Launch Taiwan
Into Higher Orbits

NARLabs 國家實驗研究院
國家太空中心
National Space Organization
NSPO

30078新竹市科學園區展業一路九號八樓
8F., 9 Prosperity 1st Road, Hsinchu Science Park,
HsinChu, Taiwan, R. O. C.

TEL +886-3-578-4208
FAX +886-3-578-4246
www.nspo.narl.org.tw

國家太空中心 中華民國一〇四年年報

National Space Organization 2015 ANNUAL REPORT

NSPO

NARLabs 國家實驗研究院
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2015

ANNUAL REPORT 中華民國一〇四年年報

福爾摩沙衛星發射全國兒童徵圖比賽
Formosa satellite launch nationwide recruitment of children Figure game

2015

ANNUAL REPORT 中華民國一〇四年年報

主任的話

2015 年是我國執行太空計畫非常關鍵的一年，國家太空中心在全體同仁與合作夥伴一起努力下，完成多項重要的里程碑。首先台灣第一顆完全自主研製的高解析度遙測衛星－福衛五號，包括地面段的衛星操控系統與影像處理系統已經完成備便，太空段的衛星本體與光學遙測以及科學酬載組裝完畢，並完成環境測試與綜合功能測試，於年底通過運送前審查 (Pre-ship Review)。福衛五號已蓄勢待發，預計 2016 年第三季運送到美國范登堡基地與獵鷹 9 號發射載具組裝，預期在第三季發射升空。

而台美合作的福衛七號計畫，第一組發射的 6 顆任務衛星，業已在國家太空中心完成組裝作業，完成環境與系統測試，正持續進行地面操控到衛星的端至端測試。福衛七號目前規劃於 2017 年第一季發射。

除了上述兩個主軸計畫在 2015 年的重要成果外，國家太空中心在推動太空科普教育方面也是不遺餘力，除了舉辦定期的太空夏令營隊外，為配合福衛五與福衛七號的發射活動，我們也特別舉辦了「看見台灣 夢想升空－福爾摩沙衛星五號、七號發射全國兒童徵圖比賽」，此次活動受到全國國小學生的矚目，共收到超過 3,500 件作品，最後選出 116 個獎項。

此外，國家太空中心在科技研發與科技管理的能力，也獲得了國內外不同單位的肯定。首先在科技研發方面，國家太空中心與國內產學研組成的研發團隊，所開發的衛星關鍵元件－光纖陀螺儀及其組件，分別榮獲美國 2015 年 R&D 100 獎項以及 2015 年行政院傑出科技貢獻獎，而在科技管理方面，福衛五號計畫管理團隊也獲得中華民國科技管理學會學研團隊類的科技管理獎。

展望未來，國家太空中心全體同仁將持續努力，面對衛星發射與任務操作的各項挑戰，全力以赴為實現我國自主太空科技的願景目標而努力。

國家太空中心主任

張桂祥

Message from the Director General

The year of 2015 is a pivotal year of our nation's space programs. With the diligent and dedicated effort from all hands of NSPO, we had conquered numerous obstacles in front of us to achieve a series of important milestones. First of all, FORMOSAT-5, the first fully NSPO indigenously built high-resolution remote sensing satellite, is ready for launch after completing its environment testing, comprehensive performance test (CPT), and successfully conducting the Pre-Ship Review near the end of 2015. Those testings and reviews assured the integrity of the ground segment, including the satellite ground operation system and image processing system, and the space segment comprising bus, remote sensing instrument and science payload. FORMOSAT-5 is planned to be shipped to the U.S. Vandenberg Air Force Base in the mid-2016 for integration with Falcon-9 launch vehicle and the tentative launch period will be the third quarter of 2016.

Next, the first batch of six FORMOSAT-7 satellites under the joint effort between Taiwan and the United States concluded its assembly, integration, and the environmental testings, and are undergoing the end-to-end test between ground operation and satellite. Tentatively, the first set of the six FORMOSAT-7 satellites are planned to be launched no earlier than Q1 of 2017.

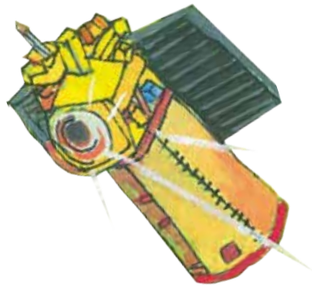
In addition to the fruitful achievements of the two important major programs in 2015, NSPO also dedicated effort to continuously promote space science and technology education in Taiwan. NSPO continued to hold the annual space summer camp. And among many variety activities related to the upcoming launch campaigns, NSPO held the children drawing competition event, titled 「Seeing Taiwan・Lifting Dream – the Launches of FORMOSAT-5 and FORMOSAT-7」, that drew great attentions of many students from elementary and junior high schools nationwide. There are 116 prizes awarded out of those 3,500 drawing works that were submitted to the competition event.

NSPO also received numerous recognition awards from domestic and overseas for the capability of technology development and management. For the achievement of technology development, Fiber Optical Gyro and its key components jointly developed by NSPO and its teams from industry, academia and research institutes won both 2015 prestigious U.S. R&D 100 Award and the Award for the Outstanding Contribution in Science and Technology from the Executive Yuan of Taiwan. In the area of technology management, NSPO received the Technology Management Award under the portfolio of academia and research institutes from the Taiwan Society for Management of Technology.

Looking ahead, all hands of NSPO will continue our diligent effort toward the future challenges on FORMOSAT-5 and FORMOSAT-7 Program from satellite launch to mission operation. Without any doubt, NSPO will continue to pursue to achieve the common goal set forth to become an indigenous space technology development nation.

Director General of NSPO

Guey Shi Chang



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25 馬英九總統視導太空中心 President Ma visited NSPO

26 美國在台協會梅健華處長參訪太空中心 AIT Director Moy visited NSPO

27「全抗輻射光纖光源」榮獲美國2015年R&D100獎項
NARLabs' Truly Radiation-Hardened Fiber Light Sources Product Received the Distinguished 2015 U.S. R&D 100 Award

28 福衛五號計畫團隊榮獲科技管理學會「科技管理獎」
Formosat-5 Program team is awarded with 2015 Technology Management Award

29「國產精密光纖陀螺儀」榮獲行政院傑出科技貢獻獎
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31 研發成果(R&D Achievements)

32 高光譜先進濾光元件研發 Hyperspectral Advanced Optical Filter Research and Development

33 台灣掩星資料處理髮系統(TROPS) Taiwan RO Process System (TROPS)

34 福衛五號影像處理系統資料擷取次系統(DIS) Formosat-5 Image Processing System (Data Ingestion Sub-system)

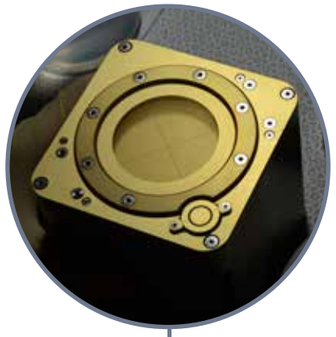
35 衛星地面操控軟體系統研發(XPSOC) Development of Satellite Operation and Control Software System (XPSOC)

36 任務規劃與排程系統(MPSS)開發 The function of Mission Planning and Scheduling System (MPSS)

37 衛星健康趨勢分析系統(N-Trend)研發 The Trending analysis of satellite state-of-health (N-Trend)

38 測試服務(Industrial Testing Services)

2015年度活動 Highlights of Annual Events



1/27

二十年磨一針 - 太空魔方 - 福衛五號科學酬載「先進電離層探測儀」記者會

「FORMOSAT-5 Advanced Ionospheric Probe (AIP) Science Payload」Press Conference

3/4

<巨人的眼睛—福爾摩沙衛星二號>於科技大樓1樓櫥窗「科學迴廊」展出

FORMOSAT-2 images exhibited in the Science Gallery of the Science and Technology Building in Taipei

3/24

完成福衛五號光學遙測酬載與衛星本體組裝

Completion of the Integration of FORMOSAT-5 CMOS RSI to the Spacecraft bus

5/12

逆風而上展翅再飛–福衛五號光學遙測酬載自主研製完成記者會

NSPO-built FORMOSAT-5 CMOS RSI Completion

7/27

2015太空科學小主播夏令營

2015 Space Science Anchor Camp

7-8月

福衛五號完成重要測試(熱真空艙測試、分離爆震測試、音震測試及振動測試)

Environmental Test Completion for FORMOSAT-5

10/17

【看見台灣 夢想升空】福爾摩沙衛星五號、七號發射全國兒童徵圖比賽頒獎典禮

National Children Drawing Contest Awards Ceremony for FORMOSAT-5, -7 Launch Campaigns

10/31

馬英九總統視導國研院太空中心

President Ma visited NSPO

11/13

福衛七號自主衛星關鍵設計審查

Critical Design Review for FORMOSAT-7 NSPO-built Spacecraft

11/16

- <全抗輻射光纖光源>榮獲美國 R&D100 獎項
- 美國在台協會梅健華處長參訪國研院太空中心

- NSPO/NARLab's “Truly Radiation-Hardened Fiber Optic Sources” was named one of the U.S. R&D 100 Finalists
- AIT Director Kin W. Moy Visited NSPO

11/20

- 遙測衛星前瞻技術暨福衛五號使用者說明會
- 福衛五號計畫團隊榮獲科技管理學會「科技管理獎」

- Advanced Remote Sensing Satellite Technology Workshop & FORMOSAT-5 User Conference
- FORMOSAT-5 program team is awarded with “2015 Technology Management Award in Academy and Research Team Category” by the Chinese Society for Management of Technology (CSMOT)

12/07

「國產精密光纖陀螺儀」榮獲2015年行政院傑出科技貢獻獎

The Precision Fiber-Optic Gyroscope Team led by NSPO Received the 2015 Outstanding Technical Achievement Award from the Executive Yuan

12/28-29

福衛五號運送前審查

Pre-Ship Review(PSR) for FORMOSAT-5

中心簡介 Brief Summary

1991 年 10 月行政院核定「國家太空科技發展長程計畫」(第一期計畫)，同時由國科會(現科技部)成立行政院國家太空計畫室籌備處，為我國太空計畫的執行單位。2003 年 6 月，財團法人國家實驗研究院成立，改隸其下。2005 年 4 月 1 日起更名為國家太空中心。國家太空中心是台灣唯一負責太空相關事務的專責單位，兼具國家太空科技政策執行與太空科技研發雙重特性。

願　　景 成為創新與卓越的太空科技研發機構 / 發展具台灣優勢與競爭力的太空計畫

任務目標 建立自主太空科技能量 / 滿足社福民生需求 / 推動尖端太空科學研究

核心價值 關鍵技術的研發 / 核心能量的傳承 / 優質團隊的養成

National Space Organization (NSPO) was established in 1991 and is the sole institute that takes charge of the execution of the national space program and the development of space technology in Taiwan. NSPO have actively implemented to become the center of innovation and excellence for the space technology through the development of satellite programs.

