



# Hands-on Satellite System

(SS1005)

## **CubeSat Missions**

Instructor: Chi-Kuang Chao

Department of Space Science and Engineering

National Central University

July 2, 2021



# 四年內發射學生立方衛星



	大一	大二	大三	大四
第一學期	工程實習 (必)	太空專題 I (必) iCASE	太空科學 太空工程	太空科學 太空工程
寒假	NI CLAD	PDR	PAR	Satellite Launch
第二學期	衛星系統實作 (選)	太空專題 II (必)	太空科學 太空工程	太空科學 太空工程
暑假	<b>AGI STK MDR/SDR</b>	CDR	SmallSat ITR	AOGS

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An Ansys Company

Products Solutions Training Support About TRY US OUT SIGN IN

# Training and Certification

Master our products with self-paced lessons, instructor-led classes, and certification programs for beginners and experts alike.

Training | Certification

All  Level One  Level Two  Level Three

EXPAND ALL

## Instructor-Led Live Training

Course	Date	Location	Action
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On-Demand Training

<https://www.agi.com/training-and-certification#train>

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# Training and Certification

Master our products with self-paced lessons, instructor-led classes, and certification programs for beginners and experts alike.

Training | Certification

All Certifications  STK  ODTK  TETK  STK Integration

## Certification Details

### Level 1: STK Certification

Prerequisites: None

Level 1 STK Certification covers the skills that are fundamental to the free version of STK. This test will require you to demonstrate proficiency with the basic features of STK, such as building basic scenarios, generating reports, and recording videos.

To prepare for the test, AGI recommends that you complete the [Level 1 Beginner tutorials](#). These lessons will take about four hours to complete. After you register for the test, you will have 14 days to complete and submit it.

[Register Now](#)

LEVEL 1

<https://www.agi.com/training-and-certification#cert>



# AGI STK



- Level 1: STK Certification
- Level 2: STK Master Certification





# 2021 暑期衛星設計導論線上 課程（無學分）



- 中大太空系張起維教授擬在 2021 年暑假針對大一生開衛星設計導論線上課程（無學分）。內容為了解人造衛星設計概論，以及如何使用AGI Systems Tool Kit (STK) 軟體進行相關分析。預計 7/19 開始，為期 4 週。每次講課及 STK 操作各 1 小時。
- 為統計人數，若有興趣請填寫以下問卷：<https://forms.gle/fFZmmeDZDLZAJ3WW6>



# 2021 暑期衛星設計導論線上



## 課程 (續)

- 內容包含：
  - Introduction to CubeSats and Systems Engineering.
  - Introduction to Orbital Mechanics Orbit Elements, Orbit propagators.
  - Eclipse Time, Power Design
  - Communications: Modulation, SNR, BER.



# 2021 暑期光學課程



- 預計 2021 年 7 月 1 日起，每週四全天線上授課，歡迎有興趣的同學以 Google Meet 方式線上學習（無學分但免費）。
- 如若系上學生有興趣，需要提供姓名、年級以及聯絡方式。
- 請填選以下表單報名：<https://forms.gle/jComCfdkPsTziSjj8>

Topic 1	Properties of Light
Topic 2	Optical Materials used in Optical Systems
Topic 3	Paraxial Optics
Topic 4	Aberrations
Topic 5	Image Quality Evaluation
Topic 6	Procedure of Optical System Design
Topic 7	Diffraction
Topic 8	Fourier Optics
Topic 9	Photometry
Topic 10	Important Photometric Parameters of LED
Topic 11	Non-Imaging Optics Design (Illumination Optics)
Topic 12	Laser Gaussian Profile Optics
Topic 13	DOE (Diffraction Optical Element) Design
Topic 14	Zoom Lens
Topic 15	Wide-Angle Lens Design
Topic 16	AR-VR(3D Visual for EYE)
Topic 17	Hartmann Wavefront Sensor



2021 暑期光學課程報名表單

預計 2021 年 7 月 1 日起，每週四全天線上授課，歡迎有興趣的同學以 Google Meet 方式線上學習（無學分但免費）。如若系上學生有興趣，需要提供姓名、年級以及聯絡方式。

