अंतरिक्ष उपयोग केंद्र की गृह-पत्रिका
House Journal of Space Applications Centre

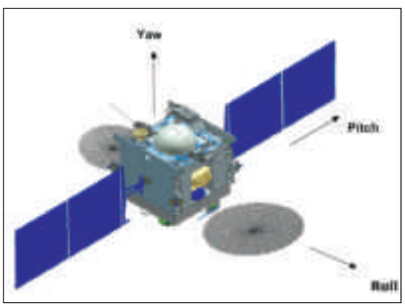
सैक कुरियर
SAC COURIER

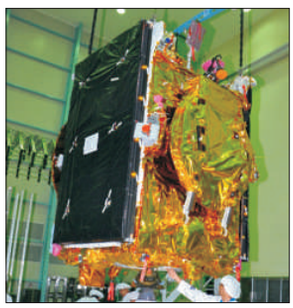
वॉल्यूम 42, अंक 03, जुलाई-अक्तूबर 2017
Vol 42, Issue 03, July-October 2017

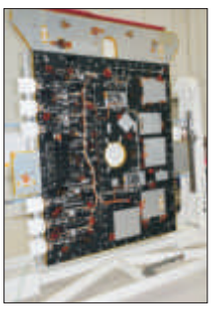
In this Issue

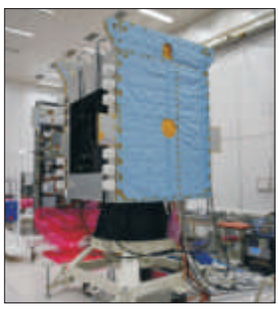
GSAT-9: Indian Satellite for South Asian Countries

SAC has flagged off GSAT-9 communication payload to ISITE, Bangalore on January 4th, 2017 for integration with spacecraft. All the payload level tests including subsystem's T&E, integrated payload test including thermos vacuum tests were successfully completed at SAC. GSAT-9 Spacecraft is a high power communication spacecraft configured using I2K bus. First time, the coverage has been provided over South Asian Countries by Indian satellite in Ku-band.

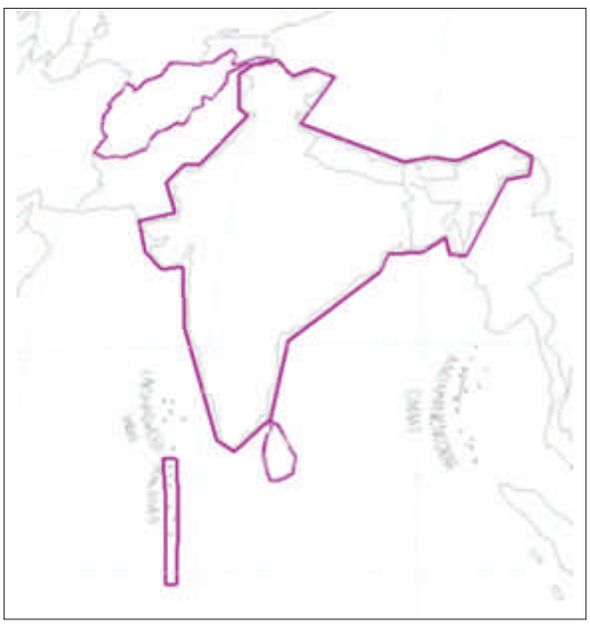








The communication payload of GSAT-9 consists of 12 Ku-Band transponders providing coverage to South Asian countries with usable bandwidth of 36 MHz.

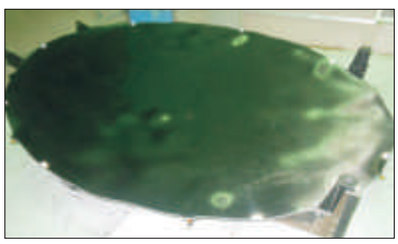


GSAT-9 will provide Fixed Satellite Services (FSS) in linear orthogonal polarization i.e. horizontal and vertical in frequency reuse manner. It will be mainly used for DTH and Ku-band VSAT services. Due to large coverage area, GSAT-9 has different EIRP and G/T over the coverage countries.

Coverage Countries	EIRP (dBW)	G/T (dB/K)
Afghanistan, Nepal, Bhutan & Bangladesh	50.5	2.5
Srilanka & Maldives	49.5	1.5
India	46.5	-1.5

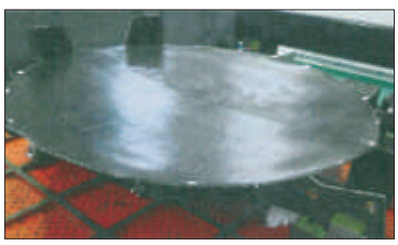
Antenna Systems

There are two antenna subsystems which cater to transmit and receive functions separately. A single shell shaped reflector of size 1.4m designed for offset fed illumination configuration will provide coverage in uplink and similar antenna of size 2x2.2 m in downlink for transponder channels. Shaping of the transmit and receive antennas is done in order to provide the shaped coverage over the desired region.

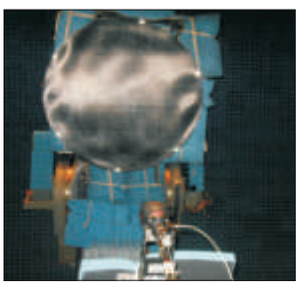


Ku-Tx Reflector Antenna: surface of fabricated antenna

Ku-Tx Reflector Antenna at SAC, CATF



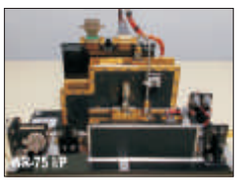
Ku-Rx Reflector Antenna: surface of fabricated antenna



Ku-Rx Reflector Antenna at SAC, CATF

Receivers

The Ku band receivers for the translating up link to down link frequency band of 11.2-11.45 GHz are designed by SAC and realized through AMPL, Hyderabad. The translation frequency is 1800 MHz.



GSAT-9 Receiver

Filters

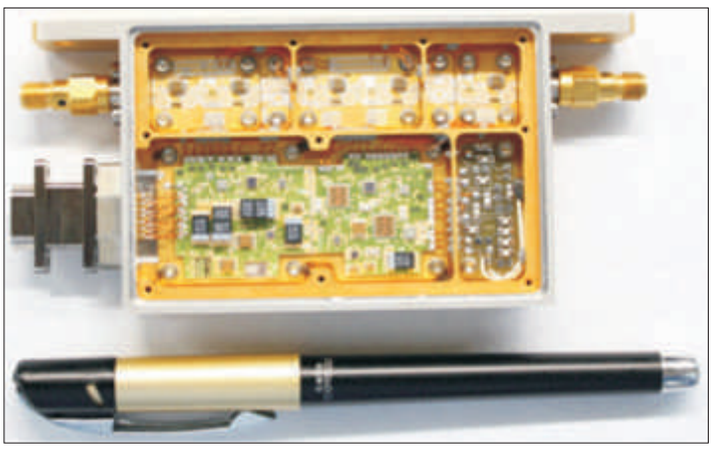
The payload consists of large number of filters including input multiplexers, output multiplexers, harmonic reject filters and passive intermodulation filters. All the filters are designed indigenously. Input multiplexers are based on dielectric resonators which results in saving of mass and volume. Ku-Band Output multiplexer uses the well-established manifold multiplexing technique, which provides the lowest insertion loss as well as the most compact size and the lowest mass in comparison to other multiplexing methods.

Input Multiplexer

Output Multiplexer

Channel Amplifiers

The Channel Amplifiers (CAMPs) are one of the important subsystems used in communication payload. These are used to provide required input drive to Traveling Wave Tube Amplifiers (TWTAs). The function of the CAMP is also on-board gain control of the transponders taking ground command or automatically depending on the input power of the transponder. Two SAC made channel amplifiers are on-board GSAT-9 along with Ten NARDA make channel amplifiers.



Channel Amplifier

Courtesy Inputs from:
Shri R. K. Metha

NOSTALGIA

Speaker : *Shri P P Kale* ***Sitting :*** *L-R : Dr. Ram Rattan, Dr. V S Iyengar, Prof. Phisharoty, Shri K Tyagarajan, Shri O P N Calla, Dr. George Joseph*

NavIC Receiver for Launch Vehicles

Introduction: Real time monitoring of Launch vehicle trajectory is very important for precise determination of Satellite Orbit at time of injection. Mainly, the trajectory of the satellite launch vehicle is determined by inertial navigation. However, the inertial sensor outputs are very noisy, hence, satellite based navigation systems like GPS, improves inertial navigation solution for launch vehicle trajectory monitoring. ISRO's launch vehicle missions use GAINS (GPS Aided Inertial Navigation) system consisting of GPS receiver and inertial navigation system. Considering successful development of 36 channel NavIC receiver, it was proposed as a candidate for replacing GAINS, starting from PSLV C-36 and it was decided to induct NavIC receiver in launch vehicle.

Basic 36 channel SPS receiver was improved for ruggedness and algorithmic changes were made to handle high dynamics (Velocity ~10.5 km/sec, jerk ~20g/sec,e tc.,). Further, the unit was subjected to PFM level T&E. As a piggyback system, NavIC receiver performed quite well in its first maiden flight of PSLV C-36 and has been subjected to several improvements with each mission. It has been used in PSLV C36-39, GSLV MK-III, HSP-PAT missions. It is further, planned to deploy the NavIC-system in all future launchers like PSLV,GSLV of ISRO.

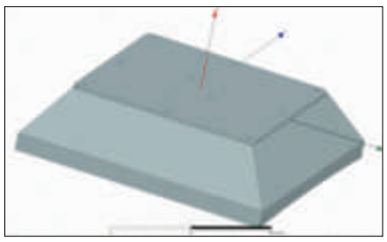
NavIC receiver (Since PSLV C-36) supports simultaneous PVT in NavIC/GPS/Hybrid modes and these outputs are fed to telemetry link and the NAINS (NavIC Aided Intertial Navigation system) processor. Considering the application, weight, size and complexity, a dual band antenna which supports both NavIC L5 band and GPS L1 band signals incorporated.