Vision
- Become a center of innovation and excellence for space technology
- Conduct space programs with Taiwan's strength and global competitiveness

Mission
- Establish indigenous space technology
- Fulfill pronounced societal impacts
- Promote frontier space science research

Value
- Innovative space technology
- Core competence heritage
- Elite integrity team

組織架構 Organization

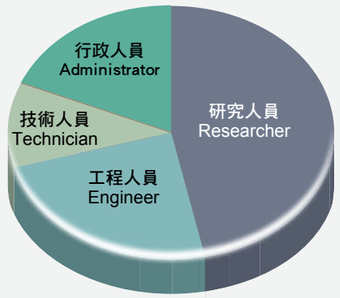
為有效執行衛星計畫，國家太空中心採用矩陣式管理，除行政功能組及技術功能組外，配合計畫執行，任務編組成立計畫室。

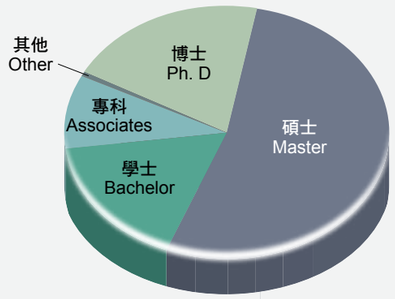
In order to implement the Space Programs efficiently, National Space Organization adopts matrix management architecture. In addition to the implementation of the general administrative and technical functional groups, various Task Forces Offices are set up to effectively execute each specific program or mission.

人力資源 Human Resource

職稱人數統計圖表
Human Resource Allocation

研究人員 Researcher	工程人員 Engineer	技術人員 Technician	行政人員 Administrator
91 人	46 人	21 人	36 人
46.9 %	23.7 %	10.8 %	18.6 %



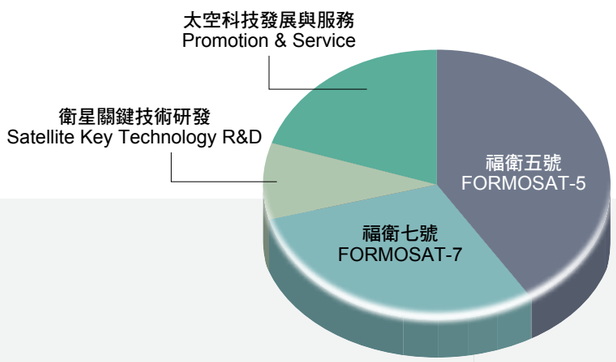


學歷人數統計圖表
Education Qualification

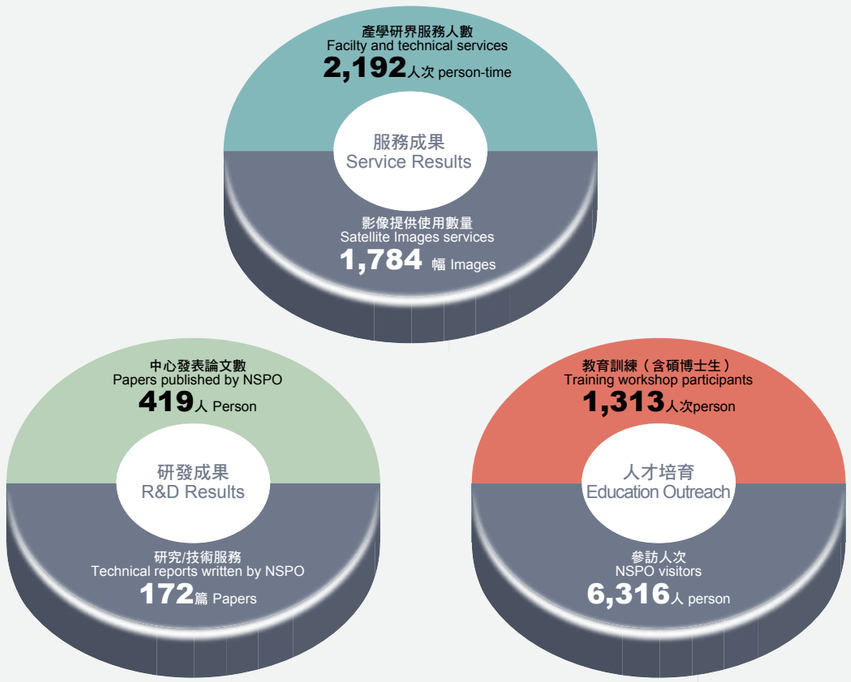
博士 Ph. D	碩士 Master	學士 Bachelor	專科 Associates	其他 Other
39 人	103 人	33 人	18 人	1 人
20.1 %	53.1 %	17 %	9.3 %	0.5 %

財務資訊 Financial Information

福衛五號 FORMOSAT-5	福衛七號 FORMOSAT-7	衛星關鍵技術研發 Satellite Key Technology R&D	太空科技發展與服務 Promotion & Service
6.48 億 19.64($M USD)	4.75 億 14.40($M USD)	1.5 億 4.55($M USD)	3.13 億 9.48($M USD)
41 %	30 %	9 %	20 %