**\*必填**

**電子郵件 \***

你的電子郵件

**姓名 \***

您的回答

**年級 \***

大一

大二

大三

大四

碩士班

博士班



# 立方衛星任務報名與審查



- **2021/7/2 (FRI):** 中午前報名，至少五人一組（最好是同班同學），請填選以下表單 <https://forms.gle/XaUcWJhz8r3vKztY7>。14:00-15:00 任務定義審查說明。
- **2021/7/30 (FRI):** 14:00-17:00 任務定義審查（Mission Definition Review, MDR）與系統設計審查說明。
- **2021/9/3 (FRI):** 14:00-17:00 系統設計審查（System Design Review, SDR）。

2021 暑期光學課程報名表單 x 2021 立方衛星任務報名表單 x

docs.google.com/forms/d/e/1FAIpQLScn9kTY6RT8uY26a39Cv\_d31e8LSXXC4...

## 2021 立方衛星任務報名表單

2021/7/2 (FRI): 中午前報名, 至少五人一組 (最好是同班同學), 14:00-15:00 任務定義審查說明。

2021/7/30 (FRI): 14:00-17:00 任務定義審查 (Mission Definition Review, MDR) 與系統設計審查說明。

2021/9/3 (FRI): 14:00-17:00 系統設計審查 (System Design Review, SDR) 。

**\*必填**

**電子郵件 \***

你的電子郵件

**任務名稱 \***

您的回答

**隊員列表 \***

您的回答

將我的回應複本寄給我。

提交

Calendar interface showing July 2021. The calendar is set to Taipei Standard Time. The month view displays dates from Sunday, July 20 to Saturday, July 31. Two specific dates are highlighted with red boxes: July 2 (Registration) and July 30 (MDR).

Navigation options: Day, Week, Month, Year. Time zone: Taipei Standard Time. Search: Search. Today: Today.

Left sidebar: iCloud, Other, Birthdays, Taiwan Holidays, Siri Suggestions.

Bottom left: June 2021 calendar view.

Sun	Mon	Tue	Wed	Thu	Fri	Sat
20	21	22	23	24	25	26
27	28	29	30	Jul 1	2 <b>Registration</b>	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30 <b>MDR</b>	31

# August 2021

- Other
- Birthdays
- Taiwan Holidays
- Siri Suggestions

Sun	Mon	Tue	Wed	Thu	Fri	Sat
Aug 1	2	3	4	5	6	7
8 Father's Day	9	10	11	12	13	14
15	16	17	18	19	20	21
22 Ghost Festival Grandparent's Day	23	24	25	26	27	28
29	30	31	Sep 1	2	3 Armed Forces Day <b>SDR</b>	4
5	6	7	8	9	10	11

< June 2021 >

S	M	T	W	T	F	S
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	1	2	3
4	5	6	7	8	9	10



# Announcement of opportunity



- International Space Challenge (ISC) 2022 in Singapore
- Dragonfly Aerospace award
- The 7th Mission Idea Contest in Japan
- NSPO's iCASE 2021 in Taiwan
- NCU CAPE



# ISC 2022



- This year ISC will be split into 2 categories – Starter and Open. The Starter's category will be from ages 13 to 18, while the **Open category will comprise of the 15 to 25 age group.** This will allow for participants with all skill levels and knowledge to take part in ISC. We hope to spread awareness amongst the youth about how diverse the space sector can be and inspire them to learn more about the space and related industries through these changes.
- **OPEN CATEGORY:** Design a satellite mission to gather key data so as to observe the changes, their causes and patterns in the Van Allen Belts.
- Website: <https://www.space.org.sg/isc/>



2022 Edition

# SPACE WEATHER

GRAND PRIZE

**\$10,000**

## STARTER

13-18 years old

*Design a novel experiment  
for the Space Station*

## OPEN

15-25 years old

*Design a satellite mission  
to study the Van Allen Belts*



Registration Deadline:  
**6 August 2021**

Created by

**SSTL**

Singapore Space  
& Technology Ltd





# Find out more about ISC 2022

## Introductory Webinar

Learn about space weather and challenge statements

Note the key dates and activities line-up

Ask us any questions you have

Find your teammates!

Open to All!