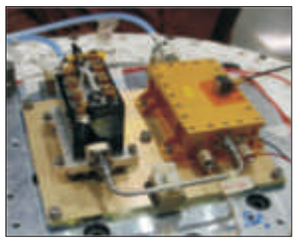
The NavIC 1553 RT (Remote Terminal) used in PSLV C-39 and other subsequent flights, has a dimension as small as 147 x 46 x 20 mm and weight of 100gms (approx). The system uses MIL-STD-1553B interface to exchange data and Sync Mode code with NAINS Processor and digital IO interface to give interrupt to NavIC-Receiver and take data over UART from NavIC-Receiver

Sub- Systems :

NavIC Rx (PSLV C-39)

NavIC Rx (PSLV C-36)





Dual band Antenna with Radome LNA+Filter Module

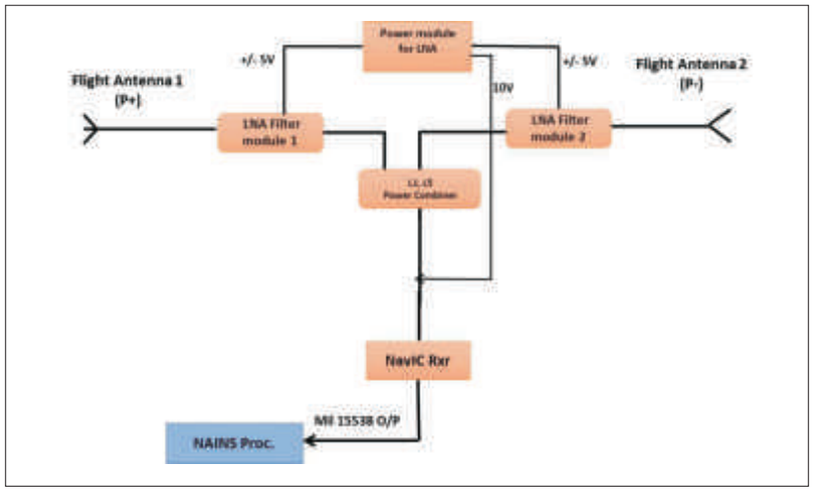
NavIC 1553 RT (Remote Terminal)NavIC Power Module

NavIC in GSLV MK-III

NavIC Sub-systems :

Sr. No	Sub-System	Size (mm)	Mass (Grams)	Qty
1	Antenna- Dual Band L5 & L1	150.4x150.4x43.4	800	2
2	Filter+LNA module	154.5x153.0x71.0	1000	2
3	Power Combiner (L5/L1+L5/L1)	70.4x53.4x16.2	250	1
4	NavIC Receiver	270.5x236.0x61.0	2500	1
5	NavIC Power Module	185.0x95.2x44.0	400	1
6	NavIC 1553 RT	147.0x46.0x20.0	100	1

Typical System Configuration :



Changes Carried out In 36 Channel NavIC Receiver to meet future launch vehicles.

For meeting launch Vehicle application requirements and based on feedback from different missions, following changes have been integrated in the original 36 channel SPS receiver.

(i) Tracking loops were changed to handle LV dynamics Velo. ~10.5 Km/sec, Acc. ~15g, Jerk 20g/sec

(ii) Implementation of efficient algorithm with additional acquisition engines yielded much improved reacquisition performance : 6-15 Sec (Typ. 10 Sec)

(iii) Monitoring of AGC gain and ADC input power, FPGA temperature, Rx health status etc. for better debugging. These data is sent through TM.

(iv) RS-485 interface was added to basic NavIc receiver hardware to interface with 1553 RT

(v) Elevation angle cut off for GPS satellites changed from -150 to 00 to avoid GPS Satellite Occultation effects on PVT

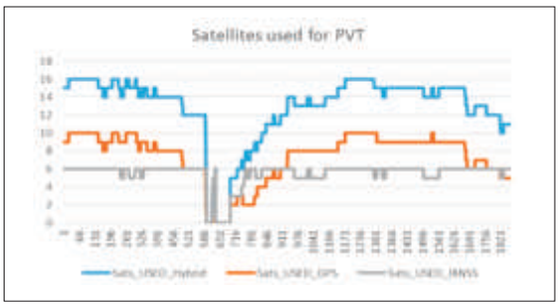
(vi) Minimum C/No value cut off for tracking set to 30 dB-Hz in order to handle spikes in Velocity outputs which were attributed to inclusion of poor quality observation in position fix.

(vii) Change in Top Cover for better heat dissipation and weight reduction. With a good thermal design consisting of copper strips and heat pipe, FPGA temperature which had gone upto 940°C was brought down to 590° C in the next mission.

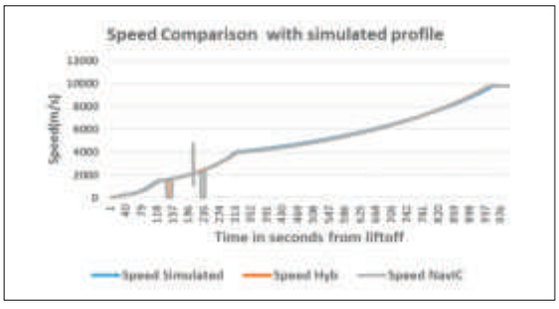
(viii) For improved heat dissipation and better thermal margins in Thermovaccum Tests, the sheet metal receiver enclosure was changed with block machining from Al Alloy. Mounting lugs were made integral part of enclosure itself.

(ix) In PSLV C-39, NavIC 1553 RT from SAC was embedded into NavIC Rx enclosure. In earlier missions, IISU supplied 1553 RT was being used.

Results : Due to very poor input signals, NavIC Rx couldn't provide position fix in PSLV C-37. In all other missions the system has worked exceptionally well. Few results of different missions are shown .



PSLV C-36

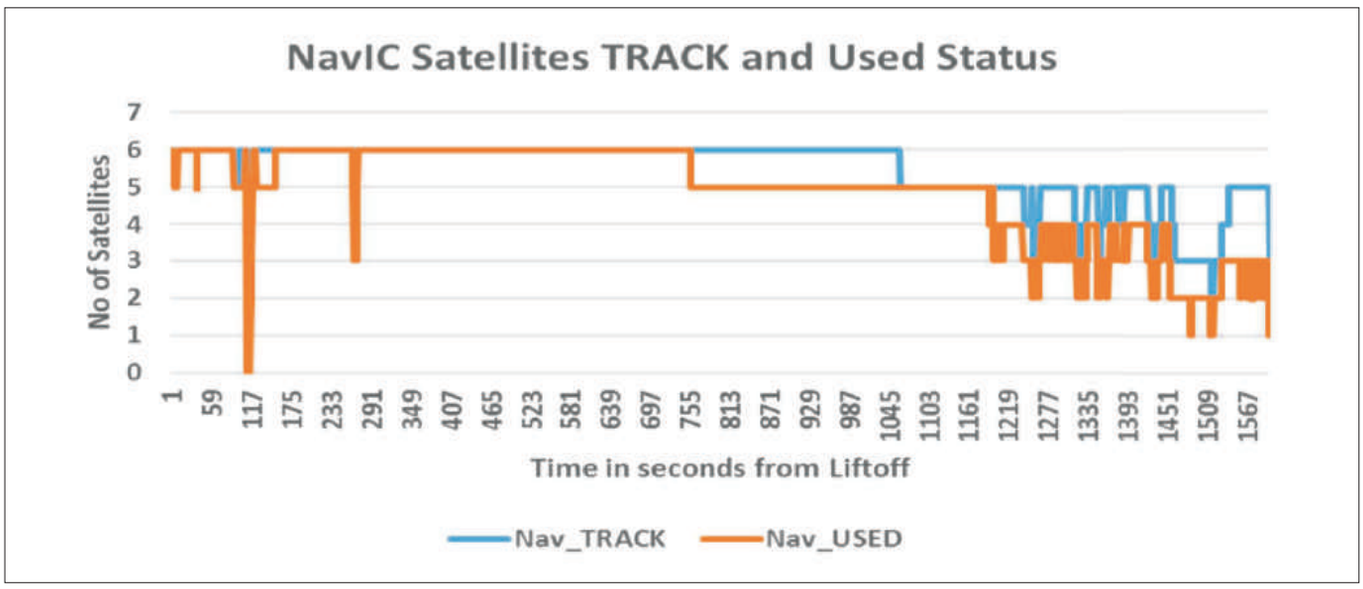


GSLV MK-III

PSLV C-39 Results :

Position Solution availability : NavIC 98.70% ,Hybrid 99.32 %

Solution Outage Instances/ Outage Time									
Event	**Time w.r.t. T0 (Seconds)**	**Position Non Availability Time (Seconds)**			**Satellite**		**Satellite Used**		
		NavIC	**GPS**	**Hybrid**	**NavIC**	**GPS**	**NavIC**	**GPS**	**Hybrid**
Lift Off	0	Position Available	Position Available	Position Available	6	10	6	8	14
PS1 Separation	+108.9	8	7	7	0	0	0	0	0
PS2 Separation	+263.5	5	Position Available	Position Available	3	7	3	7	10
PS3 Separation	+520.1	Position Available	Position Available	Position Available	6	10	6	10	16
Ps4 Shut off	+1039.3	Position Available	Position Available	Position Available	6	11	5	11	16



Conclusion : NavIC is emerging as very promising technology for Orbit determination tool and is going to be a very useful technology for different space applications like POD(Preliminary Orbit Determination) and vehicle trajectory monitoring in ISRO's LEO/GEO Satellites missions.

Coutesy Inputs From : *Shri V. K. Tank, Shri Nikhil Desai, Shri Pankaj Gupta, Dr. Raghunadh K. Bhattar and SNTD Rx Team.*

संचार उपग्रहों के लिए अंकीय लचीले बैंडविड्थ फिल्टर

सारांश: संचार उपग्रहों के लिए अंकीय लचीले बैंडविड्थ फिल्टर का निर्माण, विकास एवं परिपालन भारतीय अंतरीक्ष कार्यक्रम में किया जा रहा नवीनतम प्रयास है| लचीले बैंडविड्थ फिल्टर का उपयोग संचार उपग्रह सेवाओं में नवीन और उपन्यास है| यह फिल्टर अंतरीक्ष में विन्यासशीलता प्रदान करते हैं, जिस के कारण बैंडविड्थ का उपयोग अनुकूलित हो सकता है| आवृत्ति स्पेक्ट्रम के सी और एस बैंड भीड़ भरे हैं, जिस में बैंडविड्थ का सावधानीपूर्वक उपयोग करना अत्यंत ही अनिवार्य है| उपग्रह पर दूरादेश द्वारा इस फिल्टर के प्राचलों का चयन करने की कार्यविधि है, जो एक बढ़िया समायोजनीय फिल्टर प्रस्तुत करते है|