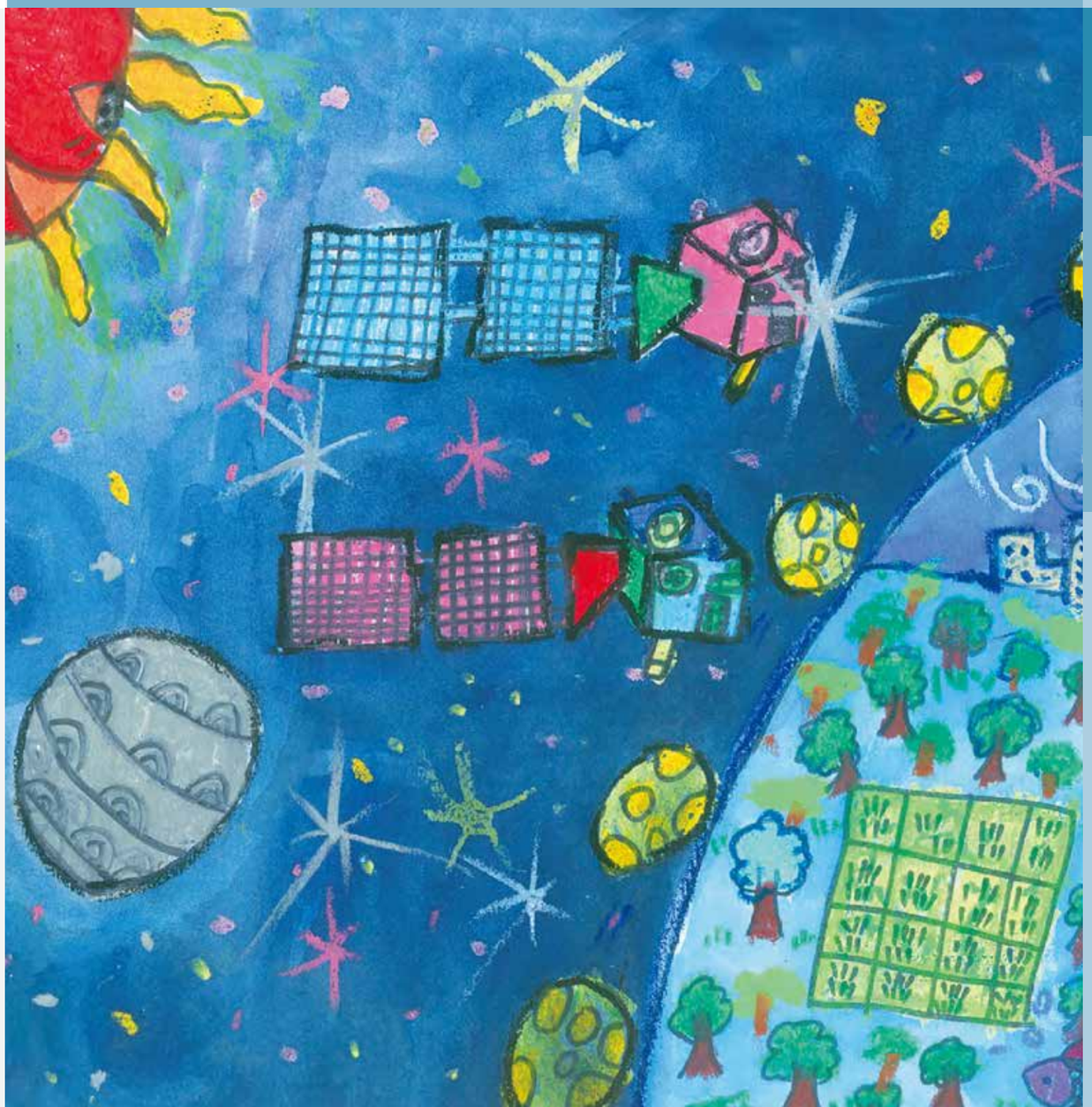


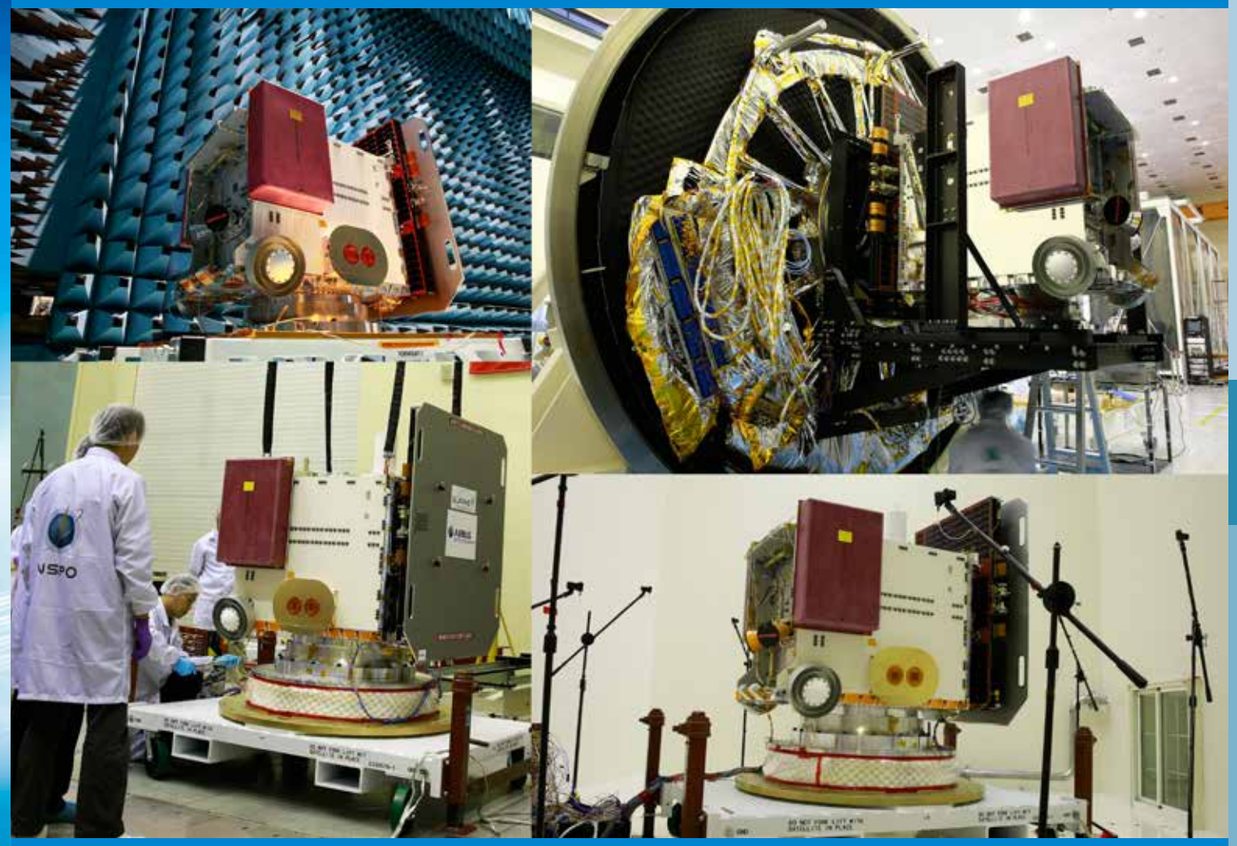
年度成果統計 Statistics of Achievements



優選 / 高慈涵

衛星任務 Satellite Missions





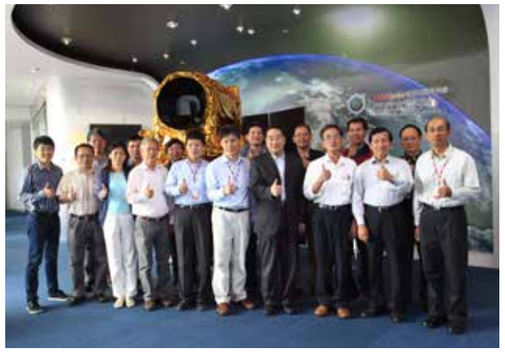
福 爾摩沙衛星七號計畫

福爾摩沙衛星七號計畫（以下簡稱福衛七號）為台美國際合作計畫，由國家太空中心與美國國家海洋暨大氣總署 (National Oceanic and Atmospheric Administration, NOAA) 共同執行，規劃分兩次發射 12 顆衛星，建立一個操作型氣象衛星星系，以接續福衛三號任務，提供更多且密集的全球氣象觀測資料，以提升氣象預報準確度。同時，太空中心也發展一顆兼具前瞻任務與技術開發的 300 公斤級自主衛星，以增加任務實用性並作為關鍵技術驗證的平台。

第一組星系的 6 顆任務衛星已於 2015 年完成組裝，並進行環境與系統測試，衛星操控系統 (XPSOC) 與任務規劃與排程系統 (MPSS) 自主開發完成，並通過福衛七號端點的測試與驗證。「台灣掩星資料處理中心 (TDPC)」完成資料處理軟體安裝及測試工作，由國內學界團隊所發展的掩星資料處理驗證系統 (TROPS) 完成第一次資料品質驗證，平均產品產出率可達 90％~105％。

另外，自主衛星完成關鍵設計審查，其衛星電腦、電力控制單元、導航接收機、光纖陀螺儀等關鍵元件已陸續完成工程體 / 工程驗證體研製，並進行功能及環境測試，而任務酬載 GNSS-R 也已完成執行規劃。

依 2015 年第 8 屆福衛三號資料使用者研討會，研究人員 E.R.Kursinki 博士的報告顯示，福衛七號第一組星系對減少天氣預報誤差的貢獻預估約為 18 ％。



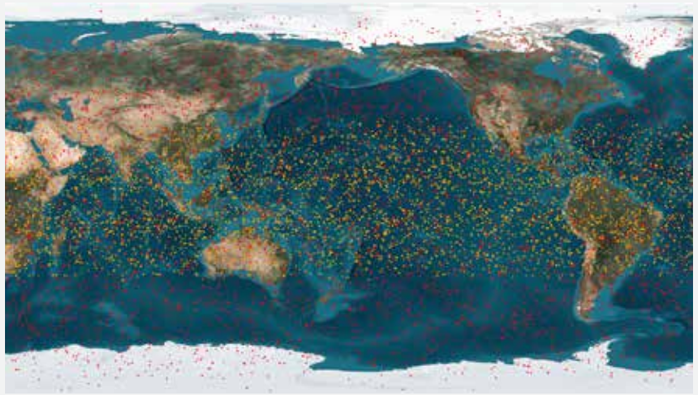
FORMOSAT-7 Program

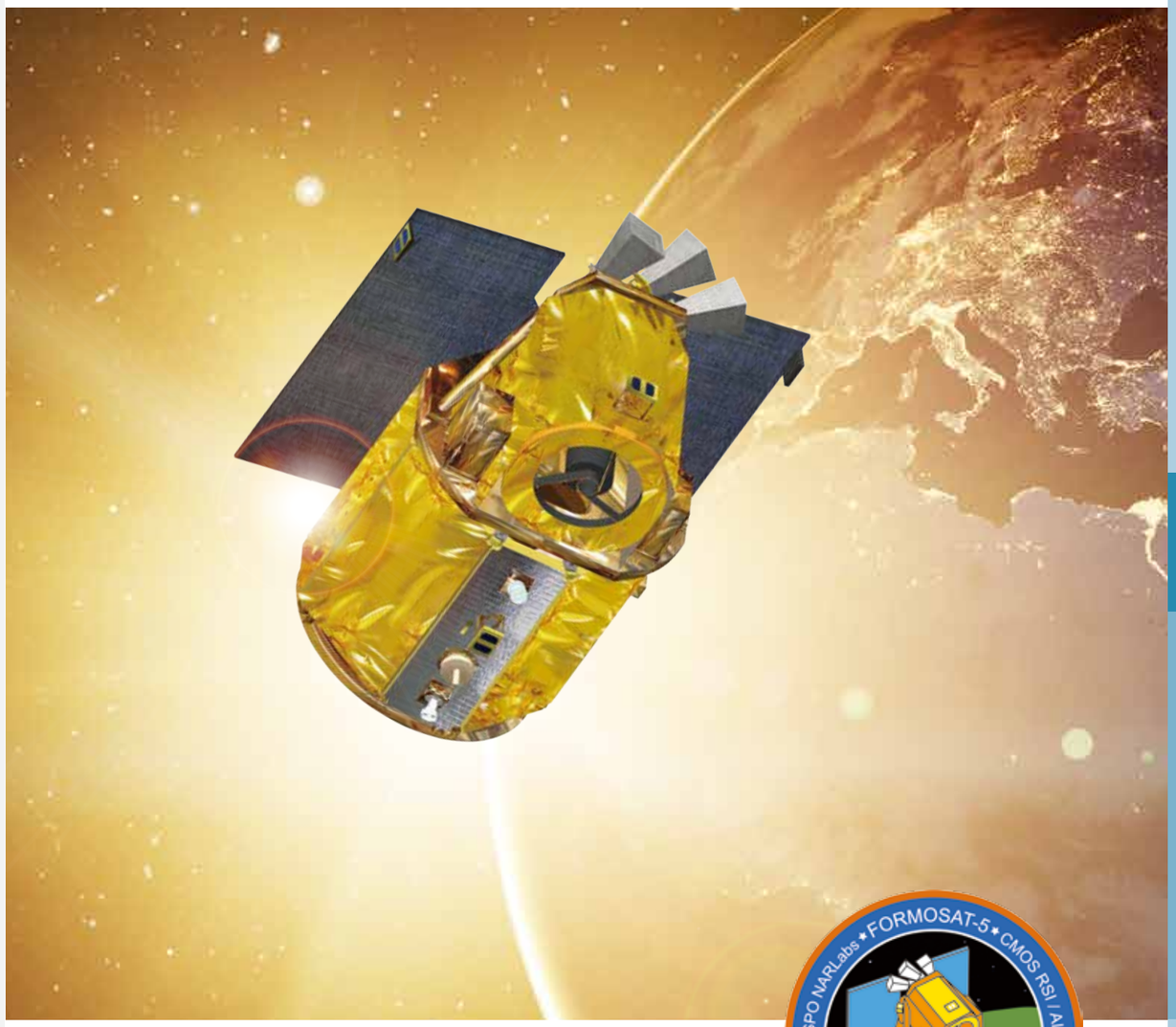
FORMOSAT-7 Program is a Taiwan-U.S. collaboration mission between NSPO and the National Oceanic and Atmospheric Administration (NOAA) of the United States. The objective of the FORMOSAT-7 Program is to provide a 12-satellite constellation to continue the FORMOSAT-3 mission. FORMOSAT-7 satellites will be launched in two batches. The completed operational FORMOSAT-7 constellation system will provide the enhanced near real-time weather observation data with greater spatial and geographical distribution density.

NSPO has completed all of the Integration of the first set of the 6 mission satellites by the end of 2015, and continue the satellite system level functional and environmental tests. NSPO has also completed the implementation of the enhanced multiple mission control platform (XPSOC) and Mission Passes Scheduling System (MPSS) that are ready to control the first set of the constellational satellites. Taiwan Data Processing Center (TDPC) has completed the system software installation and check-out in 2015. The resultant quality control of the Taiwan Radio Occultation Processing System (TROPS) developed by the domestic TDPC, indicated an averaged 90 ~ 105 % processed data through-put can be expected.

In addition, NSPO also emphasizes on a self-developed satellite with the add-on value to the joint program and with the purpose to demonstrate NSPO's capability in the class of 300-kg small satellite. The team of NSPO-Built satellite has accomplished the Critical Design Review (CDR) in November 2015. The key components including power control unit, on-board computer, GPS receiver, and Fiber Optic Gyro, have been progressing well to complete the Engineering Models (EMs) and the space-grade environmental testing. NSPO also completed the requirement system planning for GNSS-R (Reflectometry), a potential mission payload.

As indicted by Prof. Robert Kurinski in the 8th FORMOSAT-3 Data User Workshop in October 2015, the simulated lower constellation data of the first set of the 6 FORMOSAT-7 mission satellites will have a significant impact of 18 % forecast error reduction.