### Register Now

2 July (Friday)

4.30pm (GMT+8)

Created by





# ISC 2022 (cont.)



- 04 May, 2021: Registration opens, all day.
- 02 Jul, 2021: Introductory webinar, 4:30 pm - 5:30 pm.
- 06 Aug, 2021: Registration closes, all day.
- 17 Dec, 2021: Deliverables submission deadline, all day.
- Participating teams must satisfy the following conditions:
  - **Four participants per team**
  - **Team members must have a valid email address**
- If you have yet to form a team of four members, you can submit your initial registration with the details of minimum one team member.



# ISC 2022 (cont.)



- Participants in the Open Category stand a chance to win the following prizes:
  - Grand Prize: S\$10,000
  - 2 Distinction Awards: S\$1,000
  - 3 Merit Awards: S\$500
  - Young Entrepreneur Award
  - Most Creative Award
  - Best Video Award
  - 3 Women in STEM Awards: S\$500 worth of Shiseido products
  - 5 AWS Awards: \$500 worth of AWS Credit



# Dragonfly Aerospace award



- Dragonfly Aerospace wants to help other innovative projects explore and improve our Earth. That is why we are announcing a competition today!
- One of the key elements in establishing an Earth observation system is the imaging payload. Dragonfly is prepared to offer one of our compact high-resolution **Caiman imagers** for your upcoming satellite mission which aims to monitor and protect our shared global natural resources.
- Website: <https://dragonflyaerospace.com/dragonfly-is-pleased-to-announce-an-award-program/>



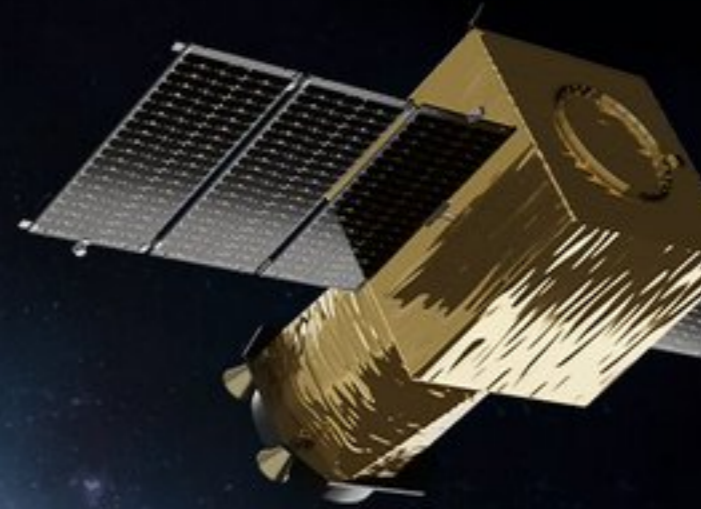
# Dragonfly Aerospace award (cont.)



- The Dragonfly Aerospace Award Program will be held from June 1, 2021 to **October 31, 2021**. The contest is open to non-profit, non-commercial organizations, including university programs and commercial start-ups. **The winning team needs to have an existing funded mission that will launch before December 31, 2022.** In order to take part, a team representative must submit an application to [award@dragonflyaerospace.com](mailto:award@dragonflyaerospace.com), providing the following information: First/Last Name, Contact info, Organization, Mission status: date of launch, launch confirmation (e.g. Letter of intent, Memorandum of understanding etc.), Mission description, Existing/potential Partners, Where the obtained data is planned to be used, What are the unique insights that your project will gather into the health of the planet and bring the most benefit to the Earth and humanity? Where did you find out about the Dragonfly Aerospace Award?



DRAGONFLY  
a e r o s p a c e



# AWARD PROGRAM

## DRAGONFLY AEROSPACE AWARD RULES

*This document sets the standard for terms and conditions for competition, where Dragonfly Aerospace (Pty) Ltd. (“DFA”) will award its imager to a winning satellite mission aimed at monitoring natural resources Global (“Competition”).*

1<sup>st</sup> June 2021

### Competition Timeline:

Applications open	June 1, 2021
Applications close	October 31, 2021
Announcement of the Winner	November 30, 2021

**Prize:** Caiman Imager

**Entry:** means entity, that is organized (incorporated or unincorporated) on non-commercial basis only (non-profit organization, university programs, or other non-commercial form of structure) or commercial start-ups, provided that the payload is planned to be launched before 31 December 2022 and that meets the requirements to Entry and to the application herein.