१. प्रस्तावना

आजकल तेजी से बढ़ती वायरलेस स्थानीय क्षेत्र नेटवर्क, सेलुलर फोन और उपग्रह संचार की दुनिया रोज़मर्रा के जीवन का एक अनूठा हिस्सा बन गई है जो अरबों लोगों तक आवाज, डेटा और वीडियो जैसे दूरसंचार अनुप्रयोगों का विशाल परिसर प्रस्तुत करते सेलुलर टेलीफोनी की बढ़ती मांग और बैंड में बढ़ते उपग्रहों की संख्या से आवृत्ति बैंड में भीड़ होती है और एनालॉग तंत्र में इन नेटवर्कों के अनुमानित विकास करने के लिए पर्याप्त क्षमता नहीं होती है, इसलिए अंकीय फिल्टर बेहतरीन उपाय प्रदान करते हैं। संचार उपग्रहों में यह अंकीय फिल्टर अपनी तेज अंतक फ़िल्टरिंग के कारण, आवृत्ति स्पेक्ट्रम में पुनः विन्यासता देते हैं। यह देश में उपलब्ध सेवाओं के लिए आवंटित कुशल आवृत्ति स्पेक्ट्रम का उपयोग प्रदान कर सकते है, उदाहरण के तौर पर- पारंपरिक एकल बीम कवरेज, एमएसएस नीतभार में, उपग्रह को निश्चित स्पेक्ट्रम सौंपा गया है| इस के खाली पड़े होने पर भी आवश्यकता के आधार पर अन्य उपग्रहों को यह स्पेक्ट्रम पुन: नियत करना संभव नहीं है, क्योंकि एनालोग चैनल फ़िल्टर की डिजाइन में बैंडविड्थ का प्राचल उपग्रह प्रक्षेपण से पहले तय कर दिया गया है। अधिकतर उपग्रहों में निर्धारित आरएफ चैनलनाइजेशन के साथ दूसरा मुद्दा यह है कि कड़े इन-बैंड रिस्पॉन्स और बैंड अस्वीकृति के प्राचल को प्राप्त करने के लिए गार्ड बैंड रखना पड़ता है, जिस के कारण फिल्टर केंद्र आवृत्ति के दोनों तरफ अतिरिक्त स्पेक्ट्रम बेकार हो जाता है| जैसेकि, जीएसएटी-१७ में कुल आवंटित बैंडविड्थ ३ मेगाहर्टज है लेकिन आसन्न बैंडों में उच्च अस्वीकृति की आवश्यकताओं के कारण, लगभग २ मेगाहर्टज बैंडविड्थ उपयोग करने योग्य है जिसके परिणामस्वरूप कुल बैंडविड्थ का लगभग ३३% अपव्यय हो जाता है।

इन समस्याओं का समाधान ऑनबोर्ड अंकीय लचीली बैंडविड्थ फ़िल्टर द्वारा किया गया है जो गार्ड बैंड की आवश्यकताओं को कम करके, स्पेक्ट्रम का कुशल उपयोग करके, अलग-अलग उपग्रहों पर स्पेक्ट्रम की मांग को पूरा कर सकता है| इस फिल्टर का निर्माण DSP तकनीक का इस्तेमाल करके FPGA में किया गया है जिस को भू-केंद्र से दूरसंदेश द्वारा उपग्रह प्रक्षेपण के बाद भी योग्य आवृत्ति एवं समायोज्य लाभ ट्यून किया जा सकता है| अतः इस प्रकार के फिल्टर बहुमुखी आवृत्ति प्रतिक्रिया प्रदान करने की क्षमता रखते है। इस फिल्टर की मुख्य विशेषताएं इस प्रकार हैं:

- दूरसंदेशों का उपयोग करते हुए लाभ, बैंडविड्थ और आवृत्ति स्थायित्व
- फ़िल्टर की स्थिति दूरमिति में प्रदान करना

इस फिल्टर के मुख्य अनुप्रयोग दूरसंचार, प्रसारण, सामाजिक अनुप्रयोग, निश्चित उपग्रह सेवाएं एवं आपदा चेतावनी, खोज और बचाव कार्य हैं|

२. अंकीय फिल्टर

उपग्रहों में अधिकतर उपयोग किये जाने वाले अनुरूप(एनालॉग) फिल्टरों को आधुनिक नमूनाकरण और डिजिटल सिग्नल प्रोसेसिंग के माध्यम से, अंकीय फिल्टरों में बदला जा सकता है खास कर उन अनुप्रयोगों में, जिनमें लचीलेपन और क्रमादेश योग्यता की आवश्यकता होती है। अंकीय फ़िल्टरों का मुख्य लाभ उनके अभिकल्प में उपलब्ध लचीलापन है; जैसे कि इन में लगभग कोई भी बैंड आकृति बन सकती है, विशेषकर खड़ी ढलान वाले प्रवण जिन्हें एनालोग फिल्टर के साथ प्राप्त करना कठिन होता है|

अंकीय फिल्टर को स्थिरता की गारंटी देने के लिए डिज़ाइन किया जाता है| इसके अलावा, वे रेखीय कला-आवृत्ति अभिलक्षण (लिनिअर फेस-फ्रीकुएंसी केरेक्टेरिस्टिक) वाले हो सकते हैं जो कि अधिकांश एनालॉग फ़िल्टर नहीं होते हैं, खासकर जब संकीर्ण बैंड या खड़ी अंतक की आवश्यकता होती है। एनालॉग फिल्टर की तुलना में अंकीय फिल्टर के निम्नलिखित फायदे हैं:

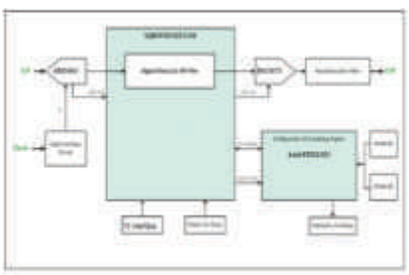
- सॉफ्टवेर प्रोग्राम्नीय, जिससे इन का निर्माण और परीक्षण आसान हो जाता है।
- संकेतों के अंकीय नमूनों पर काम करते हैं और रेखीय अंतर समीकरणों द्वारा परिभाषित हैं|
- निर्माण के लिए केवल डिजिटल तर्क घटक जैसे संकलन, घटाव एवं गुणा की आवश्यकता है|
- इन में फिल्टर कोफ्फिशियंट्स का परिचालन वांछित या अनुमानित आवृत्ति प्रतिक्रिया पाने के लिए किया जाता है।

- वे तापमान या आर्द्रता के साथ अपवाह नहीं होते या उन्हें सटीक घटकों की आवश्यकता नहीं है|
- ये फिल्टर निर्माण के रूपों अथवा वय से ग्रस्त नहीं है।

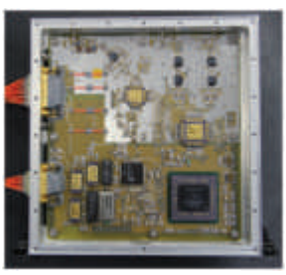
अनेक फायदों के साथ अंकीय फिल्टर कि मुख्य त्रुटि यह है कि संकेतों को नमूनों में बाँट कर अंकीय रूप में परिवर्तित किया जाना चाहिए। इससे सटीकता जाती है, बैंडविड्थ उपयोग में कठिनाई आती है और रव बढती है| इन प्रभावों को दूर करने के लिए उच्च नमूना दर, गहराई (प्रति नमूना प्रति बिट) तथा अधिक फिल्टर विस्तार लगाया जा सकता है| लेकिन इससे घटकों की संख्या बढती है और अधिक प्रसंस्करण गति आवश्यक है|

३. लचीली बैंडविड्थ फिल्टर का अभिकल्प: उदाहरण

अंकीय फिल्टर हमारी प्रणाली के लिए अत्यंत उपयोगी साबित हो सकते हैं| इसीलिए अंकीय लचीली बैंडविड्थ फ़िल्टर का अभिकल्प GSAT-17 संचार उपग्रह में लागू किया गया। डिजाइन और कार्यान्वयन बहु-दर अंकीय संकेत संसाधन तकनीक से एफपीजीए पर आधारित है, एक एडीसी निवेश अंतरापृष्ठ और डीएसी निर्गमन अंतरापृष्ठ पर है। आकृति-1 अंकीय लचीले बैंडविड्थ फिल्टर के हार्डवेर खंड आरेख को दर्शाता है| इसमें कालद आवृत्ति बाहर से ली गई है, दूरादेश और दूरमिति के लिए परिपथ उपलब्ध है| भू-स्थिर कक्षा में उपयोग के लिए, Xilinx FPGA XQR4VSX55 के सहित Actel RTSX32SU भी लगाया गया है, जो कोड को स्क्रब करता है ताकि अतिवेधी विकिरण हो पाए| डीएसी के बाद सही संकेत बनाने के लिए पुननिर्माण फिल्टर लगाया है|



आकृति-1: DFBF का हार्डवेर खंड आरेख



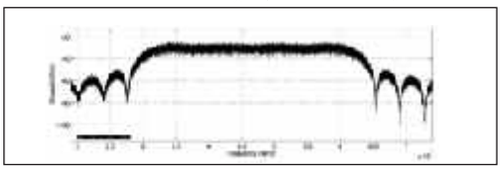
अंकीय लचीले बैंडविड्थ फिल्टर की तस्वीर

तालिका-1 में फिल्टर के विनिर्देश दिए गए हैं। फिल्टर का अभिकल्पन उपग्रह की ३६ मेगाहर्ट्ज निवेश बैंडविड्थ लेकर किया गया है; जिसमें 100 किलोहर्ट्ज़ के विभेदन से बैंड में किसी भी आवृत्ति का चयन किया जा सकता है| इस आवृत्ति पर 1 से 4 मेगाहर्ट्ज की बैंडविड्थ भी चयन की जा सकती है जिसका परिणाम नीचे तस्वीर में दिखाया है| इन फिल्टरों का रूप गुणक अति तीक्षण है, पारक बैंड चपटा है और इतर- संकेत रव तल के नीचे है|

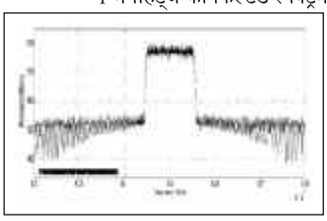
तालिका-1: DFBF के विनिर्देश

प्राचल	विनिर्देश
इनपुट आवृत्ति	29-85 मेगाहर्ट्ज
इनपुट शक्ति तल	-35 to-1 dBm
निवेशन हानि	-14 dB
पारक बैंड रिप्पल	±0.5 dB
प्रतिचयन कालाद दर	250 मेगाहर्ट्ज
निराकरण (-१ dBm इनपुट शक्ति पर)	45 dB
लाभ स्थापन	-7 से +7 dBm
बैंडविड्थ स्थापन	1-4 मेगाहर्ट्ज
केंद्र आवृत्ति विभेदन	100 किलोहर्ट्ज़

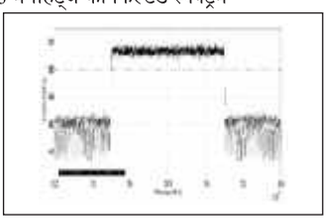
निवेश संकेत स्पेक्ट्रम (36 मेगाहर्टज बैंड)