福爾摩沙衛星五號計畫

福爾摩沙衛星五號（以下簡稱福衛五號）是我國第一顆自主發展的遙測衛星，將提供對地解析度黑白 2 米，彩色 4 米的高解析度衛星遙測影像，具有全球涵蓋取像及兩天再訪的特性。福衛五號計畫完成 100％ 臺灣製的高解析度光學照相機及先進電離層探測儀，並成功開發出衛星電腦、電力系統、飛行軟體等多項關鍵元件，除滿足國計民生於環境監控及災害評估等需求外，也達到自主遙測衛星能量建立的主要效益。

2015 年，福衛五號持續進行最後的環境測試，完成衛星最後綜合功能驗證、端至端測試以及第 4 次任務操控工作會議後，衛星系統業已備便，而地面系統和相關發射活動規劃也已就緒。福

衛五號預定 2016 年第三季運送至美國與火箭結合，第三季在加州范登堡基地發射。將可提供福衛五號影像與科學資料服務。

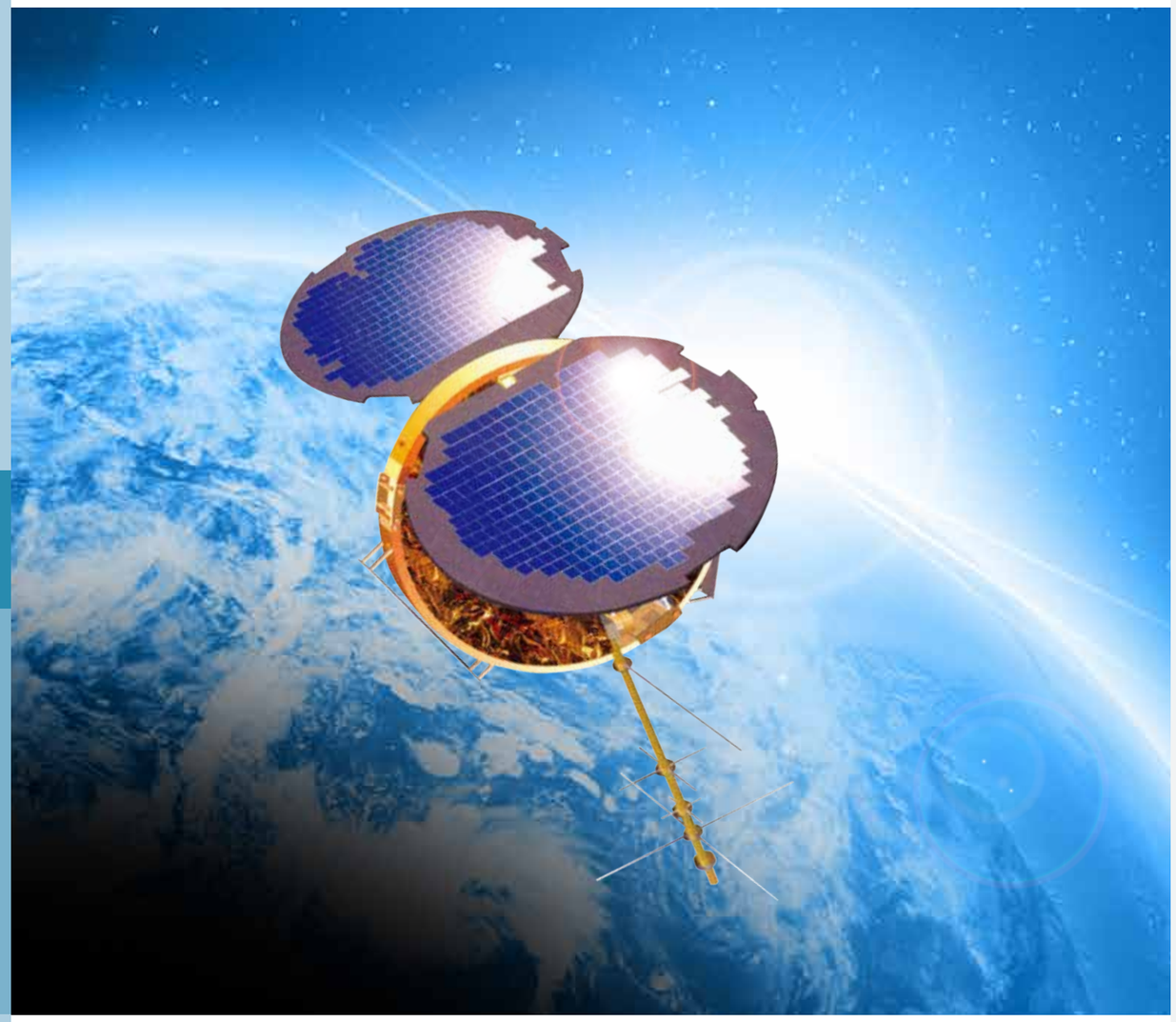
福衛五號的遙測酬載 (RSI) 是採用線型、大尺度封裝、且具高性能的 CMOS 為感測器，而中央大學太空科學研究所負責研製的科學酬載「先進電離層探測儀 (AIP)」，則是國際間首創以單一探測儀實現多合一的電漿量測儀器，可量測離子密度、離子速度、離子溫度、電子溫度等。近年已有許多文獻探討電離層參數變化與地震的關聯度，該量測資料，將有助於電離層地震前兆等研究，對防災科技的進步提供貢獻。

FORMOSAT-5 Program

FORMOSAT-5 is the first remote sensing satellite that NSPO takes full responsibility for the complete satellite system engineering design which provides 2-m resolution panchromatic (PAN, black & white) and 4-m resolution multi-spectral (MS, color) imagery with capabilities of two-day revisit and global coverage. The satellite equipped with payloads of an optical Remote Sensing Instrument (RSI) and an Advanced Ionospheric Probe (AIP). Moreover, key components, such as Flight computer, power control system and flight software have been successfully developed and made in Taiwan. The program has met the Taiwan needs in disaster management and earth observation in one hand, and accomplished the objective of self-reliant development capability of the remote sensing satellite.

FORMOSAT-5 is now at the final satellite environmental test phase. The satellite has completed the comprehensive performance test (CPT), end-to-end test, the forth mission operation working group (MOWG-4) meeting. Both the satellite and the ground operation support eguipments have been ready to be shipped to the U.S. launch site for final satellite preparation and integrating to the launch vehicle for the scheduled launch in the third quarter 2016. It's expected that the data of remote sensing and science payloads from FORMOSAT-5 satellite will be provided to the users in the fourth quarter in 2016.

The optical Remote Sensing Instrument (RSI) is the first large IC package of CMOS linear sensor and the AIP, developed by National Central University, is an all-in-one plasma sensor to measure ionospheric parameters, such as plasma concentrations, velocities, and temperatures over a wide range of spatial scales. Recent studies reveal that changing parameters of ionosphere are relative to seismic precursors of earthquakes. Measurements of those parameters will speed up research of seismic precursor and eventually mitigate the loss of disasters.



福爾摩沙衛星三號計畫

「福爾摩沙衛星三號計畫（簡稱福衛三號）」為臺美國際合作計畫，於 2006 年發射 6 顆衛星，是第一個運用衛星星系來量測對流層、同溫層和電離層的系統，目前除我國中央氣象局外，加拿大、美國、英國、日本、澳洲、韓國、歐盟等重要氣象預報單位，均已將福衛三號資料納入其氣象預報作業系統中。截至 2015 年底，福衛三號資料已提供給 81 國家 2975 位科學資料使用者。

國研院颱洪中心針對 2015 年期間 26 個颱風，分析同化福衛三號掩星資料對於颱風路徑與降雨預報的效益，結果顯示福衛三號資料降低颱風 72 小時路徑誤差約 3.9 %，表示颱風登台地理位置的預估準確性提高約 10 公里，且增加約 6 小時的防災預警時間。

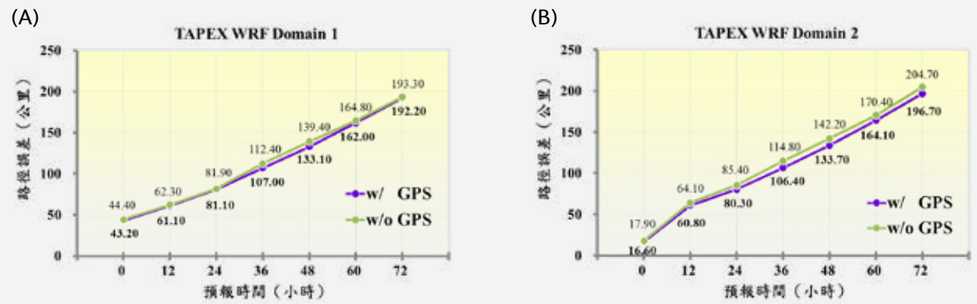
2006 年福衛三號發射後至 2015 年底，計有超過 1000 篇掩星相關研究期刊論文，其中有 42 % 論文引用福衛三號的資料。

FORMOSAT-3 Program

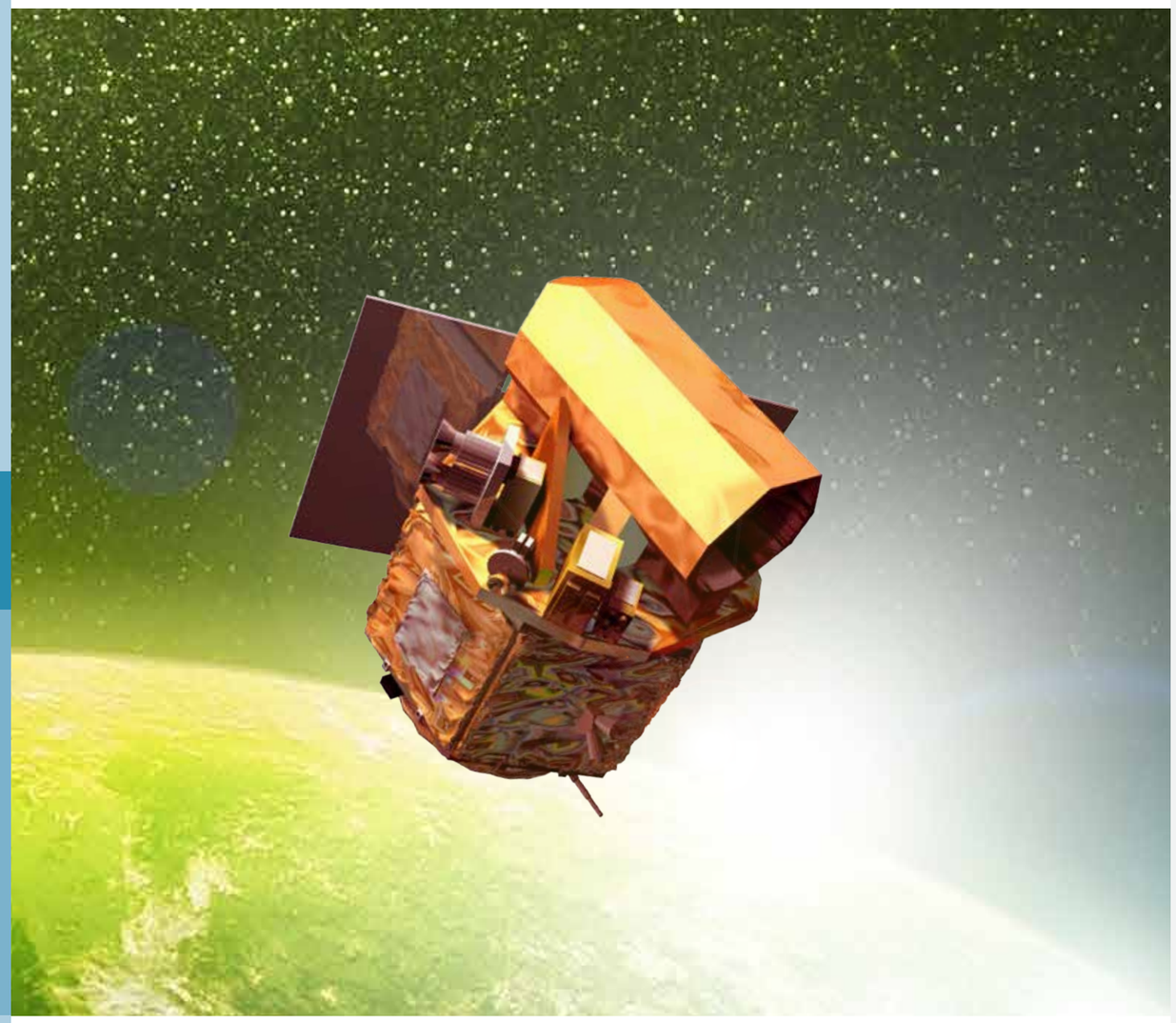
FORMOSAT-3 Program is a Taiwan-U.S. collaboration mission between NSPO and the University Corporation for Atmospheric Research (UCAR) of the United States. Following the successful launch in April 2006, the FORMOSAT-3 6-satellites constellation was deployed to form a global earth observation network and to provide the near real-time radio occultation weather data. The Taiwan Analysis Center for COSMIC (TACC) co-located with the Central Weather Bureau in Taipei and the COSMIC Data Analysis and Archive Center (CDAAC) located in UCAR at Boulder, Colorado are two synchronized but independently operated centers to process, analyze, distribute, and to archive the retrieved near real-time FORMOSAT-3 constellation data via the remote receiving ground stations. The retrieved atmospheric and ionospheric data in vertical profiles are widely used for operational weather forecast, research, and related applications. As of the end of 2015, the FORMOSAT-3 global data user community has grown to 2,975 registered users in 81 nations.