**Application / Missions:** All and any studies related to ecology: Vegetation, soil and water cover, inland waterways and coastal areas are among the monitoring objectives as well as discover new insights into our world's interior and climate.

### Requirements for Entry:

1. You must be at least 18 years old and have reached the age of majority in your jurisdiction of primary residence and citizenship to participate in Competition.
2. The Entry needs to have an existing funded mission that will launch before December 31, 2022.
3. Applying representative is fully authorized to accept and agree under the Rules herein
4. You are not engaged directly or indirectly in restricted end uses, neither military end use; you are not and will not export. Reexport or otherwise transfer Prize to persons or entities on any sanctions or export-related list;
5. You will use the Prize for the Winning application Mission purposes only

You may not enter the Competition if you are a director, member, partner, employee, tenant (or employee of a tenant), agent, consultant or supplier to DFA, or their respective spouses, partners, family members (parents, siblings and children), business partners or associates.

Participation is free. **No payment** for Entry to participate in Competition.

**Application:** Applications have to be submitted to [award@dragonflyaerospace.com](mailto:award@dragonflyaerospace.com) before October 31, 2021 and have to include the following information:

1. First/Last Name
2. Contact info
3. Organization
4. Mission status: date of launch, launch confirmation (e.g. Letter of intent, Memorandum of understanding etc.)
5. Mission description
6. Existing/potential Partners
7. Where the obtained data is planned to be used

8. What are the unique insights that your project will gather into the health of the planet and bring the most benefit to the Earth and humanity?

Alternatively, you may proceed with the [online form](#).

If the information is provided in sufficient scale the Entry will receive email confirming their participation in the Competition.

Entries understand and agree that in order to offer the Competition, the DFA must collect and use personal information about Entries. All applications become the property of DFA and will not be returned. DFA assumes no responsibility for applications (or portions thereof) that are lost, late, delayed, destroyed or misdirected for any reason whatsoever. DFA shall not be responsible for any errors, negligence, losses or damages of any nature whatsoever that may arise or occur in connection with this Competition. The Entries grant DFA the right to use the materials submitted to be used to promote this Competition and the missions participating in it.

**By sending us your application you accept and agree to these Rules which will govern the Competition. Furthermore, you verify that you are unaware of any reason legally prohibiting you from entering this Competition and, if the Competition requires the submission of photographs, artwork or images of people, or of anything else that requires consent or copyright, that you have the necessary consent and authority to do so, if required. Any Entry who contravenes these Rules may be disqualified from the Competition. The Rules can only be modified by DFA in a written revision posted on the Competition web page or any other official competition communication methods.**

**Judging:** The judging committee of four judges from DFA will review the applications with missions and select the winning Entry (“Winner”). The judging committee session will be organized in November 2021. The judging committee consists of :

Bryan Dean, CEO and Co-founder,  
Eugene Yakovlev, Chief Business Officer  
Janine Nicolson, Head of Business development  
Rikus Cronje, Electro Optical Systems Engineer and Co-founder

DFA will try to contact the Winner within seven days following Announcement. If the winner cannot be contacted or does not respond to messages within that period of time, or chooses to decline the Prize, then the Prize will be forfeited and another winner will be selected by judging committee as soon as possible.

All decisions of DFA and the judges are final and binding without right of appeal with respect to all aspects of this Competition, including, without limitation, eligibility and disqualification of Entries. This Competition is subject to applicable federal, provincial and municipal law. Void where prohibited.

DFA and the Competition judges will not be liable for:

- any incomplete or inaccurate information caused by any technical or human error that may occur in the capturing and/or processing of Entries
- the theft, loss, destruction or unauthorized access to, or alteration of, applications
- any failure of any message or email to be received by or from DFA and/or any failure of an application to be captured, recorded or received for any reason;

- any typographical or other errors in the offer or administration of this Competition, including but not limited to errors in advertising, these terms and conditions, the selection and/or announcement of the winner; and
- any combination of the above.

The Prize shall be made available to Winner by DFA as is. In event the Winner fails to collect the Prize, DFA shall have the right to select the new Winner from the Entries. DFA in no event shall be liable to pay any consideration, fee or compensation to the Winner or Entry. The prize is neither negotiable nor transferable, and may not be exchanged for cash.