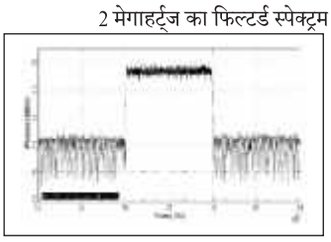
1 मेगाहर्ट्ज का फिल्टर्ड स्पेक्ट्रम



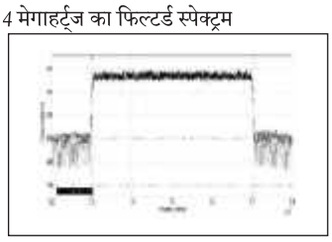
3 मेगाहर्ट्ज का फिल्टर्ड स्पेक्ट्रम



2 मेगाहर्ट्ज का फिल्टर्ड स्पेक्ट्रम



4 मेगाहर्ट्ज का फिल्टर्ड स्पेक्ट्रम



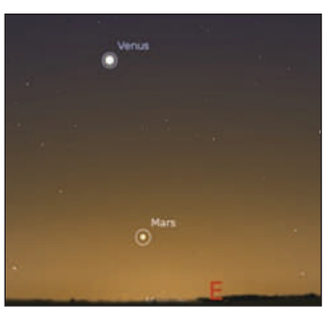
अंकीय लचीली बैंडविड्थ फिल्टर की अवधारणा बहुत ही आकर्षक है क्योंकि दूरसंदेशों का उपयोग कर लाभ, बैंडविड्थ और आवृत्ति स्थायित्व मिल सकता है, हमारी प्रणाली में यह महत्वपूर्ण योगदान दे सकते है| यह आवृत्ति और शक्ति स्तर में लचीलेपन सहित उपर्युक्त अनेक गुण प्रदर्शित कर सकते है जो भारतीय अंतरिक्ष कार्यक्रम के संचार उपग्रह परिदृश्य में एक प्रतिमान परिवर्तन प्रदान कर सकते है। किन्तु इस की कई चुनोतियाँ भी है; जैसे कि हार्डवेर की शक्ति खपत घटाना, घटकों का सही चयन, कलन विधि का सही चयन ताकि भ्रामक सिग्नलों से बचा जा सके आदि|

– ***साभार :*** *आसिया टोपीवाला, अक्षय खरे, नीरज मिश्रा, रजत अरोड़ा, टी वी एस राम*

મંગળ ગ્રહ વિશેના પ્રારંભિક અવલોકનો

પ્રાચીન કાલથી જ મંગળ ગ્રહના આકર્ષણના કારણે તેના વિષે જાણવાની જીજ્ઞાસાવસ વિવિધ યુગોમાં તેનું સતત નિરીક્ષણ કરવામાં આવ્યું છે. પછી અલગ અલગ અવલોકનો દરમ્યાન વિવિધ પૂર્વધારણાઓ, દંતકથાઓ અને રહસ્યો ઉદભવ્યા તથા તેનું સમાધાન થયું. મંગળ નિરીક્ષણનો ઇતિહાસ આપણને પ્રાચીન ઇજિપ્શિયન ખગોળશાસ્ત્રના દ્વિતીય સહસ્ત્રાબ્દી BCE ના યુગમાં લઈ જાય છે. મંગળની ગતિ વિષે ના અવલોકન, ઝોઉ રાજવંશ (૧૦૪૫ BCE) ના ઉદ્‌ભવ પહેલા ચીનીઓએ નોંધ્યા. મંગળની વિગતવાર સ્થિતિનું અવલોકન બેબીલોનના ખગોળશાસ્ત્રીઓ દ્વારા કરવામાં આવેલું કે જેમણે ગ્રહોની ભાવી સ્થિતિની આગાહી કરવા માટેની અંકગણિત તકનીકો વિકસાવી. ગ્રહોની ગતિને સમજાવવા માટે પ્રાચીન ગ્રીક તત્વચિંતકો અને હેલેનિસ્ટીક ખગોળશાસ્ત્રીઓએ ભૂ-કેન્દ્રીય મોડલ વિકસાવેલ. ભારતીય અને ઈસ્લામિક ખગોળશાસ્ત્રીઓએ મંગળનું કદ અને પૃથ્વીથી તેના અંતરનો અંદાજ આપ્યો. ૧૬મી સદીમાં, નિકોલાસ કોપરનિક્સે સૌર વ્યવસ્થા સુર્ય કેન્દ્રીય મોડલનો પ્રસ્તાવ મુક્યો જેમાં ગ્રહો સુર્યની આસપાસ ગોળાકાર કક્ષામાં પરિભ્રમણ કરે છે. જેને જોહન કેપ્લર દ્વારા એમ સુધારવામાં આવી કે, મંગળ લંબગોળ ભ્રમણ કક્ષા ધરાવે છે અને નિરીક્ષણ દ્વારા મળેલ માહિતી સાથે તે વધુ ચોક્કસપણે મળે છે.

મંગળનું પ્રથમ ટેલિસ્કોપિક અવલોકન ઈ.સ. ૧૬૧૦માં ગેલોલીયો ગેલેલીએ કર્યું. એક સદીની અંદર, ખગોળશાસ્ત્રીઓએ ગ્રહ ઉપર અલબેડો લક્ષણો, ધ્રુવીય ધબ્બાઓ, મુખ્ય પ્લેનમ અને ધ્રુવીય હિમશિખરોની શોધ કરી. તેઓ ગ્રહોનો ભ્રમણ સમયગાળો અને ધરીનો વળાંક નક્કી કરવા સક્ષમ બન્યા. આવા અવલોકનો મુખ્યત્વે એવા સમયગાળા દરમ્યાન કરવામાં આવ્યા હતા જયારે ગ્રહની સ્થિતિ સુર્યની સામે હતી (મંગળ અને પૃથ્વી સુર્યની એક જ બાજુ), જે મંગળના પૃથ્વીની એકદમ નજીક હોવાનો નિર્દેશ કરે છે.



૧૯મી સદીના ઉત્તરાર્ધમાં સારા ટેલિસ્કોપના વિકાસના કારણે મંગળની કાયમી અલબેડો લાક્ષણીકતાઓને વિગતવાર મેપિંગ કરવું શક્ય બન્યું. મંગળનો પ્રથમ કાચો નકશો ઈ.સ. ૧૮૪૦માં પ્રકાશિત કરવામાં આવ્યો હતો, આગળ જતા વધુ પરિશુદ્ધ નકશાઓ ૧૮૭૭ બાદ રજૂ થયા. જયારે ખગોળશાસ્ત્રીઓએ ભૂલથી વિચાર રજુ કર્યો કે તેમણે મંગળના વાતાવારણમાં વર્ણપટદર્શક પર પાણીની નિશાની મળી, ત્યારે લોકોમાં મંગળ પર જીવ હોવાનો વિચાર ખુબ પ્રસિદ્ધ થયો. પર્સિવલ લોવેલ એવું માનતા કે તેઓ મંગળની કૃત્રિમ કેનલનું નેટવર્ક જોઈ શકે છે. પછીથી આવી સીધી લાક્ષણીકતાઓ દ્રષ્ટિવિષયક આભાસ કે ભ્રમ સાબિત થઈ, અને આ વાતાવરણ પૃથ્વી સમકક્ષ વાતાવરણને ટેકો આપવા બાબતે ખુબ જ પાતળું અનુભવાયું.

૧૮૭૦થી જ મંગળ ઉપર પીળા વાદળો જોવામાં આવ્યા હતા, જે યુગેન એમ. એન્ટોનીઆદીની સુચના મુજબ પવન દ્વારા ઉડતી રેતી અથવા ધૂળ હતા. ૧૯૨૦ દરમ્યાન, મંગળની સપાટીનું ઉષ્ણતામાણની સીમા માપવામાં આવી, આ તાપમાનનો વિસ્તાર -૮૫ °સે. તો ૭ °સે. (-૧૨૧ °ફે. થી ૪૫ °ફે.) જેટલો હતો.

ગ્રહીય વાતાવરણ માત્ર ઓક્સિજન અને પાણીના અલ્પાંશ સાથે શુષ્ક જણાયેલું. ૧૯૪૭માં ગેરાર્ડ કુપરે દર્શાવ્યું કે મંગળના પાતળા વાતાવરણમાં વધુ પ્રમાણમાં કાર્બન ડાયોક્સાઈડ ધરાવે છે, લગભગ પૃથ્વીના વાતાવરણ કરતા બમણી માત્રામાં. મંગળની અલબેડો લાક્ષણીકતાઓનું પ્રથમ પ્રમાણભૂત નામકરણ ઈન્ટરનેશનલ એસ્ટ્રોનોમીકલ યુનિયન દ્વારા ૧૯૬૦ માં અપનાવવામાં આવ્યું હતું. ૧૯૬૦ના દાયકાથી, મંગળની સપાટી અને ભ્રમણકક્ષા પરથી નિરીક્ષણ અર્થે બહુવિધ રોબોટિક અવકાશયાન મોકલવામાં આવ્યા. ગ્રાઉન્ડ અને અવકાશ-આધારિત ઈન્સ્ટ્રુમેન્ટ દ્વારા વિદ્યુત ચુંબકીય વર્ણપટની વ્યાપક શ્રેણી માટે ગ્રહને નિરીક્ષણ હેઠળ રાખવામાં આવ્યો. મંગળ પરથી ઉદ્‌ભવીને પૃથ્વી પર પડેલી ઉલ્કાઓની શોધના કારણે, ગ્રહ પરની રસાયણિક પરિસ્થિતિના પ્રાયોગિક પરીક્ષણની અનુમતિ મળી. એકદમ નજદીકના અભિગમ અનુસાર, મંગળનું કોણીય માપ આશરે ૨૦ આર્કસેકન્ડ જેટલું છે, જે નરી આંખે પૃથ્થકરણ કરવા માટે અત્યંત સૂક્ષ્મ છે. જેથી ટેલિસ્કોપના ઉદ્‌ભવ પહેલા, આકાશમાં તેના સ્થાન સિવાય અન્ય કોઈ જાણકારી ન હતી. ઈટાલીના વૈજ્ઞાનિક ગેલેલિયો ગેલેલી ટેલિસ્કોપના ઉપયોગથી ખગોળશાસ્ત્રને લગતા અવલોકન કરનાર પ્રથમ વ્યક્તિ હતા. તેમની નોંધ દર્શાવે છે કે તેમણે ટેલીસ્કોપની મદદથી મંગળને જોવાની શરૂઆત સપ્ટેમ્બર ૧૬૧૦થી કરી. ગ્રહ પરની કોઈપણ સપાટીની વિગતવાર પ્રદર્શિત કરવા માટે આ સાધન ખુબ જ પ્રાચીન ઢબનું હતું, જેથી તેમણે શુક્ર અને ચંદ્રની જેમ મંગળના આંશિક અંધકારને તબક્કાવાર જોવાનો ધ્યેય નક્કી કર્યો. જોકે સફળતાઓની અનિશ્ચિતતા વચ્ચે પણ, ડીસેમ્બરમાં તેમણે મંગળના કોણીય માપમાં ઘટાડાની નોંધ લીધી. ૧૬૪૫માં પોલીશ ખગોળશાસ્ત્રી જોહાનીસ હેવેલીયસ મંગળની વિવિધ કળાનાં નિરીક્ષણ માટે સફળ રહ્યા હતા. ૧૬૪૪માં, ઈટાલીયન જેસુઈટ ડેનીએલો બાર્ટોલીએ મંગળ પર બે ઘાટ્ટા ધબ્બાઓ (પેચ) જોયાનો અહેવાલ આપ્યો. ૧૬૫૧, ૧૬૫૩ અને ૧૬૫૩ દરમ્યાન તદ્‌ન