In 2015, Taiwan Typhoon and Flood Research Institute (TTFRI) studied 26 cases of Typhoon through TAPEX system. With the assimilated FORMOSAT-3 data, the 72-hr mean typhoon path error in 10 km resolution model can reduce to 3.9 % or a 6-hour advanced warning for disaster prevention, as indicated in the result of study.

By the end of 2015 since the 2006, there are more than 1,000 GNSS RO related papers presented in the worldwide prestige science journals, research articles, and/or conference papers. 42 % of these papers are cited using FORMOSAT-3 RO data.



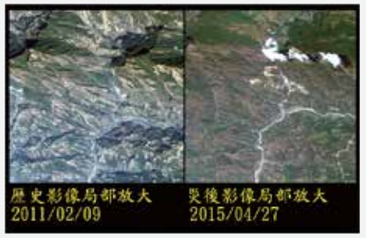
2014 年度 TAPEX 實驗統計 21 個颱風於 (a) 最外層預報區域、(b) 中層預報區域之路徑預報誤差。圖中線條分別代表同化（紫）及無同化（綠）福三掩星資料之結果
2014 TAPEX experiment statistics: forecast errors for 21 typhoons in (a) outermost forecast regions; (b) central regions. The lines represent results from assimilated (purple) and non-assimilated (green) FORMOSAT-3 RO data



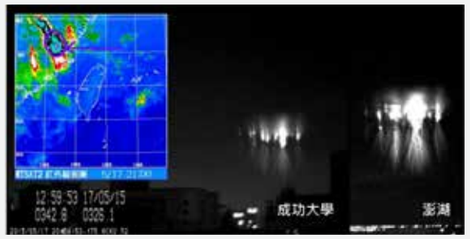
福爾摩沙衛星二號計畫

福爾摩沙衛星二號（以下簡稱福衛二號）是我國第一顆高解析度遙測衛星，可提供黑白 2 米，彩色 8 米的衛星遙測影像。另外福衛二號也搭載高空向上閃電儀，觀測高空短暫發光現象。自 2004 年 5 月發射至 2015 年底，全球累計取像面積超過 1,393 百萬平方公里。2015 年與分送中心，共計支援 62 項政府機關計畫、35 項學術研究及 7 項國內產業應用，應用領域涵蓋環境監測評估、農業規劃應用、土地利用規劃、水資源管理、災害防治評估、科學研究與各主題地圖製作等。由於，福衛二號具有每日再訪的獨特優勢，2015 年協助尼泊爾地震、日本新岳火山噴發、尼加拉瓜 VOLCAN TELICA 火山爆發、台灣蘇迪勒風災、台灣杜鵑颱風等國內外救災計 49 項。此外，太空中心也與日本遙測衛星技術中心 (RESTEC) 合作，提供福衛二號日本影像進行影像加值產品製作。

福衛二號高空向上閃電儀，2015 年所觀測到的高空短暫發光現象事件中，有紅色精靈 (sprites)137 例、精靈暈盤 (halos)42 例、淘氣精靈 (elves) 2,366 例、巨大噴流 (gigantic jets)1 6 例，藍色噴流 (blue jet) 527 例，共有 3,088 個，這些觀測資料持續提供給國內外研究單位使用。此外 ISUAL 科學團隊也於成功大學物理二館、台東大學教學大樓、澎湖科技大學實驗大樓以及金門金城國中頂樓設置地面觀測站，以增加劇烈天氣與高空短暫發光現象關聯的瞭解。



福衛二號尼泊爾地震局部比對
Regional comparisons by FORMOSAT-2 in the Nepal earthquake



2015 年 5 月 17 日 20:59:53，由設於成功大學與澎湖的地面觀測站同步攝得成群紅色精靈。相對應於左上方雲圖中，箭頭所示為產生事件的對流系統。
At 20:59:53 on May 17, 2015, sprites were simultaneously captured by ground stations located at NCKU and Penghu. The arrow indicates the convective system that corresponds to the satellite image in the upper left corner. The convective system that produced the indicated event.

FORMOSAT-2 Program

FORMOSAT-2 is the first high resolution remote sensing satellite developed by NSPO. The primary payload, remote sensing imagery (RSI), provides a 2-m panchromatic (PAN, black & white) and a 8-m multi-spectral (MS, color) imagery. FORMOSAT-2 also carries a scientific payload, the Imager of Sprite/ Upper Atmospheric Lightening (ISUAL), for observing Transient Luminous Events (TLEs).

The satellite has been operating for 11 years since its launched in May 2004, as of the end of 2015, total area of image, acquired by FORMOSAT-2, were over 1,393 million square km.

In 2015, FORMOSAT-2 images have supported 62 government projects , 35 academic research projects, and 7 domestic industry applications, including the fields of environmental monitoring and analysis, agricultural plan and application, land use and physical planning, water resource management, disaster prevention analysis, scientific research, and various map constructing…etc.

Moreover, the advantage of FORMOSAT-2 daily revisit assisted a total of 49 domestic and international disaster supports in the year of 2015, which include the earthquake in Nepal, volcanic eruption in Japan, VOLCAN TELICA volcanic eruption in Nicaragua, typhoon Soudelor and typhon Dujuan in Taiwan. On the other hand, NSPO also teamed up with Remote Sensing Technology Center of Japan (RESTEC) to enhance the visibility of FORMOSAT-2 image in the international market through providing FORMOSAT-2 value-added products of Japan images.

FORMOSAT-2 scientific payload (ISUAL) has observed and recorded a total of 3,088 High-altitude short luminescence phenomenon including 137 sprites, 42 halos, 2,366 elves, 16 gigantic jets, and 527 blue jets provided for domestic and foreign research institutes in the year of 2015. These observed data from FORMOSAT-2 continued to be provided to the global data users. In addition, ISUAL science team has implemented more ground observation sites including at the NCKU in Tainan, the NTTU in Taitung, the NPUST in Penghu, and JC Junior High School in Kinmen to enhance the observations of the Transient Luminous Events occurred above Taiwan.

焦點報導
Annual Focus

優選 / 鄭子萱

看見台灣 夢想升空
福爾摩沙衛星五號、七號發射全國兒童徵圖比賽

為慶祝福爾摩沙衛星五號、七號即將發射升空，太空中心於 2015 年舉辦「看見台灣 ・ 夢想升空」福爾摩沙衛星全國兒童徵圖比賽，帶領兒童認識福爾摩沙衛星與台灣衛星科技發展歷程。此活動總共收到 3,694 件作品，於 8 月 14 日選出首獎、優選、佳作及網路人氣王共 116 個獎項。福衛五號首獎由新北市蘆洲區成功國民小學朱嘉尹同學獲得，她的畫作將繪製於福衛五號的發射火箭上；福衛七號首獎由臺南市東區崇明國民小學林可惟同學獲得。兩位首獎得主與隨行家長將可赴美國參觀衛星發射。

徵圖比賽評審們表示，本次參賽作品不論質與量，均令評審感到驚喜，絕大多數都能表現「衛星」和「台灣」的重要元素，至於表現方式，則各憑想像與實力，展現繽紛多元且亮麗的作品。得獎畫作並於 10 月 18 日至 11 月 1 日於國立臺灣科學教育館展出。

焦點報導 Annual Focus

2015 ANNUAL REPORT

Seeing Taiwan · Lifting Dream · National Children Drawing Competition for FORMOST-5 and FORMOST-7 Launch Campaigns

NSPO held “Seeing Taiwan · Lifting Dream " chidren drawing competition to promote the upcoming FORMOSAT-5 and -7 launch campaigns. Taking the opportunity of this drawing competition to lead the children to understand national missions of the FORMOSAT satellites and the space technology development in Taiwan. There are a total of 3,694 works that were submitted, and among them 116 prizes were awarded on August 14 to the winners of the first prize, the excellent works, the good works , the most internet popularity-vote elected work. The first prize of FORMOSAT-5 launch campaign was awarded to Xi-Yin Chu, a student of New Taipei City. Her winning drawing image will be formed as part of the decal that will be printed on the launch vehicle for FORMOSAT-5 satellite. And the first prize of FORMOSAT-7 launch campaign was awarded to Ke-Wei Lin, a student of Tainan City. Both of the first prize winners accompanied by their parents will be invited to the respective FORMOSAT-5 and -7 launch sites in the United States to witness the glory of the satellite launch.

The judges of the children drawing competition for the launch campaigns complimented that they were pleasantly surprised by the submitted drawings both in their quality and quantity. Most of them showed the important elements of "satellite" and "Taiwan", the themes of the launch campaigns. The children’s works are full of diversified imagination and the brighten coloring to highlight the lifting dreams. All the winning paintings were exhibited between October 18 to November 1 at the National Taiwan Science Education Center in Taipei.

福衛七號首獎畫作 / 林可惟
First place, drawing of FORMOSAT-7

福衛五號首獎畫作 / 朱嘉尹
First place, drawing of FORMOSAT-5

馬英九總統視導太空中心

馬英九總統於 10 月 31 日，在行政院毛治國院長及科技部徐爵民部長陪同下，蒞臨太空中心視導，瞭解福衛五號及七號衛星的整合及測試進度，並為辛苦的工作人員加油打氣。

馬總統表示，雖然我國發展太空計畫的進程，受到資源有限以及國際上對敏感科技設備輸出政策的限制，但在政府支持及國內產、學、研共同努力下，透過福衛一號、二號、三號衛星，以及福衛五號與七號的研發經驗，培育出許多優秀的太空工程師與團隊，終能排除萬難，落實我國自主發展太空科技的目標，他代表國人表達對包含科技部、國研院及太空中心在內的全體工作團隊肯定與嘉勉。

President Ma visited NSPO

On October 31, President Ma Ying-Jeou accompanied by Premier Mao Chi-Kuo of the Executive Yuan and Minister Shyu Jyuo-Min of the Ministry of Science and Technology, visited National Space Organization (NSPO) and witnessed the productions of FORMOSAT-5 and FORMOSAT-7 satellites.