The prize may be subject to additional terms and conditions not mentioned hereunder, but in accordance with relevant South African legislation.

**Announcement:** DFA will announce the Winner on November 30, 2021 on DFA webpage.

**Delivery:** The Prize shall be Ex-Works (Incoterms 2020) DFA place of business, with the Entry carrying all costs associated with charges.

Once the Prize is available to Entry or its representatives at DFA place any further shipment, transportation, logistics, custom clearance, export/import regulations compliance, insurance and other risks shall be carried by Entry.

**Indemnity against liability:** Entry is personally responsible for use or inability to use the Prize. Entry agrees to indemnify, defend, and hold harmless DFA, DFA's joint venturers, business partners, licensors, employees, officers, directors, owners, and agents from and against all claims, losses, expenses, damages and costs (including, but not limited to, direct, incidental, special, consequential, punitive, exemplary, and indirect damages), and reasonable attorneys' fees, resulting from or arising out of Entry's use, misuse, or inability to use the Prize, or any violation by Entry of these Rules.

IN NO EVENT SHALL DFA BE LIABLE TO ENTRY OR TO ANY THIRD PARTY FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES (INCLUDING WITHOUT LIMITATION LOST PROFITS, LOST SAVINGS, OR LOSS OF BUSINESS OPPORTUNITY) ARISING OUT OF OR RELATING TO PRIZE, EVEN IF DFA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. ENTRY FURTHER AGREES THAT THESE LIMITATIONS SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY.

**Import and export licenses/approvals:** The Entry shall be responsible for applying for any necessary export/import licenses or approvals from any government as may be applicable.

In addition to South Africa and its territories, DFA accepts international Entries. However, some applications may be rejected from participation in Competition for reasons related to court decisions, governmental rulings, countries laws and regulations, sanctioned lists, end-user requirements and therefore may not be available for shipment outside the South Africa. Entries of international origin or Prize destination may be subject to export control laws, restrictions, regulations and orders. Entry agrees to comply with all applicable export control laws, restrictions, regulations and orders or applicable foreign jurisdictions, agencies or authorities. Winning Entry shall not, directly or indirectly, sell, export, transfer, transship, assign, use, or dispose of Prize in a manner which may result in any noncompliance with applicable export control laws, restrictions, regulations, and orders or applicable foreign jurisdictions, agencies or authorities. Winning Entry is responsible for obtaining any license or other official authorizations that may be required to export, re-export or import Prize.

The Prize is authorized for export only to the country of ultimate destination for use by the ultimate consignee or end-user(s) identified by Winning Entry and Mission description.

**Taxes and duties:** Any taxes, duties and charges to which Prize / Prize Delivery is liable shall be borne by the Entry.

**Applicable law and construction:** The South African law shall govern these Rules in all respects.

Should any provision of the Rules be deemed illegal or void by a competent court of law then that provision shall be deemed severed from the Rules which shall continue in force notwithstanding such severance.

**Language:** All correspondence, data and information exchanged with regard to or arising under the Rules shall be in English.

**Assignment:** Entry shall not assign, transfer, charge or otherwise dispose of or purport to assign, transfer, charge or otherwise dispose its rights hereunder or any part hereof without obtaining the prior written consent of DFA.