વિરુદ્ધ સ્થાને હોવા છતાં, ગ્રહ જયારે પૃથ્વીથી નજીક આવ્યો ત્યારે ઈટાલિયન ખગોળશાસ્ત્રી ગીયોવન્ની બેટ્ટીસ્ટા રીસ્યોલી અને તેમના વિદ્યાર્થી ફ્રાન્સિસ્કો મારિયા ગ્રીમાલડીએ મંગળ પર વિભિન્ન પરાવર્તકતા ધરાવતા પેચની નોંધ લીધી. પ્રથમ વ્યક્તિ કે જેમણે મંગળના ભૂપ્રદેશની લાક્ષણીકતા દર્શાવતો નકશો દોર્યો એ ડચ ખગોળશાસ્ત્રી ક્રિશ્ચન હ્યુગેન્સ હતા.

નવેમ્બર ૨૮, ૧૬૫૯ ના રોજ તેમણે મંગળ પરનો સ્પષ્ટ ઘેરો પ્રદેશ દર્શાવ્યો જે આજે સાયટ્રીસ મુખ્ય પ્લેનમ તરીકે ઓળખાય છે અને જે સંભવત એક ધ્રુવીય બરફ આચ્છાદિત કેપ છે. એજ વર્ષમાં તેમને ગ્રહનો ચક્રીય આવર્તનકાળ માપવામાં સફળતા મળી જે આશરે ૨૪ કલાક જેટલો હતો. તેમણે મંગળના વ્યાસ નો અંદાજ લગાવ્યો અને અનુમાન કર્યું કે પૃથ્વી કરતા તેનું માપ ૬૦% જેટલું હશે જેની આધુનિક સમયની આંકડાકીય માહિતી ૫૩% સાથે બંધ બેસે છે. લગભગ, મંગળના દક્ષિણ ધ્રુવીય બરફ શિખરનો ચોક્કસ ઉલ્લેખ પ્રથમ વાર ઈટાલિયન ખગોળશાસ્ત્રી ગીયોવાન્ની ડોમેનીકો કાસીનીએ ૧૯૬૬માં કર્યો હતો. એજ વર્ષમાં, તેમણે મંગળની સપાટી પરના માર્કિંગના અવલોકનોના આધારે તેનો ચક્રીય આવર્તન કાળ ૨૪ કલાક, ૪૦ મિનીટનો નિર્ધારિત કર્યો. જે આજના સમયમાં સ્વીકારેલી કિંમત કરતા ૩ મિનીટ ઓછી છે. ઈ.સ. ૧૬૭૨માં હ્યુગેન્સે ઉત્તર ધ્રુવ પર અસ્પષ્ટ સફેદ કેપની નોંધ લીધી.

૧૬૭૧ માં કેસીનીના પેરીસ વેધશાળાના નિદેશક બન્યા પછી, તેમણે સોલર પ્રણાલીના ભૌતિકીય પ્રશ્નોનો સામનો કર્યો. ગ્રહીય કક્ષાનું સાપેક્ષ માપ કેપ્લરના ત્રીજા નિયમની મદદથી જાણ્યું હતું, આથી હવે જરૂર હતી ગ્રહોની કક્ષાના સાચા માપ જાણવાની. આ કારણોથી, પૃથ્વીના અલગ અલગ બિંદુઓથી તારાઓને અનુલક્ષીને મંગળનું સ્થાન માપવામાં આવ્યું અને આમ ગ્રહની ડાયઅર્નલ પરેલેક્ષ માપવામાં આવી. આ વર્ષ દરમ્યાન, ગ્રહ સૂર્યની નજીક હતો અને પોતાની કક્ષાના જ અગાઉના બિંદુઓમાંથી પહેલાની જેમ પસાર થયો. કાસીની અને જેન પિકાર્ડે પેરિસથી મંગળનું સ્તઃન નક્કી કર્યું, જયારે ફ્રેંચ ખગોળશાસ્ત્રી જીન રીચરમેડે સાયેન, દક્ષિણ અમેરિકાથી માપ લીધા. જોકે આ અવલોકનો માંથી સાધનોની ગુણવત્તા અવરોધરૂપ બની અને કાસીની દ્વારા માપેલ પેરેલેક્ષ સાચા મૂલ્યની ૧૦%ની અંદર આવી. જોહન ફ્લેમસ્ટીડે તુલનાત્મક માપનના પ્રયત્નો કર્યા અને આવા જ પરિણામો પ્રાપ્ત થયા.

૧૭૦૪માં ઈટાલિયન ખગોળશાસ્ત્રી ફિલીપ મરાલ્ડીએ દક્ષિણ કેપનો ક્રમબદ્ધ અભ્યાસ કર્યો અને ગ્રહના ભ્રમણના કારણે વિવિધ અવલોકન નોંધ્યા, જે દર્શાવતું હતું કે કેપ પોલના કેન્દ્ર માં નથી. તેમણે સમયાંતરે કેપના માપમાં ફેરફાર પણ જોયો. જર્મનીમાં જન્મેલા બ્રિટીશ ખગોળશાસ્ત્રી સર વિલિયમ હર્શેલે ૧૯૭૭માં મંગળનો અને ખાસ કરીને ગ્રહની ધ્રુવીય કેપના અવલોકનો શરુ કર્યા. ૧૭૮૧માં તેમણે નોંધ્યું કે કેપ ખુબ જ વિસ્તૃત છે, જેના કારણે છેલ્લા ૧૨ મહિનાથી ધ્રુવ પર અંધારું હતું. ૧૭૮૪માં દક્ષિણ કેપ ખુબ જ નાની દેખાઈ, જે સૂચિત કરે છે કે ગ્રહની ઋતુઓ પ્રમાણે તે બદલાય છે અને તે બરફની બનેલ છે. ૧૯૮૧માં તેમણે મંગળનો ભ્રમણ સમય ૨૪ કલાક ૩૯ મિનીટ અને ૨૧.૬૭ સેકન્ડનો અંદાજ આપ્યો અને ગ્રહીય ધ્રુવ અને કક્ષીય સમતલ વચ્ચે અક્ષીય કોણ ૨૮.૫૦ માપ્યો. તેમણે નોંધ્યું કે મંગલ પર વાતાવરણ બહુ વધારે નહિ પણ સામાન્ય છે અને ત્યાંના નિવાસીઓ વિવિધ રીતે આપણી જેમ જ બધી પરિસ્થિતિનો આનંદ લેતા હશે. ૧૭૯૬અને ૧૮૦૯ની વચ્ચે ફ્રેંચ ખગોળશાસ્ત્રી ઓનરફ્લેગેર્યુંસે મંગલ પર ભગવા રંગથી આચ્છાદિત સપાટી સૂચિત કરી. અગાઉ પણ મંગલ પર સંભવિત પીળા વાદળો અથવા વાવાઝોડાનો ઉલ્લેખ હતો. ૧૮૭૭ દરમ્યાન, ઈટાલિયન ખગોળશાસ્ત્રી ગીયોવન્ની સ્કીપેરેલીએ ૨૨ સે.મી.(૮.૭ ઈંચ)ના ટેલીસ્કોપની મદદથી મંગળનો પ્રથમ વિસ્તૃત નકશો બનાવ્યો.

મંગલ ગ્રહની વિગતો:

૧. ભૂમધ્ય ત્રિજ્યા	:	૩૩૯૬.૨ ± ૦.૧ કિમી. અથવા પૃથ્વી કરતા ૦.૫૩૩ ગણી
૨. ધ્રુવીય ત્રિજ્યા	:	૩૩૭૬.૨ ± ૦.૧ કિમી. અથવા પૃથ્વી કરતા ૦.૫૩૧ગણી
૩. પૃષ્ઠ ક્ષેત્રફળ	:	૧૪૪૭૯૮૫૦૦ કિમી.^{2} અથવા પૃથ્વી કરતા ૦.૨૮૪ ગણું
૪. ઘનફળ	:	૧.૬૩૧૮ x ૧૦^{૧૧} કિમી.^{3} અથવા પૃથ્વી કરતા ૦.૨૮૪ ગણું
૫. ઘનતા	:	૩.૯૩૩૫ ± ૦.૦૦૦૪ ગ્રામ/સેમી.^{3}
૬. પૃષ્ઠ તાપમાન	:	૧૩૦ કે. અથવા -૧૪૩° સે. (લઘુત્તમ) ૩૦૮ કે. અથવા ૩૫° સે. (મહત્તમ)

*- **સૌજન્ય :** શ્રી અંકુશકુમાર & શ્રી આશિષ સોની*

Payloads delivered

Cartosat-2E Payload delivered to ISAC, Bengaluru on April 18, 2017.

IRNSS-1H Payload was flagged to ISAC, Bengaluru on May 05, 2017.

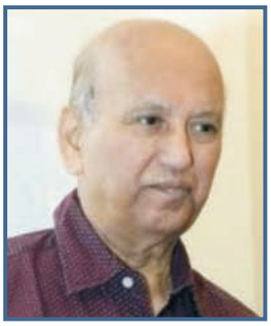
GSAT-11 (HTS) Payload being flagged off by Shri Tapan Misra, Director, SAC on September 06, 2017.

Former ISRO Chairman, Space Commission, Prof. U. R. Rao passed away

The entire ISRO family is in deep sorrow over the sad demise of one of its Eminent Scientist and Former Chairman, Space Commission, Prof. Udupi Ramachandra Rao, who passed away on July 24, 2017.