President Ma proudly indicated at the end of his visit that NARLabs and NSPO at the leadership and support of the Ministry of Science and Technology have successfully integrated the space related domestic industry, research organizations, and academia institutes to complete the infrastructure of the space development and incubate numerous space scientist and engineers through the execution of FORMOSAT-1 through FORMOSAT-7 major series programs. In particular, NSPO has been realizing to achieve the national common goal to become an indigenous space technology development despite the fact that the limited resource in natural and the international export restrictions for space activities. President Ma, on behalf of the people, praised and encouraged the whole team of MOST, NARLabs, and NSPO.

美國在台協會梅健華處長參訪太空中心

美國在台協會梅健華（Kin Moy）處長一行人於 11 月 16 日蒞臨太空中心參訪。

太空中心早在 20 年多前就開始與美國太空科技單位合作，福衛一號、二號及三號均委由美方火箭成功發射，其中 2006 年發射的福衛三號，是台美第一次太空科技合作計畫，所提供的大氣觀測資料對全球氣象社群貢獻卓著。為接續福衛三號任務，台美雙方繼續攜手合作，發展福衛七號星系計畫。

參訪後，梅健華處長表示，他對太空中心的設備及能力留下深刻印象，並高度肯定台灣太空科技的發展成果及對國際社群的貢獻，美國在台協會也將持續推動及協助提升台美雙方在科技領域的合作關係。

AIT Director Moy visited NSPO

American Institute in Taiwan (AIT) Director Kin W. Moy visited the National Space Organization (NSPO) on November 16, 2015. NSPO has been collaborating with space organizations and industries in the United States over the past two decades in space technology development and joint space programs. NSPO's FORMOSAT-1, 2, and 3 satellite programs used the American launch vehicles. The FORMOSAT-3/COSMIC mission, launched in 2006, was the first U.S.-Taiwan cooperative space mission, providing breakthrough advances in meteorology, climatology, and other scientific fields. The United States and Taiwan are broadening this cooperation with the FORMOSAT-7/COSMIC-2 Program.

Director Moy's visit underscored the importance of U.S. and Taiwan space collaboration, a key component of the robust scientific cooperation between these two nations. During his visit, Director Moy had the opportunity to witness the production of the FORMOSAT-7/COSMIC-2 satellites and NSPO's indigenously developed FORMOSAT-5 earth imaging satellite.

Director Moy praised NSPO's advanced expertise and world-class facilities, calling it "a natural partner" for U.S. space organizations. AIT looked forward to working closely with NSPO to expand the space cooperation in the areas that provide scientific benefits to economies of both sides and the global community.

全抗輻射光纖光源
榮獲美國 2015 年 R&D100 獎項

太空級光纖陀螺儀關鍵元件「全抗輻射光纖光源」繼 2014 年獲得德國紐倫堡發明展社會組金牌獎後，2015 年在美國再榮獲有發明奧斯卡之稱及全球產品創新重要指標 R&D100 的得獎認證 (IT/Electrical 項目)，成為去年全世界最具創造力與競爭力的百大研發產品之一。此項評選包括美國所有國家實驗室、美國航太總署多家研發中心、麻省理工學院林肯實驗室及知名大公司共一千多項先進產品報名參加，初步入圍決選的有三百多項產品，最終挑選出最具技術突破性的百項新產品。此項得獎產品應用市場廣大，除太空感測與遙測應用於福衛七號自主衛星精準姿態控制的太空級光纖陀螺儀外，還可擴展到太空雷射光通訊領域，光頻寬較目前微波系統可擴增千倍以上，更重要的是此項產品可應用到核子電廠災防與災變的偵測與傳輸等，即使在災變時，還可將重要輻射偵測參數傳出，確實掌控災變情況因應，避免無謂傷亡。未來此技術更可應用於雷射核融合引擎，為下一代不需傳統液態或固態燃料的航太引擎，協助實現人類星際旅遊的夢想。

NARLabs' Truly Radiation-Hardened Fiber Light Sources Product Received the Distinguished 2015 U.S. R&D 100 Award

Following the recipient of gold medal award in the iENA Nuremberg Invention Fair in 2014, NARLab' "Truly Radiation-Hardened Fiber Light Sources" product, a key component in the space-grade fiber-optic gyroscope, received 2015 U.S. R&D 100 award in IT/Electrical category. The U.S. R&D 100 Awards, called the "Oscars of Innovation", recognize and celebrate the top 100 technology products of the year. All U.S. national labs, NASA affiliated labs, MIT Lincoln Lab, and major companies submitted over one thousand products in total into competitions. About three hundred products was selected in the initial round as the finalists, then the top one hundred most innovative products of the year was picked by a committee to receive the award. This patented truly radiation-hardened technology in rare-earth doped fiber has vast application potential. It has being employed in a 4-axis space-grade fiber-optic gyroscope for the FORMOSAT-7 self-reliant satellite developed by NSPO/NARLabs. In addition, it is able to sustain the fiber amplifier gain under severe space radiation, and hence greatly improve the reliability of space laser communication systems for a factor of one thousand improvement in bandwidth over the current RF link, and hence allow volume data collected in space to be relayed to ground in real or near real time without degradation. Moreover, being a truly radiation-hardened fiber light source in a distributed fiber sensor system, it is capable to detect critical radiation parameters and communicate with the outside world even under severe radiation environment such as nuclear disaster event. In the future, this unique radiation-hardened technology can also be employed in Boeing's patented invention of laser/nuclear driven engine which requires no liquid or solid fuel in future aviation or space flights, making deep space travel a reality.

福衛五號計畫團隊榮獲科技管理學會「科技管理獎」

福衛五號計畫團隊創新規劃「福衛五號計畫管理方案」、「系統工程管理方案」、「計畫技術審查手冊」與「福衛五號計畫品保方案」，奠定計畫執行基石。並以跨中心組織整合工作團隊 (Integrated Product/Process Team, IPT) 矩陣管理方式，整合國研院跨領域工程能量，依計畫研發流程執行各系統之設計、審查、製造、整合測試等工作。同時，該計畫將矯正預防與系統風險管理 N2 Matrix，融合規劃 - 執行 - 查核 - 修正（PDCA）品質管理循環方法，創新建置符合 ISO 9001 要求之太空品質管理系統。六年來，該團隊克服困難，完成多項衛星關鍵元件、全世界首例以線型大尺寸 CMOS 為感測器的遙測酬載 (RSI)，以及國際間首創可同時量測離子密度、速度與溫度，空間取樣率最高的先進電離層探測儀 (AIP) 科學酬載，獲得中華民國科技管理學會 2015 年度「科技管理獎」學研團隊類的殊榮。

FORMOSAT-5 program team is awarded with “2015 Technology Management Award in Academy and Research Team Category” by the Chinese Society for Management of Technology (CSMOT)

FORMOSAT-5 program team has innovatively developed the FORMOSAT-5 Program Management Plan, the FORMOSAT-5 System Engineering Management Plan, and the FORMOSAT-5 Product Assurance Program Plan as the management baseline for the program. The program has implemented an Integrated Product/Process Team (IPT) across different engineering disciplines among the centers and laboratories within the National Applied Research Laboratories (NARLabs). Based on these program management plans, the FORMOSAT-5 has successfully completed the development processes including design, fabrication, integration and tests. The program has built preventive and corrective actions, as well as risk management with N2 chart, in the Plan-Do-Correction-Action cycle of quality management system. It’s a space quality system and compliant to ISO 9001. The team has overcome various difficulties to develop many critical space-qualified components of Remote Sensing Instrument (RSI) and Advanced Ionospheric Probe (AIP) payloads. The RSI is the first large IC package of CMOS linear sensor and the AIP is an all-in-one plasma sensor to measure ionospheric plasma concentrations, velocities, and temperatures over a wide range of spatial scales. Accordingly, the FORMOSAT-5 Program team is awarded with “2015 Technology Management Award in Academy and Research Team Category” by the Chinese Society for Management of Technology (CSMOT).

國產精密光纖陀螺儀
榮獲 2015 年行政院傑出科技貢獻獎

由國家太空中心劉人仰資深研究員帶領的產、學、研團隊，包括 4 家科技公司、11 個學術團隊、與 2 個國家研發單位，十年在地深耕，成功研發受美國管制出口的精密光纖陀螺儀，於探空九號飛試成功。本團隊先後獲得國內外 8 項專利、2014 德國紐倫堡發明展社會組金牌獎、2015 美國 R&D100 獎項與國家實驗研究院傑出科技貢獻優良獎。此光纖陀螺儀使用國產超高可靠度光纖，並以獨特「光致退火」技術修復光纖光源於太空輻射照射下的退化損毀機制，為國際間首次能達成全修復的抗輻技術；而所開發單軸與三軸光纖陀螺儀，其角速度飄移穩定度與噪訊指標，分別優於外購陀螺儀 60 倍與 40 倍，並已進入小型量產，未來可大幅節省政府預算經費。此創新儀器與元件技術可應用於航太飛行器、太空遙感與通訊、太空穩定平台、地面與水下無人載具導控、國造潛鑑精準導航以及智慧型電網電流監控等。研製成果除了掌握重要國防與太空科技外，也具有廣大產業與學術效益，其卓越的貢獻因而獲選 2015 年行政院傑出科技貢獻獎。

The NSPO Led Precision Fiber-Optic Gyroscope Team Received the 2015 Outstanding Technical Achievement Award from the Executive Yuan

A domestic Integrated Product Development Team (IPDT) led by NSPO(National Space Organization) over the last ten years, consists of teammates from four local high-tech companies, eleven academic research groups, and two national research institutes, had successfully developed and fly-tested precision fiber-optic gyroscopes (FOG) in NSPO sounding rocket No.9. The FOG IPDT had been awarded so far eight US and Taiwan patents, and received prestige invention recognitions such as a gold medal award in the iENA Nuremberg Invention Fair in 2014, and the so called "Oscars of Innovation" the US R&D 100 award in 2015. The team also received the 2015 annual distinguished technology contribution award from NSPO's parent organization NARLabs(National Applied Research Laboratories) which oversees ten national research centers in Taiwan. The NSPO space-grade FOG employs a self-reliant highly-reliable single-mode fiber, and incorporates a patented photo-annealed technology to enable the total recovery of radiation-induced-attenuation(RIA) in rare-earth doped fiber light source. It was the first of its kind to being able to recover RIA totally in rare-earth doped fiber. The bias stability and random noise of the developed single, and three-axis FOGs are superior to those imported units by a factor of sixty and forty respectively. These domestic FOG units including all key components and modules are in small volume production. With all parts produced by local vendors, it is able to control FOG costs, and hence has great potential to lower government budget needed in many space and defense platforms employed precision attitude control, and guidance and navigation systems. The innovative domestic FOG instruments and their associated key components are applicable to spacecraft attitude control, space remote sensing, communication and stabilized platforms, submarine and underwater unman vehicle navigations, smart grid current monitoring and many more. The team not only enhanced the vital self-reliant defense and space technology pools, but also made broad impact to local industry and academia. Therefore, the FOG IPDT team was named as one of the four recipients of Taiwan's most prestige outstanding technical achievement award from the Executive Yuan in 2015.