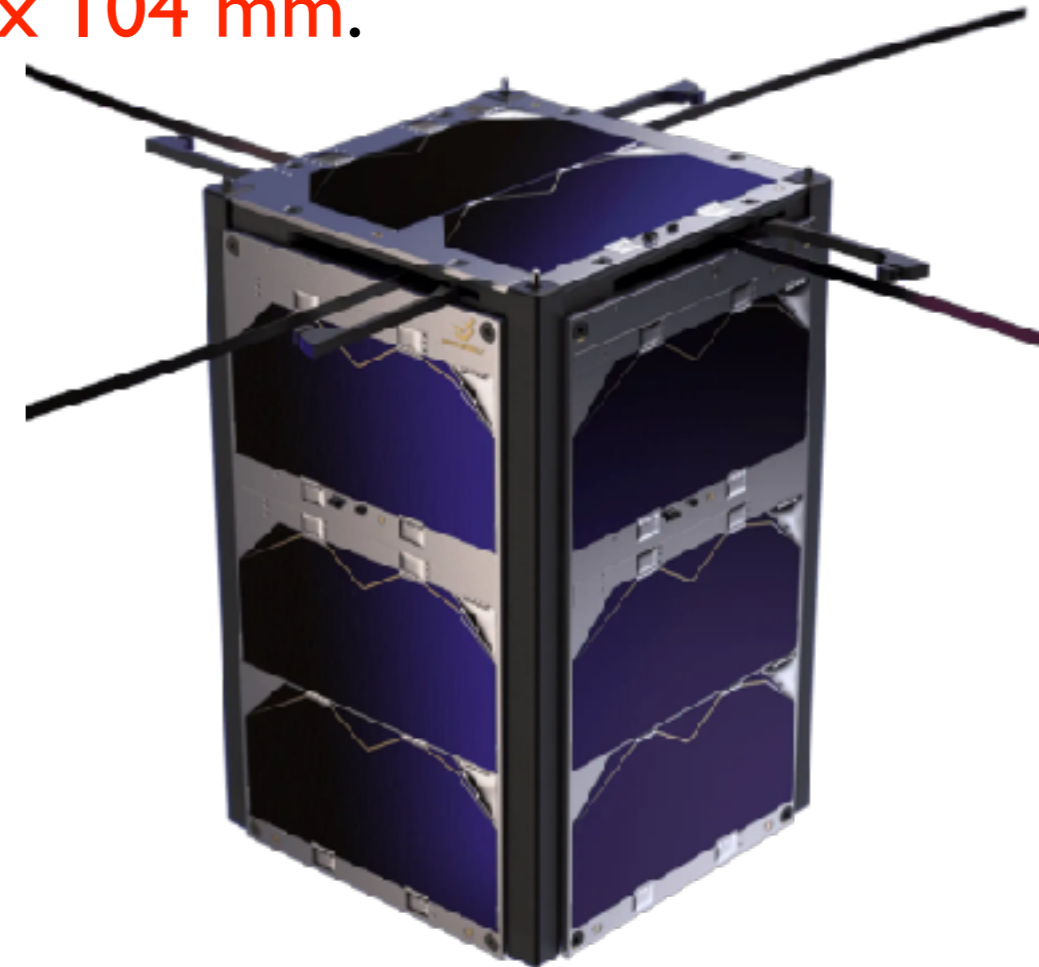
DFA reserves the right to cancel, modify or amend the competition at any time if deemed necessary in their own opinion or if circumstances arise outside of their control.

ANY ATTEMPT BY AN ENTRY OR ANY OTHER PERSON TO UNDERMINE THE LEGITIMATE OPERATION OF THE COMPETITION OR ANY WEBSITE ASSOCIATED WITH THE COMPETITION IS A VIOLATION OF CRIMINAL AND CIVIL LAWS AND, SHOULD SUCH AN ATTEMPT BE MADE, DFA RESERVES THE RIGHT TO SEEK DAMAGES FROM ANY SUCH PERSON TO THE FULLEST EXTENT PERMITTED BY LAW.



# 1.5U CubeSat (EnduroSat)

- Satellite bus price: **USD 50,000** (TBD).
- Bus mass: 1,050 g.
- Bus dimension: 100 mm x 100 mm x 170.2 mm.
- Available payload volume: **97 mm x 97 mm x 104 mm**.
- Available payload mass: **950 g**.
- Available payload power available: **0.9 W**.
- Data rate (UHF): up to 19.2 kbps.
- Mission life time: > 2 years.
- [www.endurosat.com](http://www.endurosat.com)





# The 7th MIC



- The Mission Idea Contest (MIC) was established in 2010 to provide aerospace engineers, college students, consultants, and anybody interested in space with opportunities to present their creative ideas and gain attention internationally. The primary goal of MICs is to open a door to a new facet of space exploration and exploitation.
- Development of micro/nano-satellites started as an educational and research program primarily at university laboratories. As the micro/nano-satellite technology matures, it has spread rapidly across the academics and industry for practical application.
- Website: <http://www.spacemic.net>





# The 7th MIC (cont.)



- The 7th Mission Idea Contest for Deep Space Science and Exploration with Nano/Micro Satellite will be held as follows:
  - October 23, 2020: restart announcement
  - February 15- March 19: virtual Lectures
  - **July 7, 2021: deadline of abstract submission**
  - August 18, 2021: notification of finalists
  - September 30, 2021: deadline of final paper submission
  - November 13, 2021: final presentation (the location is to be determined.)
- Please propose an innovative mission idea which contributes to deep space science and exploration.