Convinced of the imperative need to use Space Technology for the Nation's development, he undertook the responsibility for the establishment of Satellite Technology in India in 1972. Under his able guidance, beginning with the first Indian satellite 'Aryabhata' in 1975, over 18 satellites were designed and launched for providing Communication, Remote Sensing and Meteorological services.

Prof. U. R. Rao, was born on March 10, 1932 at Adamaru, Udupi, India. He completed his graduation from Banaras Hindu University and his Doctorate from Gujarat University. In his initial years he worked at PRL, Ahmedabad and served in different capacities before taking charge as Director, ISAC, Bangalore. He took charge as Chairman, Space Commission and Secretary, Department of Space in 1984 and accelerated the development of critical Rocket Technology which resulted in the successful operationalization of launch vehicles like ASLV and PSLV. He initiated the development of GSLV and the development of Indigenous Cryogenic Technology in 1991.



He was honoured with 'Padma Bhushan' in 1976 and 'Padma Vibhushan' in 2017 for his exemplary contribution in the field of Science. He became the first Indian Space Scientist to be inducted into the highly Prestigious "Satellite Hall of Fame" at Washington DC, USA on March 19, 2013.

His immense contribution to the development of Space Science and Technology shall always be remembered and continue to drive the aspirations of the Indian Space Program.

Sad Demise of Founder Director of Space Applications Centre, Prof. Yashpal

Founder Director of the Space Applications Centre, Ahmedabad, Prof. Yashpal passed away on July 24, 2017. Prof. Yashpal built the centre into an Internationally Recognised Institution of Excellence in the field of applications of Space Technology for the benefit of mankind. Under his overall direction, Space Applications Centre was involved in the novel Satellite Instructional Television Experiment (SITE) which was aimed at providing a system test of Direct Television Broadcast Technology for disseminating educational and developmental programmes for rural population. SITE was Largest Mass Communications Experiment ever carried out in the World.

Prof. Pal was a Fellow of the Indian Academy of Sciences and the Indian National Science Academy. He was the President of the Indian Physics Association; Chairman, National Council of Science Museums; Member, Electronics Commission; Council Member of several academic and scientific organisations such as Film and Television Institute of India, Indian Institute of Mass Communication, Indian Institute of Tropical Meteorology and the Indian Council of Scientific and Industrial Research. He was also a member of the Senior Advisory Board of the Princeton-based Space Studies Institute.

After completing his Masters degree in Physics at the Punjab University in 1949, Prof. Pal joined the Tata Institute of Fundamental Research. He obtained his Ph.D. degree in Physics from the Massachusetts Institute of Technology in 1958. He has been a Visiting Professor at several universities and institutions including the Niels Bohr Institute, Copenhagen, University of Maryland and California Institute of Technology.

A scientist of international repute, Pal was awarded the Padma Bhushan in 1976 and India's second highest civilian honour, the Padma Vibhushan, in 2013. In 1980 the Marconi International Fellowship Council awarded him the prestigious Marconi International Fellowship Award to recognize wise and humane leadership in applying modern communications technology to meet the needs of isolated rural villagers in India. He was given recognition by the Academy of Sciences of the German Democratic Republic and the University of Sofia.

Sorrowful demise of Dr. K N Shankara, Former Director, SAC, Ahmedabad

Dr. Koodli Nanjunda Ghanapathi Shankara passed away on July 17, 2017 leaving behind a void that can't be filled. An Outstanding Scientist in the field of Satellite Technology, he spearheaded two prominent ISRO Centres during his tenure as the Director of Space Applications Centre, Ahmedabad and later ISRO Satellite Centre, Bangalore. He headed the Satellite Communications Programme and was the Programme Director, INSAT at ISRO Headquarters, Bangalore.

Born on May 7, 1945, he pursued his graduation in Science and showed keen interest in the field of Space Science. He joined Space Applications Centre, Ahmedabad in 1971 and a year later completed his Doctorate in Electrical Communication Engineering from Indian Institute of Science, Bangalore in 1972.

He worked extensively on the design, development and realization of Communication payloads for INSAT series of satellites and he contributed significantly towards successful operationalisation of INSAT 2A/2B/2C satellites. His work led to new developments in the area of Microwave Technology and Spacecraft Electronics.

Having served as Hon. Professor at the Gujarat University, a large number of publications in National and International Journals are credited to his name.
He was the recipient of various awards in the field of Electronics & Space Technology like Om Prakash Bhasin Award, Ramlal Wadwa Gold Medal Award & VASVIK Award. For his exemplary contribution in the field of Space Science and Technology, he was awarded 'Padma Shri' in 2004.

His efforts and contribution towards the development of Space Science and Technology shall always be remembered by the ISRO fraternity.

Prof. Yashpal during a lecture at SAC

Prof. U. R. Rao-second from right, during a demonstration of talk back DRS on September 8, 1989.

Prof. Yashpal, during his visit at SAC

Dr. K N Shankara, addressing an event at SAC

VSSE celebrates National Technology Day – 2017

On May 11, 1998 India achieved a major technological breakthrough by successfully carrying out nuclear tests at Pokran. This day is commemorated as National Technology Day.

This year Vikram Sarabhai Space Exhibition (VSSE) celebrated National Technology Day on May 17, 2017 with a theme "Satellite Communication". Several events like Video documentaries, Live demonstrations, Posters & Presentations related to SATCOM applications were organised to mark the occasion.

About 2182 visitors including students visited VSSE. Students of Various ITI colleges, Physically challenged students from VRC ITI, L D Engineering College, SSIT, Dholakiya School-Rajkot, Apang Manav Mandal (Blind School) were among the visitors. Quiz competition on different aspects of science was also conducted to grace the occasion.

Smart India Hackathon 2017

ISRO/DOS Organized 36-hours non-stop Smart India Hackathon-2017 (SIH) Grand Finale during April 1-2 , 2017, at Ahmedabad Nodal Centre, along with Gujarat Technological University (GTU), Gujarat University (GU) and All India Council for Technical Education (AICTE) under the aegis of Ministry of HRD (MHRD). Smart India Hackathon 2017 harnesses creativity & expertise of students, builds funnel for 'Startup India, Standup India' campaign, crowd-sources solutions for improving governance and quality of life, and provides opportunity to citizens to provide innovative digital solutions to India's daunting problems.

During the 'Grand Finale' at Ahmedabad, on April 1 & 2, 2017, 49 teams consisting of 392 youngsters (6 students & 2 mentors per team) participated and worked nonstop for 36 hours to build innovative digital

solutions for 21 out of 53 problems posed by ISRO/DOS. On the night of April 1st, 2017, Honb'le Prime Minister, Shri Narendrabhai Modi, addressed all the participants across India and also interacted via Live Video Conference with student participants. Honb'le education minister of Gujarat, Shri Bhupendrasinhji Chudasma, along with Director-SAC, Shri Tapan Misra, Vice Chancellor of Gujarat Technological University (GTU), Dr. Navin Seth and In charge VC of Gujarat University, Dr. Himanshu Pandya were the chief guests at the inaugural function of SIH-2017. Chairman-ISRO/Secretary-DOS, Shri A.S.Kirankumar, Vice Chancellor of GTU, Dr. Navin Seth, and Associate Director-SAC, Shri D K Das were the chief guests at the Valedictory function on April 2nd, 2017. Chairman-ISRO gave away the certificates and Mementos to all the participating teams and had photo sessions with all the teams.

International Yoga Day celebrations at SAC

Director, SAC interacting with newly joined Scientists/Engineers.

SAC observed 'Fire day & Fire service week-2017' during April 14-20, 2017 on the theme 'Firemen- your partner for saving life and property'.

OBITUARY

SAC Courier deeply mourns the sad demise of our colleague

Shri Jivanbhai Parmar

ADMIN-P&GA-Canteen

AVIRIS-NG Science meet on July 12-14, 2017

SAC organized AVIRIS-NG science meet on July 12-14, 2017. About 130 delegates have participated from different ISRO centres, JPL/NASA and Academia. Results from AVIRIS-NG Phase-1 campaign were presented and discussed during the meet. Initial planning for second phase campaign with joint collaborative activities was also discussed and a science report from Phase -1 airborne campaign hyperspectral data has been released during the meet.

SAMUDRA start up meet

SAMUDRA (Satellite based Marine Process Understanding, Development, Research and Applications for blue economy). Start up meeting was conducted at SAC on May 2, 2017. There were 32 participants from 28 national agencies. Themes discussed were PFZ, DA-OSF, Ocean Energy, Ocean Analyses, Oil spill tracking, coastal vulnerability and the instruments planned under SAMUDRA. Major participating agencies are Indian Navy, IITs (Kharagpur, Delhi, Chennai and Bhubaneswar), NIO, INCOIS, NIOT, Annamalai University, Andhra University, Kerala University, KUFOS, FSI, CMLRE, CMFRI, CDA, ONGC, FSI, Goa University, CIFT, KSNDMC, IIRS, NRSC, TNFU,PDPU, TERI and NIWE.

Dr. C. V. Raman Award to Shri Dipak Pandya, VSSE

Shri Dipak Pandya, VSSE, SAC had been awarded the Dr. C. V. Raman Award for the Year 2017, by the Raman Science & Technology Foundation, to the nation and his station towards popularizing space science. This award was presented to him on the National Science Techno Fair held at Pilvai (Gujarat) on July 15, 2017.

Training on Satellite Altimetry Applications: Emphasis to SARAL AltiKa

As part of Satellite Meteorology and Oceanography Research and Training (SMART), SAC conducted one-week training programme on 'Satellite Altimetry Applications: Emphasis to SARAL AltiKa' in two batches during 04-08 and 25-29 September 2017. Totally 29 participants from 26 Institutions/Universities participated in these two training programmes. Training programme comprised of lectures and hands-on with SARAL AltiKa data. Applications of SARAL AltiKa data for Oceanography, Hydrology, Cryosphere and Geological studies are demonstrated.

Technology Transfer, Industry & Academic Interface

SAC signed technology transfer agreement with ECIL, Hyderabad for three antenna feeds; Design of Ku band Cassegrain feed for 7.2m antenna, Design of C band LP/CP Cassegrain feed for 7.2m and 11m antenna & Design of L and S band Cassegrain feed for 11m antenna on April 18, 2017

SAC signed technology transfer agreement with M/s. Adani Green Energy Ltd. for Supplying Solar insolation data from Indian Geo-Stationary Satellite on May 13, 2017

SAC developed Optical Imaging System, a long range imaging camera operating in Vis-NIR, with a resolution of 3 cm at 5 Km. This technology was transferred to M/s. Bharat Electronics Ltd. On June 12, 2017

SAC signed licensing agreement with M/s. Ashok Prakashan Mandir, Ahmedabad on September 1, 2017. By this agreement publishing rights were granted to M/s. Ashok Prakashan Mandir for Chitra Pushtika, " Antarix ki Duniya me Vartalap".