研發成果
R&D Achievements

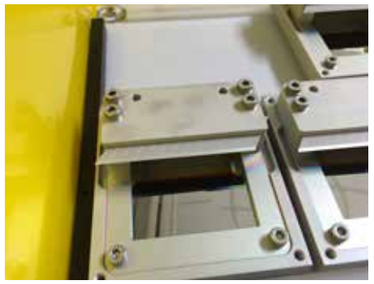
優選 / 黃愉婷

高光譜先進濾光元件研發

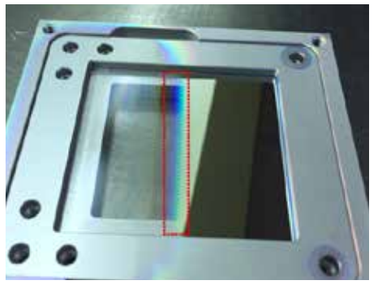
太空中心與台科大團隊共同研發高光譜先進濾光元件一線性漸變濾光片 (LVF) 製造技術。2015 年已完成濾光元件理論推導與分析、濾光元件理論設計模型建立及模擬、濾光元件薄膜膜層結構模型建立及模擬、現有之濾光元件製造技術評估、機台選定與參數分析、製造治具設計與組裝與濾光元件薄膜蒸鍍等。2015 年並完成 VNIR(可見光 / 近紅外光) 波段濾光元件首批試製，產品良率高且性能符合規格需求。不同於其他一般濾光元件，LVF 擁有線性漸變薄膜膜厚的特性，可在不同位置利用窄帶帶通或高通方式篩選光波，成為機載或衛載高光譜影像儀 (HSI) 酬載的關鍵元件，並可推廣至國內生醫光電產業相關領域的應用。

Hyperspectral Advanced Optical Filter Research and Development

The manufacturing technology of hyperspectral advanced filter component, i.e., Linear Variable Filter (LVT), has been developed by the team composed of National Space Organization (NSPO) and National Taiwan University of Science and Technology (NTUST). Quite a few tasks have been accomplished for the optical filter development in the year of 2015 including theoretical derivation and analysis, construction of theoretical modeling and simulation, modeling and simulation of thin film layer structure, evaluation of current fabrication technologies, tooling evaluation and analysis of fabrication parameters, design of fabrication components and assembly for thin film coating, etc. Furthermore, the first batch of the optical filter in VNIR (Visible / Near Infrared) band with satisfying the required specification was produced in a high yield rate in 2015. Different from other commercial optical filters, the current LVF has the characteristics of linearly varying coating thickness, and thus, it can screen the light wave by using narrow band pass filtering or high pass filtering in different positions. Therefore, the current LVF will become one of key components for the airborne or satellite payload of Hyperspectral Imager (HSI). Besides, it can be also applied to many other related areas in biomedical and opto-electronics industry.



線性濾光元件製造治具設計與組裝
Fixture design and assembly for linear optical filter manufacturing



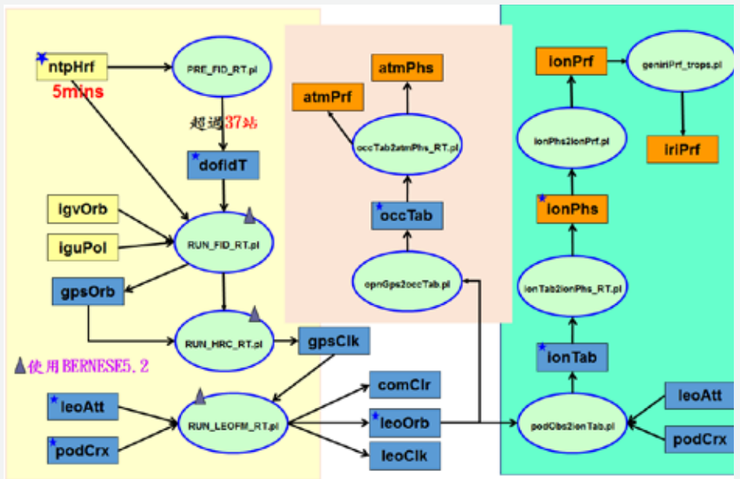
完成鍍膜之 VNIR 波段之線性漸變濾光元件
(方形虛線區為實際線性漸變濾光片區域)
Optical filters in the VNIR band with plated film (the rectangular dotted section represents the actual LVF area)

台灣掩星資料處理驗證系統 (TROPS)

太空中心結合交通部中央氣象局與國內學研界，共同發展本土化 GNSS 掩星資料處理驗證平台 (Taiwan RO Process System, TROPS)，作為福衛七號資料中心獨立驗證工具。TROPS 系統骨幹、資料處理模組與對外服務等功能均為本土自行研發，已完成 11 項產品，其產品產量與美方所發展的福衛三號資料處理中心相比，衛星精密衛星軌道平均產量為福衛三號資料處理中心的 100％~110％，其餘產品平均為 90％~105％。在產品品質部分，精密軌道平均可達 10 公分以下 (福衛三號資料處理中心為 15 公分)，而電離層產品品質較福衛三號資料處理中心優良。此系統即時資料處理時間由 20 分鐘縮短至 5 分鐘內完成所有產品產出，已達福衛七號資料處理的任務需求。

Taiwan RO Process System (TROPS)

Taiwan Radio Occultation Process System (TROPS), as FORMOSAT-7 independent data processing verification platform, is developed by the domestic team including NSPO, Central Weather Bureau, National Central University, and National Cheng Kung University. The team has completed the development of the TROPS system, such as system backbone, data processing modules, and service system. Comparing 11 product yield of TROPS with the FORMOSAT-3 data processing system, the average yield of LEO satellite precise orbit product is 100~ 110％, and of the other product is 90~105％. In product quality, LEO satellite precise orbit tracking is up to 10 cm (FORMOSAT-3 data processing system is 15 cm), while the ionosphere product quality is also better. The team also improved the efficiency of TROPS. The real-time data processing time is from 20 minutes down to 5 minutes, which fulfills the mission of FORMOSAT-7.



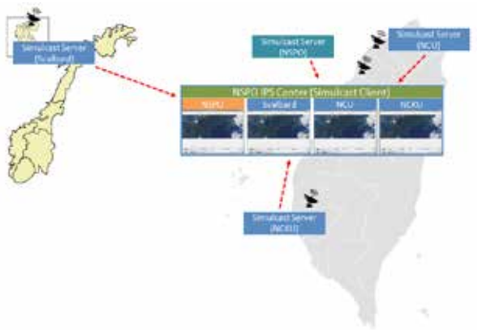
TROPS 即時處理作業流程圖
TROPS real-time data processing workflow

福衛五號影像處理系統資料擷取次系統 (DIS)

資料擷取次系統在影像處理系統中扮演前端即時擷取影像訊號與解密解壓縮等關鍵性角色。過去福衛二號資料擷取次系統，由於衛星外購，關鍵技術之衛星空中壓縮程式無法取得，所以必須採取外購方式取得。10 年來包括太空中心、備援及海外接收站的維護經費頗為龐大。福衛五號在自製的利基下，掌握解壓縮、解密、解封包等核心技術，並採用挪威 Kongsberg 公司已成熟發展熟的快速擷取板與核心程式整合，成功完成系統開發，並藉由衛星與地面系統的端對端測試驗證系統功能完備。

Formosat-5 Image Processing System (Data Ingestion Sub-system)

Data Ingestion sub-systems play the important role of front-end image acquisition in Image Processing System, to real time acquire image signal and perform critical processing like frame-synchronization, decompression and decryption etc. FORMOSAT-2 Data Ingestion Subsystem take the outsourcing approach, since satellite was designed and manufactured by Astrium Company, the key technology of on-board compression program cannot be acquired. NSPO has suffered from expense maintenance fee for central, backup and overseas stations in the past 11 years. In the niche of self-development for FORMOSAT-5, NSPO can acquire the core technology of decompression, decryption and source format decomposition, and successfully integrate the core application program with the mature front-end acquisition board by Norway Kongsberg company, we can claim the completion of system development by passing the satellite End-to-End test.

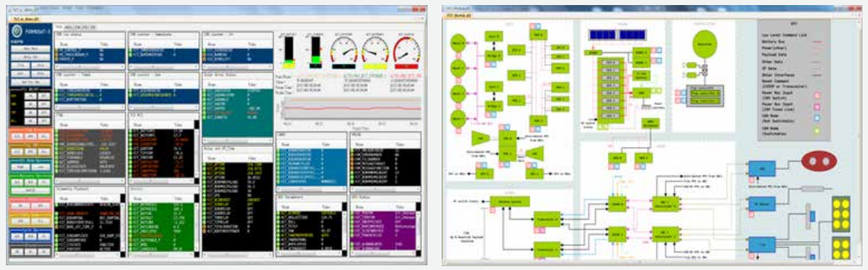


衛星地面操控軟體系統 (XPSOC)

地面衛星操控軟體系統是與衛星任務極度相關的系統。自太空中心成立以來，其建置與發展，擺脫皆仰賴國外合約商的技術與支援，其相關技術完全掌握在國外合約商的手中。為徹底摒除長久以來對國外技術的依賴，並建立國內地面衛星操控系統的自主能力，於 2009 年 12 月成立「衛星地面操控軟體系統 XPSOC 研發」案，本研發案建立了國內地面衛星操控系統的自主能力，於福衛五號與七號衛星等關鍵測試項目中，系統完整性、可用性與可靠度均得到驗證，並成功運用此研發系統取代原有國外合約商供應的系統，創造了台灣地面衛星操控系統的新紀元。

Development of Satellite Operation and Control Software System (XPSOC)

Satellite operation and control system is highly related to a satellite mission. In the beginning, NSPO had been relied on the technology and support from foreign contractors to provide the system. The related technology had been controlled by the foreign contractors. To get rid of the control and build up a domestic system, NSPO started a research project of “Development of Satellite Operation and Control Software System” in December 2009. The project realizes many technology breakthroughs and methodology strategy, establishes the self-dependent capability, and abandons the long-term reliance and technology support from foreign country. The system integrity, availability and reliability have been verified during the critical testing in FORMOSAT-5 and FORMOSAT-7 satellite. The newly developed system has replaced the original system provided by foreign contractors. The satellite operation and control system now enters a new era in Taiwan.

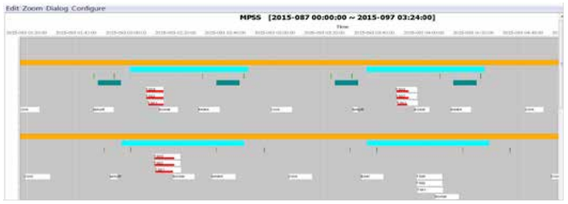


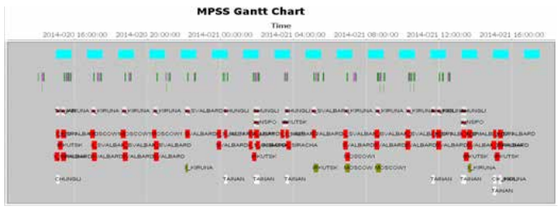
任務規劃與排程系統 (MPSS)

任務規劃與排程系統 (MPSS) 的功能為衛星及酬載活動的規劃與排程，系統主要的組成有衛星與酬載操作時程的規劃、操作排程的衝突解決、衛星地面站的操作時序規劃與確認、衛星操作指令集的產生等，是由太空中心與新鼎系統股份公司共同合作的研發案。本案除含括現有的系統功能外，也增加了整合訂單系統及可行性評估系統，且為使系統更富有彈性，並兼具人性化，開發案中加強了訂單接收的自動化，藉以降低系統操作的人力，同時縮短緊急排程的處理時間。

The function of Mission Planning and Scheduling System (MPSS)

The function of Mission Planning and Scheduling System (MPSS) is to plan and schedule the activities of the satellite and payload. The system consists of the capability of operation planning, scheduling and conflict resolution, ground station operation timeline and confirmation, and satellite commands generation. It is a research project cooperated by NSPO and a domestic company, ACS. The project not only includes the existing system functions, but also adds an integrated booking function and feasibility assessment function. To make the system more flexible and humanized, the system automates the booking function to reduce the system manpower loading and shorten the processing time of emergency planning.