# iCASE 2021

- Date: **16 November, 2021.**
- Please be ready for **CubeSat Mission Design Contest.**



## iCASE2021

International Conference on  
Astronautics and Space Exploration

## 第三屆 立方衛星任務設計競賽

## The Third CubeSat Mission Design Contest

### 目的

第三期國家太空計畫自2019年開始，計畫包含科學創新和外太空探索。台灣「太空發展法」也於今年6月16日公告，本國的立方衛星任務設計競賽將鼓勵利用立方衛星做太空科學及技術的基礎及應用研究，以激勵更多人發揮創意在太空計畫上。

### 參賽者資格

- ◆ 世界各地高中及大學以上學生
  - ◆ 台灣的研究機構或企業人士
  - ◆ 台灣的個人或團體，對立方衛星和航太領域有興趣者
  - ◆ 由2到5人組成一隊，成員可來自不同背景；每隊可以有1到2位的指導者。
- 備註：正接受國家太空中心經費補助的團隊不能參加此競賽。

### 競賽內容

使用立方衛星執行的太空任務及衛星概念設計。  
例如：低地球軌道的通訊立方衛星星系、光學遙測立方衛星、編隊飛行的立方衛星、月球立方衛星、火星立方衛星(例如MarsCO衛星)、口袋衛星(PocketQube)任務...等。

### 評分準則

- ◆ 任務設計 20%
- ◆ 衛星設計 20%
- ◆ 長摘要內容 30%
- ◆ 口頭報告 30%

### 獎項

- ◆ 第一名獎金 美金US\$2,000
- ◆ 第二名獎金 美金US\$1,000
- ◆ 第三名獎金 美金US\$500
- ◆ 贊助廠商特別獎。

卓越太空任務有機會獲得國家太空中心  
資助研製組裝及發射機會

### 競賽時程

- 摘要交付期限：2021年9月16日
- 摘要允收通知：2021年9月23日
- 長摘要交付期限：2021年10月7日
- 口頭簡報通知：2021年10月21日
- 口頭簡報競賽日：2021年11月16日



## iCASE2021

<https://www.espa.nsl.org.tw/zh/MyiCASE/2021/>



# 太空系學生專享權益



- 為鼓勵對太空具有夢想與熱情的全國高中職生投考中大太空科學與工程學系，推動太空系學生能儘早投身太空科學研究或參與太空產業研發，本校**太空科學與科技研究中心**每年編列預算最高**一百萬元**，選拔表現優異且具創意的學生，補助參加國內外各項**太空科學與科技會議**、**太空相關機構的參訪與實習**、**研製與發射自製的酬載與立方衛星**，一圓學子的太空夢。
- 在**四年內**發射與執行自行規劃的**立方衛星**任務。





# Teams



- **Team 1: [chouu@g.ncu.edu.tw](mailto:chouu@g.ncu.edu.tw)**
  - Mission: **Relay Satellite Communication Experiment and Burial**
  - Members: 周徽徽、蔣汶儒、趙宇翔、侯博瀚、郭哲文、郭家欣、王恩柔、陳奕廷
- **Team 2: [elisha9172611@gmail.com](mailto:elisha9172611@gmail.com)**
  - Mission: **尋人衛星**
  - Members: 張楚羚、張媛婷、陳柏安、陳永捷、陳冠緯
- **Team 3: [ljc.universe@gmail.com](mailto:ljc.universe@gmail.com)**
  - Mission: **利用高光譜儀進行環境監測與管理**
  - Members: 林楨翔、王暉荏、賴以芸、林威志、陳宥鈞、侯冠宇、王聖霖、張恩瑞、廖晟佑



# Teams



- 指導老師
  - 學長姐協助
  - 場地與設備
  - 經費與機會