Technology transfer agreement was signed between SAC and M/s. Prism Circuitronics Pvt. Ltd, Mumbai on September 4, 2017. The agreement was to transfer process technology of Gold Plating on Aluminum 6061 T6 and Kovar.

MoU with Hindustan Aeronautics limited, Hyderabad for Academic & Research based Interactions for development of relevant Aerospace Technologies on May 09, 2017

MoU with Indian Navy for the co-operation of Satellite based Naval Applications in Oceanology and Meteorology on May 15, 2017

MoU with JECRC University, Jaipur, Rajasthan for IRNSS Navigation receiver field Trail and Data Collection on May 26, 2017

MoU with Gujarat Co-operative Milk Marketing Federation Limited, (Amul) Anand, Gujarat to provide technical support to GCMMF for setting up a remote sensing data processing centre for fodder acreage assessment on May 26, 2017

MoU with NITI Aayog for development of Geospatial Energy Portal of India on June 02, 2017

MoU was signed between SAC and Institute of Plasma Research, Gandhinagar for Technical Co-operation & Capacity Building on September 1, 2017.

SAC participated as an exhibitor in Textiles India 2017 Symposium from June 30th 2017 to July 2nd 2017 at Mahatma Mandir, Gandhinagar. The ISRO pavilion was centre for attraction for executives, defence personnel, school children, college students, urban people and rural people.

In its commitment towards Capacity Building SAC has imparted in-plant training to ITI (Mechanical) students. The training was scheduled for a month from June 1st, 2017 to June 30th, 2017. SAC is providing theory and practical training to ITI Mechanical students every year for one month under a MoU with Government of Gujarat. In last two years SAC has provided 252 man hours of training to 60 students. Approval also has been obtained to conduct similar training for ITI-Electronics also.

Lecture Series

Lecture on Operation, Maintenance and Calibration of Payload Handling Equipment by Shri D M Vaidya, Director Trivedi & Associates Tecknical Services (P) Ltd., Vadodara on April 10, 2017.

Lecture on Dr. B. R. Ambedkar's Life and Mission by Dr. P G Jyotikar. Advocate, Professor & Social Activist, Ahmedabad on April 18, 2017.

Lecture on MOSDAC: Indian Store House for Space based Weather & Ocean Data by Dr. Nitant Dube Group Head, MRG/EPSA on April 25, 2017.

Lecture on VEDAS (Visualization of Earth Observation Data and Archival System) by Shri Shashikant A Sharma,Group Head - VRG/EPSA on May 09, 2017.

Lecture on Selected Topics in Air Interface and Ground Segment Development of Satellite Communication Systems by Dr. Yash Vasavada, Associate Professor, DA-IICT, Gandhinagar on May 11, 2017.

Lecture on "General Financial Rules (GFR) - 2017 and Government e - Market (GeM)" by Shri Rajesh Singh, P & S Officer, ADMIN/ PURCHASE on June 23, 2017.

Lecture on Swachh Bharat Abhiyan by Dr. Sanket Patel, Assistant Health Officer, Ahmedabad Municipal Corporation (AMC) on June 28, 2017.

Lecture on 'Particle Accelerator & Laser and their Applications' by Shri Purushottam Shrivastava Outstanding Scientist, Raja Ramanna Centre for Advanced Technology (RRCAT), Indore on August 1, 2017.

Lecture on 'LiHySI observations & Results' by Dr. Ratan Singh Bisht, Sci/Eng, SEDA, on September 27, 2017.

Educational Visits

Educational visit of 164 students from R C Patel Institution of Technology, Shirpur, Bhagwant University, Ajmer & IIT, Gandhinagar on April 18, 2017.

Educational visit of 70 students from Sankalchand Patel College of Engineering, Visnagar on April 19, 2017.

Educational visit of 40 students from Vikram A Sarabhai Community Science Centre, Ahmedabad on May 25, 2017.

Educational visit of 22 students from Defence Institute of Advanced Technology, Pune on June 1-2, 2017.

Educational Visit of 40 students from IPR, Gandhinagar on July 04, 2017 at SAC.

Educational Visit of 75 students from Silver Oak College of Engineering & Technology, Ahmedabad & Gujarat Power Engineering & Research Institute, Mehsana on August 22, 2017 at SAC.

Educational Visit of 45 Navy Officers from INS Valsura, Jamnagar on September 01, 2017 at SAC.

Educational Visit of 52 B.Tech students from DAIICT, Gandhinagar on September 20, 2017 at SAC.

Educational Visit of 70 BE/BSc students from VPM Maharshi Parshuram College of Engineering, Valneshwar, Maharashtra and Sheth R A College of Science, Ahmedabad on September 26, 2017 at SAC.

Workshops, Seminars & Training Programmes

Workshop on Applications of "Metamaterials: From Microwave to Optical Frequencies" was organized to understand the properties of Metamaterial to utilise/implement in SAC applications during April 07-08, 2017. 22 participants attended the workshop.

Programme on Matlab for Engineers was organised to provide practical exposure in image processing and applications using Matlab during April 17-22, 2017 at Nirma University, Ahmedabad. 31 participants attended the programme.

Refresher Course on "Fundamentals of RF and Microwave Engineering" organised for middle level sci./engrs. to refresh the fundamental knowledge of RF and Microwave at IIT-Kharagpur during May 15-27, 2017. 30 participants attended the course including 6 from ISAC and VSSC.

Workshop on "Advanced Excel" on June 07-08, 2017. 21 participants attended the workshop.

Seminar on "IC Design" on June 15, 2017. 38 participants attended the workshop.

Workshop on "MathWorks HDL design flows for FPGAs" on July 20, 2017. 16 participants attended the workshop.

Seminar on "Goods and Services Tax (GST)" on July 25, 2017. About 75 participants attended the seminar.

Workshop on "Public Procurement under General Financial Rules (GFR)- 2017 and Government e - Market (GeM)" during July 26-27, 2017. 41 participants are attending the workshop.

Programme on Android-based Applications Development during August 07-12, 2017. 23 participants attended the programme.

Training Programme for Housekeeping Workers on August 20, 2017 at Ahmedabad Management Association (AMA), Ahmedabad. 38 participants attended the programme.

Refresher Course on 'Fundamentals and Applications of Radar Imaging for GeoResource Operations' at IIT-Kharagpur during August 21 – September 02, 2017. 22 participants attended the programme.

Joint Inaugural Function of Post Graduate Diploma Courses under CSSTEAP

The Post Graduate Diploma Courses, namely, Eleventh Satellite Communications (SATCOM-11) and Second Global Navigation Satellite Systems (GNSS2) of CSSTEAP started on August 01, 2017 at SAC Ahmedabad. Total 21 participants from nine countries of Asia Pacific region, namely Bangladesh, Bhutan, India, LaoPDR, Mongolia, Myanmar, Nepal, Sri Lanka and Tajikistan are attending SATCOM-11 course. Similarly, 12 participants from five countries, namely, Bangladesh, India, Mongolia, Sri lanks and Tajikistan are attending GNSS-2 course. The Joint Inaugural function was held on 01 August, 2017 at Bopal Campus, SAC.

Participants of SATCOM-11 Course with Dignitaries

Participants of GNSS-2 Course with Dignitaries

Sculpture of Dr. Sarabhai was inaugurated by Director, SAC on the occasion of Dr. Vikram Sarabhai Birth Anniversary Celebration on August 12, 2017 at VSSE.

Success celebration of Cartosat-2(S)E, GSAT-17 & GSAT-19 at SAC on July 7, 2017.

SAC celebrated 5th Anniversary of RISAT-1 on May 1st, 2017. On this occasion a book on 'A Glimpse of India by RISAT-1: Part 1' was released by Shri Tapan Misra, Director, SAC.

SAC Conducted 'NavIC Celebration' on the successful launch of India's seventh Navigation Satellite IRNSS-1G completing the constellation with new name NavIC.

Blood Donation Camp was organized at SAC on August 23, 2017. Total 303 Units of blood were collected.

हिंदी तकनीकी संगोष्ठी – 2017

अंतरिक्ष उपयोग केंद्र, अहमदाबाद में दिनांक 07 जुलाई, 2017 को "भारतीय अंतरिक्ष कार्यक्रम में हो रहे नवीनतम प्रयास" और "इसरो में राजभाषा का प्रयोग : चुनौतियाँ एवं समाधान" विषय पर हिंदी तकनीकी संगोष्ठी का आयोजन किया गया।

संगोष्ठी के उद्घाटन सत्र के मुख्य अतिथि परमाणु ऊर्जा विभाग तथा अंतरिक्ष विभाग की संयुक्त सलाहकार समिति के सदस्य एवं हिंदी विद्वान डॉ. टी.आर. भट्ट रहे। कार्यक्रम की अध्यक्षता निदेशक, सैक श्री तपन मिश्रा ने की। साथ ही मंच पर सह निदेशक सैक एवं संगोष्ठी आयोजन समिति के अध्यक्ष श्री डी.के. दास, नियंत्रक, सैक श्री पीयूष वर्मा और वरिष्ठ हिंदी अधिकारी श्रीमती नीलू सेठ उपस्थित रहीं। डॉ. भट्ट ने अपने उद्बोधन में भाषा के शुद्ध प्रयोग पर बल दिया। संगोष्ठी के लेख-संग्रह की पुस्तक और सीडी का विमोचन किया गया। तकनीकी और राजभाषा सत्र के लिए कुल 50 लेख चुने गए। उद्घाटन सत्र के पूर्व संगोष्ठी के लेखकों एवं एसएमसी सदस्यों द्वारा वृक्षारोपण किया गया और इसकी जियो-टैगिंग की गई।

प्रथम सत्र के विषय "नाविक : नवीनतम अनुप्रयोग और नई संभावनाएँ" तथा "स्मार्ट इंडिया के लिए सैटकॉम का प्रयोग" थे। इस सत्र के अध्यक्ष श्री के.एस. परीख, उप निदेशक-एसएनपीए थे और सत्र संचालक श्री दिनेश अग्रवाल, वैज्ञानिक/अभियंता थे। द्वितीय सत्र का विषय "सुदूर संवेदन के नए आयाम" था। इसकी अध्यक्षता श्री राजीव ज्योति, उप निदेशक-एमआरएसए ने की और संचालन सुश्री अर्पिता गजरिया, वैज्ञानिक/अभियंता ने किया।