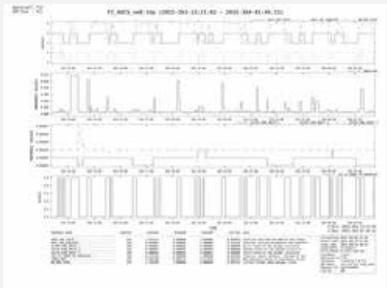


衛星健康趨勢分析系統 (N-Trend)

衛星健康趨勢分析是衛星任務操作重要的一環，而衛星健康趨勢分析系統則是掌握衛星健康狀態及元件性能的重要工具。太空中心長期以來，衛星健康狀態的相關分析，都仰賴國外提供的軟體系統來執行。經過多年來的衛星操控經驗及自主研發能力的提升，已擺脫對國外廠商提供的依賴，結合國內資訊廠商，共同建立衛星健康狀態資料分析的核心程序 N-Trend。該系統已運用於福衛二號及三號衛星計畫，提供工程師掌握衛星相關的健康資訊與長期的趨勢，而效能也優於國外所提供的系統。N-Trend 系統並將提供福衛五號及七號衛星計畫使用。

The Trending analysis of satellite state-of-health (N-Trend)

The trending analysis of satellite state-of-health (SOH) is an important part of satellite operations. The trending analysis system is a tool to understand the SOH status and component performance of a satellite. NSPO relied on the trending system developed by foreign contractor for a long time. The trending system is highly satellite dependent. Different satellite requires some revision, expansion or updates. NSPO experienced three times of updates for FORMOSAT-1, FORMOSAT-2 and FORMOSAT-3. The updates usually faced some limitation from the original contractor, and took a lot of cost to revise. Through years of operation experience and self-development enhancement, NSPO has got rid of relying on the foreign contractor, and cooperated with a domestic company, SYSCOM, to develop a new trending system called N-Trend. The new system has been applied on FORMOSAT-2 and FORMOSAT-3. The performance of N-Trend is better than that of the foreign contractor’ s system. N-Trend will also be used in FORMOSAT-5 and FORMOSAT-7.



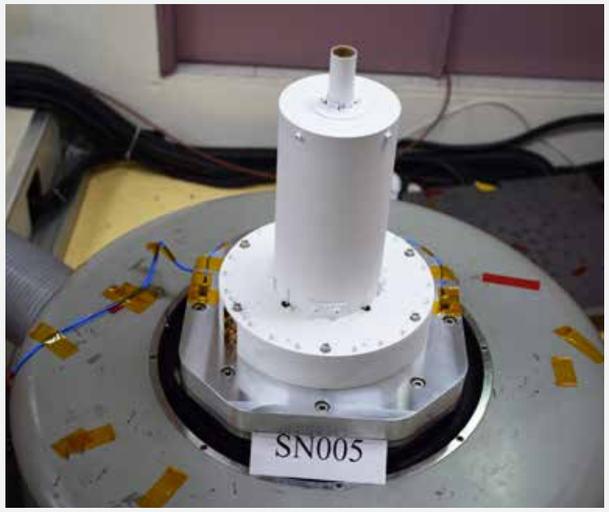
測試服務

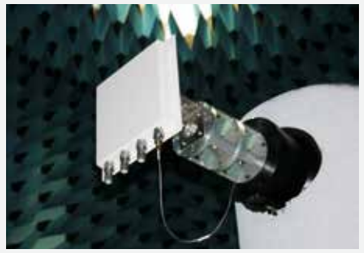
Industrial Testing Services

太空中心衛星整測大樓是國內唯一擁有完整且符合國際太空標準的衛星組裝和測試場地。自設廠以來，太空中心人員及設備已累積完整的機電整合測試能力與經驗，能依據不同需求及設計，針對不同類型之機電設備提供完整規範測試。於 2004 年開始，正式對外界提供機電整合測試服務，協助客戶進行產品檢測。

服務項目	規格	
1. 振動測試服務 Vibration Test - 環境噪音振動測試 - 環境振動 / 結構振動測試	150KN 大型振動機 最大推力 : 150KN peak 最大位移 : 38mm peak-peak on 5Hz ~ 15Hz 最大速率 : 1.78m/s on 15Hz ~ 88Hz 最大加速度 : 100g on 88Hz ~ 2,000Hz 4400 磅小型振動機 最大推力 : 2000kgf peak 最大位移 : 50mm peak-peak on 5Hz ~ 7.5Hz 最大速率 : 1.15m/s on 7.2Hz ~ 102Hz 最大加速度 : 75g on 102Hz ~ 2,000Hz	150KN vibration machine Maximum thrust: 150KN peak Maximum offset: 38mm peak-peak on 5Hz ~ 15Hz Maximum speed: 1.78m/s on 15Hz ~ 88Hz Maximum acceleration:100g on 88Hz ~ 2,000Hz 2000kgf vibration machine Maximum thrust: 2000kgf peak Maximum offset: 50mm peak-peak on 5Hz ~ 7.5Hz Maximum speed: 1.15m/s on 7.2Hz ~ 102Hz Maximum acceleration: 75g on 102Hz ~ 2,000Hz
2. 音震艙測試服務 Acoustic Test - 噪音振動測試	艙體內部空間 : 6.25m(L)X 5m(W) X 8.4m(H) 操作頻率範圍 : 50Hz ~ 10,000Hz 總噪音度 : 155dB	Operation Space: 6.25m(L)X 5m(W) X 8.4m(H) Frequency range: 50Hz ~ 10,000Hz Total noise level: 155dB
3. 電磁相容相關測試服務 EMC Test & Antenna measurement - 電磁相容測試設備 - 天線量測設備	電磁相容測試 MIL-STD-461 傳導性電磁放射測試 MIL-STD-461 傳導性電磁耐受測試 MIL-STD-461 輻射性電磁放射測試 MIL-STD-461 輻射性電磁耐受測試 天線量測設備 量測頻帶 : 1~10 GHz X/Y 軸掃描距離 : 3 m 近場平面、球面、柱面及遠場掃描	EMC test MIL-STD-461CE test MIL-STD-461CS test MIL-STD-461RE test MIL-STD-461RS test Antenna measurement Frequency range: 1~10 GHz X/Yscan range: 3 m Near-field and Far-field
4. 熱真空測試設備服務 Thermal vacuum test - 大型熱真空艙 - 小型熱真空艙	大型熱真空艙 艙體大小 : 3m(D)×3.5m(L) 極限壓力 : 10-7 mbar 工作溫度範圍 : -196℃ in LN2 mode -173℃ (100K) ~ 127℃ (400K) in GN2 mode 最大溫度改變率 : 1K/min 小型熱真空艙 艙體大小 : 1.5m(D)×1.5m(L) 極限壓力 : 10-7 mbar 控溫罩工作溫度範圍 : -196℃ in LN2 mode -173℃ (100K) ~ 127℃ (400K) in GN2 mode 控溫罩最大溫度改變率 : 80K/h from -173℃ ~ 127℃ 熱控基板工作溫度範圍 : -60℃ (213K) ~ 100℃ (373K) in GN2 mode 熱控基板最大溫度改變率 : 80K/h from -60℃ ~ 100℃	Giant Thermal Vacuum Chamber Operation volume:3m(D)×3.5m(L) Ultimate pressure: 10-7 mbar Temperature range: -196℃ in LN2 mode -173℃ (100K) ~ 127℃ (400K) in GN2 mode Maximum temperature adjustment rate: 1K/min Miniature Thermal Vacuum Chamber Operation volume: 1.5m(D)×1.5m(L) Ultimate pressure: 10-7 mbar Temperature range: -196℃ in LN2 mode -173℃ (100K) ~ 127℃ (400K) in GN2 mode Substrate temperature control range: -60℃ (213K) ~ 100℃ (373K) in GN2 mode Substrate adjustment rate: 80K/h from -60℃ ~ 100℃
5. 質量特性量測服務 Mass Property Measurement - 機械組件之質心 (CG)、慣性矩 (MOI)、 慣性積 (POI) 精密量測	最大測試重量 : 3,175kg 重量最大量測誤差 : < 0.04kg 質心最大量測誤差 : 0.2875mm 慣性矩最大量測誤差 : 0.25 %	CG、MOI、POI Maximum test weight: 3,175kg Maximum weight offset: < 0.04kg Maximum centroid offset: 0.25 %
6. 導航訊號模擬設備服務 Navigation Signal Simulation Equipment-GPS 與 Galileo 合成射頻訊號模擬 Service GPS 與 Galileo 合成射頻訊號模擬 GPS/Galileo combined signal	GPS 與 Galileo 合成射頻訊號模擬 : - 高動態 GPS/Galileo 各 12 通道射頻訊號模擬	GPS 與 Galileo 合成射頻訊號模擬 Multi-Channel High Dynamic GPS/Galileo Simulation System
7. 高光譜影像儀推掃取像服務 Testing and Technical Service: Hyper-Spectral Pushbroom Imaging	波長範圍 : 400~1100nm 光譜解析度 : <3nm 視角範圍 : 多組精密光學鏡頭可供選擇 可變光強連續波長光源	Wavelength: 400~1700nm Spectral Resolution: <3nm FOV: several ulra-high quality optical lens can be selected and installed by our professional team. Light source: variable-intensity stabilized broadband light source
8. 金屬表層厚度測量和材料分析服務 FISCHERSCOPE X-RAY XULM XYm	量測艙體尺寸 : 360 x 380 x 240mm 測試台面可移動 (X - Y)：50 × 50 mm 樣品尺寸重量最大 2 kg 樣品高度最高不大於 240 mm 樣品長寬不大於 50 × 50 mm	Interior dimensions measurement chamber: 360 x 380 x 240mm Manual X/Y-stage: (X - Y)：50 × 50 mm Maximum sample mass: 2 kg Maximum sample height: 240 mm Maximum travel 50 × 50 mm
9. 三次元量床 CMM	工作範圍 : 2m*2m*1.5m 床台載重 : 8 噸 量測精度 : 4μm	Measuring range: 2m*2m*1.5m Maximum loadiong: 8 ton Measureing error: 4μm

工業測試服務網頁 http://www.nspo.narl.org.tw/services/tw/index.htm
連絡人 : 陳先生 電話：03-578-4208 分機：7274
E-mail：edchen@nspo.narl.org.tw





NARLabs 國家實驗研究院
國家太空中心
National Space Organization
NSPO

發行人 Publisher

張桂祥 Guey-Shin Chang

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