तृतीय सत्र की अध्यक्षता नियंत्रक, सैक श्री पीयूष वर्मा ने की तथा सत्र संचालन श्रीमती नीलू सेठ, वरिष्ठ हिंदी अधिकारी ने किया। चतुर्थ सत्र के विषय "अंतरिक्ष विज्ञान की जनता तक पहुँच" और "डिजिटल इंडिया की ओर हमारे बढ़ते कदम" थे। इसके सत्राध्यक्ष निदेशक, डेकू श्री वीरेंद्र कुमार थे और सत्र संचालक श्री सी.एन. लाल, प्रधान-प्रकाशन एवं जनसंपर्क थे। पाँचवे सत्र का विषय "पदार्थ, तकनीकी प्रक्रियाएँ एवं गुणवत्ता" था। इसके अध्यक्ष श्री एच.आर कंसारा, उपनिदेशक-मेसा और संचालक श्री आशिष सोनी, वैज्ञानिक/अभियंता थे।

संगोष्ठी के अंत में पैनल चर्चा रखी गई। इसके पश्चात निदेशक, सैक श्री तपन मिश्रा द्वारा प्रतिभागियों को प्रमाण-पत्र वितरित किए गए। प्रत्येक सत्र के दौरान प्रस्तुत सर्वश्रेष्ठ आलेखों को पुरस्कृत भी किया गया - प्रथम सत्र में सुश्री आसिया टोपीवाला और श्री कल्पेश बोरसदिया, द्वितीय सत्र में सुश्री अनुजा शर्मा और श्री शौकिन फोगाट, तृतीय सत्र में श्री राजेन्द्र गायकवाड़ और सुश्री अर्पिता गजरिया, चतुर्थ सत्र में श्री संतोष गव्हाणे, पाँचवे सत्र में श्री अश्वनी कुमार और सुश्री क्रिष्णा मकाणी एवं पोस्टर सत्र में सुश्री आभा छाबड़ा और सुश्री ऊष्मा डाड। इस वर्ष सैक ने एक नई पहल करते हुए 'ग' क्षेत्र के लेखकों को प्रोत्साहन देने के उद्देश्य से विशेष पुरस्कार प्रदान किया।

हिंदी माह 2017

अंतरिक्ष उपयोग केंद्र में सितंबर 2017 के दौरान सैक एवं डेकू के स्टाफ सदस्यों के लिए हिंदी माह का आयोजन किया गया। उद्घाटन समारोह की अध्यक्षता निदेशक, सैक, श्री तपन मिश्रा ने की। इस अवसर पर श्री डी.के.दास, सह निदेशक, सैक, श्री पीयूष वर्मा, नियंत्रक, सैक तथा श्रीमती नीलू सेठ, वरिष्ठ हिंदी अधिकारी, सैक भी मंच पर उपस्थित रहीं। सभी ने अपने-अपने वक्तव्य में हिंदी के प्रयोग को बढ़ावा देने पर बल दिया। उद्घाटन समारोह में सांस्कृतिक कार्यक्रम आयोजित किए गए जिनमें कर्मचारियों के बच्चों द्वारा नृत्य, कर्मचारियों द्वारा गीत-संगीत, नाटिका आदि प्रस्तुत किए गए।

माह के दौरान हिंदी और हिंदीतर भाषा वर्गों के लिए 15 अलग-अलग प्रतियोगिताओं का आयोजन किया गया। इस वर्ष विशेष तौर पर 'ग' क्षेत्र के कर्मचारियों के लिए वर्ग पहेली प्रतियोगिता और समाचार वाचन प्रतियोगिता आयोजित की गई। वाहन चालक और कुक, गार्डनर आदि स्टाफ सदस्यों के लिए सरल लेखन प्रतियोगिता आयोजित की गई। हिंदी माह के दौरान कर्मचारियों के परिवार के सदस्यों के लिए भी 7 प्रतियोगिताएँ आयोजित की गई। कर्मचारियों के विवाहितियों के लिए वर्ग पहेली प्रतियोगिता और कथा वृत्तांत/वाचन प्रतियोगिता तथा आश्रित बच्चों के लिए पोस्टर कलर, सुलेखन, श्रुतलेखन, आशुभाषण और वाद-विवाद प्रतियोगिताओं का आयोजन किया गया।

सैक पुस्तकालय द्वारा संपूर्ण हिंदी माह के दौरान हिंदी पुस्तक प्रदर्शनी का आयोजन किया गया। 14 सितंबर, 2017 को हिंदी दिवस के उपलक्ष्य में चिकित्सा संबंधी एक विशेष व्याख्यान आयोजित किया गया।

हिंदी माह के दौरान आयोजित विविध प्रतियोगिताओं में सैक/डेकू के 1200 से भी अधिक स्टाफ सदस्यों ने भाग लिया। हिंदी माह के दौरान स्टाफ सदस्यों के लिए हिंदी में अधिकाधिक कार्य करने हेतु प्रोत्साहन योजना भी लागू की गई।

दिनांक 04 अक्तूबर 2017 को हिंदी माह के विजेता प्रतिभागियों को श्री अपूर्व भट्टाचार्य, उप निदेशक, एस्सा तथा श्री पीयूष वर्मा, नियंत्रक, सैक द्वारा प्रमाण पत्र प्रदान किए गए। हिंदी माह के दौरान स्टाफ सदस्यों के बीच यह संदेश पहुँचाने का प्रयास किया गया कि वे सरल हिंदी का प्रयोग करते हुए दैनंदिन कार्य हिंदी में करने में गौरव का अनुभव करें।

30 अगस्त 2017 को संपन्न राजभाषा कार्यशाला की रिपोर्ट

सैक/डेकू के नवनियुक्त वैज्ञानिक/अभियंता-एससी की प्रथम बैच के लिए 30 अगस्त 2017 को एक दिवसीय राजभाषा कार्यशाला का आयोजन किया गया। कार्यशाला के उद्घाटन सत्र की अध्यक्षता श्री एस. एस. सरकार, उप निदेशक-सेडा ने की। कार्यशाला के सत्र लेने के लिए अंतरिक्ष विभाग के पूर्व संयुक्त निदेशक (राजभाषा) श्री बी.आर. राजपूत को आमंत्रित किया गया। केंद्र की वरिष्ठ हिंदी अधिकारी श्रीमती नीलू सेठ ने सभी प्रतिभागियों और अतिथि वक्ता का स्वागत करते हुए संक्षेप में कार्यशाला के प्रयोजन और राजभाषा के महत्व पर चर्चा की। हिंदी अधिकारी श्री सोनू जैन ने आभार ज्ञापित किया।

प्रथम सत्र में हिंदी की संवैधानिक स्थिति का संक्षिप्त परिचय दिया गया। द्वितीय सत्र में प्रतिभागियों को सरल शब्दों में राजभाषा विभाग के वार्षिक कार्यक्रम, निरीक्षण व रिपोर्टों के बारे में जानकारी प्रदान की गई। तृतीय सत्र में कंप्यूटर पर हिंदी एक्टिवेट करने और हिंदी में ईमेल आदि करने की जानकारी दी गई। साथ ही सभी प्रतिभागियों को अंतरिक्ष विभाग की विभिन्न प्रोत्साहन योजनाओं के विषय बताया गया।

कार्यशाला के पश्चात कई प्रतिभागियों ने हिंदी अनुभाग को हिंदी में ईमेल किए और कार्यशाला के आयोजन के लिए धन्यवाद दिया। इनमें अनेक हिंदीतर भाषा वर्ग के प्रतिभागी भी थे जिन्होंने आगे से अधिकतर कार्य हिंदी में करने में रुचि दर्शायी।

SUPERANNUATION

The following colleagues superannuated from SAC during April-September 2017. SAC appreciates their valuable services during their tenure at SAC.

SAC Courier wishes them a happy, peaceful and healthy retired life
(Details indicate Name, Division and Journey commencement at SAC)

April 2017

SMT. ANJANA N PATEL
SNPA-RFSG-RFSD
24-02-1978

SRI. S J OZARKAR
ESSA-EFMG-TIMCD
07-09-1978

SRI. ANIL CHAND MATHUR
MESA-ASMG
25-09-1978

SRI. KANU U VANIA
ADMIN-PURCHASE-STORES
18-11-1987

May 2017

SRI. S D NAROLA
EPSA
15-04-1976

MRS. RAMILA D SOYANTAR
ADMIN-PURCHASE
08-03-1978

SMT. REKHA B SHAH
ASG-AMF
14-04-1978

June 2017

SMT. SARLA N CHAWLA
ADMIN-P & GA
20-06-1978

SRI. CHATURBHAI HEMABHAI BHAMAT
ESSA-EFMG-PEFD
19-08-1978

SRI. AMRUTBHAI M. PATEL
MESA-MSFG-FSF
07-08-1978

SRI. BHAILALBHAI B VASAVA
MESA-STG-VTF
22-05-1986

SRI. MOTIBHAI B PATEL
DECU
09-03-1989

SRI. HARESH DAHYALAL MEHTA
ESSA-MEG
21-06-1978

June 2017

SRI. BHARAT DINKERLAL MEHTA
SNPA-RFSG-ETAD
01-01-1979

SRI. DAHYABHAI G RATHOD
ESSA-EnTSG-TTSD
29-04-1981

SRI. ASHOK I CHANDNANI
ADMIN-CMG
29-06-1978

July 2017

SRI. N K MEHTA
ESSA-EFMG-ESSD
10-06-1988

SRI. CHAMANLAL S PATANI
MESA-MSFG-FSF
10-08-1984

SRI. MUKESH PRABHUDAS GONDALIA
ADMIN-CMG
21-06-1978

September 2017

SRI. RAMANLAL SOMABHAI PATEL
ADMIN-CMG-CED
01-04-1978

SRI. D N PANDYA
PPG-VSSE
21-07-1978

SRI. KISHORKUMAR PARBHUBHAI BHARUCH
SEDA-OSG-HOD
06-01-1983

SMT. K B GAJJAR
SRG-EQCD
15-07-1978

SRI. ASHOKKUMAR N VAGHELA
ADMIN-PURCHASE-STORES
13-01-1984

SRI. KAMLESH K PANDYA
ADMIN-PURCHASE
14-04-1986

Shri Shri Ravishankarji visited SAC on August 10, 2017 and addressed the SAC/ISRO Family.

71st Independence Day celebration at SAC with the hoisting of National Flag by Director, SAC on August 15, 2017.

Illumination of SAC building on the eve of Independence Day.

Swachh Bharat pakwada is observed at SAC during 16-30 June, 2017. Various activities like painting competition, cleaning of office buildings were carried as a part of this campaign.

Published by: Space Applications Centre, ISRO, Ambawadi Vistar P. O., Jodhpur Tekra, Ahmedabad - 380051. Web: www.sac.gov.in
Prepared by: PPMD/PPG, SAC, Ahmedabad. Printed by: Surya Offset, Ambli Gam, Ahmedabad.