Generative-AI Navigation Information Competition for UAV Reconnaissance in Natural Environments I：Image Data Generation

Competition Description

Technological advancements have brought convenience to human life, yet they have also raised ecological sustainability concerns, such as environmental degradation and natural resource depletion. Acquiring information about the natural environment of a region is essential for achieving a sustainable society. Unmanned aerial vehicles (UAVs), leveraging their inherent advantages, can efficiently and rapidly survey terrain and natural environments from the sky. This capability aids in quickly obtaining crucial data about a nation's natural environment, fostering the application and development of green energy technology and circular economies within society.

Obtaining real-world images from the perspective of UAVs can be costly. Generative AI, on the other hand, can produce a substantial amount of realistic data with a limited dataset. Therefore, this project will utilize generative AI to generate images of roads and rivers from the viewpoint of UAVs under specified conditions.

Currently, there are few competitions worldwide that combine both generative AI and AI-driven UAVs. This competition aims to merge the two fields, hoping that participants will gain a deeper understanding and enhance their capabilities in applying these technologies in real-world scenarios.

Competition Registration Guidelines

1. Eligible participants include nationwide individuals aged 18 and above, including undergraduate and graduate students, as well as professionals from various industries. Minors under the age of 18 may register with the consent of their legal guardians. If a team has at least one member who is not a student, that team will be categorized as the "Professional" group.
2. Each participating team can consist of 1 to 5 members.
3. Each participant is allowed to join only one team. Once a participant joins a team, they cannot switch to another team. During the competition, teams cannot merge or split. After the registration deadline, the team members' list and the number of team members cannot be changed.
4. Participating teams are not allowed to register multiple accounts to participate in the same competition. If any member of a team violates this rule or registers another account to join another team, it will be considered as using multiple accounts for the competition. Consequently, all teams involving the violating member will lose their eligibility to compete and receive awards.
5. Participants who are joining the competition as part of their school curriculum requirements should name their team following their school's course regulations to facilitate classroom assessment.

Competition Registration Process

1. Each member of the registering team must register as a member on 'T-Brain Machine Learning Competition' using their Google or Facebook account.
2. Each member of the registering team must log in to the 'AI CUP Registration System' and fill in the required information for each team member (see Note 1) as shown on the registration page. Complete the team formation process to proceed with competition registration.
3. After 1-2 business days of completing the competition registration on the 'AI CUP Registration System,' each team member can participate in the competition on ' T-Brain Machine Learning Competition.'
4. The competition is divided into two categories: Student Group and General Public Group. The Student Group requires all team members to be students; if there is at least one non-student member in a team, the entire team will be categorized as the General Public Group.
5. After registration, each participant is requested to assist in completing the "Pre-Competition Survey."
   Pre-Competition Survey link
6. After the competition concludes, all participants are kindly requested to assist in completing the "Post-Competition Survey."
   Post-Competition Survey link

Note 1: For registration guidelines, please refer to the registration process on the AI CUP registration system. In the team member information, please provide the email address that each team member used to register on ' T-Brain Machine Learning Competition' If the email address provided on the registration page does not match the email address on ' T-Brain Machine Learning Competition', the registration will be considered unsuccessful.

Eligibility and Methods for Receiving Awards

1. The competition is divided into two categories: Student Group and General Public Group. The Student Group requires all team members to be students; if there is at least one non-student member in a team, the entire team will be categorized as the General Public Group.
2. The awards for this competition include 11 "Student Group Ranking Awards" and 3 "Trend Micro Sponsorship Awards."
3. **Student Group Ranking Awards** (Note 2): Winning teams agree to the following arrangements by the organizing committee; otherwise, they will forfeit the award eligibility.
    - All members of the team must be enrolled as students on the registration day, meeting the student status criteria of higher education institutions in the Republic of China. Only teams with all student members are eligible for the Student Group awards and must provide relevant proof during the award presentation.
    - Prize money will be disbursed in New Taiwan Dollars via bank transfer, and winning teams are required to comply with the income tax regulations of the Republic of China.
    - The final evaluation criteria include two components: (1) the team's ranking on the Private Leaderboard, accounting for 80% of the total weight, and (2) the reports submitted by the team before the announcement deadline, accounting for 20%. Both contribute to the actual award determination.
    - The top 25% of teams on the Private Leaderboard (not exceeding 30 teams) must release their implementation code and related design documents on a designated code hosting platform by the specified deadline (2024/6/4). The organizing committee and the expert panel from the Ministry of Education's Artificial Intelligence Competition and Annotation Data Collection Project will verify and score the released materials. Teams failing to provide complete documentation by the deadline or submitting after the deadline will forfeit the opportunity for evaluation.
    - The organizing committee will provide a report template before the end of the competition. The report must follow the format and content outlined in the template, including (but not limited to) pre-processing code, training code, generation code, parameter settings (including training weights, execution instructions/scripts for participant weights, and generated random seed), and execution environment. The assessment criteria for the report (20%) include three parts: (1) Report Completeness (8%), (2) Report Accuracy (8%), and (3) Technical Model Originality or Improvement Effectiveness (4%). Note that the executability and verifiability of the code will impact the report score.

- The top 11 teams in the "Student Group Ranking Awards" will receive a certificate from the Ministry of Education after approval by the organizing committee's panel of judges. Other teams ranking in the top 25%, as verified by the judging panel (including the "Student Group Ranking Awards" teams, not exceeding 30 teams), will receive an electronic certificate from the Ministry of Education's Artificial Intelligence Competition Project Office.
- The advisor or instructor of the winning team in the "Student Group Ranking Awards" will receive one certificate but will not be eligible for cash rewards. However, the advisor cannot participate in the competition alongside the students. Please provide the advisor's/instructor's name, school/department, and contact email in the final report.
- If any member of the winning team in the "Student Group Ranking Awards" has achieved a top-three ranking (including Gold/Silver/Bronze medals) in the "Ministry of Education National University/College Artificial Intelligence Competition (AI CUP)" organized by the "Ministry of Education Artificial Intelligence Competition and Annotation Data Collection Project" on three occasions or more (including the current competition), the team will only receive a certificate from the Ministry of Education, and no cash prize will be awarded. The cash prize will be given to the next-ranked team, and both teams will be ranked the same. This rule is not retroactive, and the count of awards starts from the 2022 Fall Season.
- Winning teams must delegate at least one representative to participate in the subsequent award ceremony as notified by the organizing committee. If no team member is available, a friend or family member may represent the team in receiving the award and giving a brief presentation.

4. **Trend Micro Sponsorship Awards**：Winning teams agree to assist the organizing committee with the following arrangements; otherwise, they will forfeit their eligibility for receiving the award.
    - This award is open to participants of any identity and is presented to the top three ranked teams in the final standings of this competition. Winning this award does not preclude recipients from also receiving the "Student Group Ranking Awards."
    - The final evaluation criteria consist of two components: (1) the team's ranking on the Private Leaderboard, accounting for 80% of the total weight, and (2) the reports submitted by the team before the announcement deadline, accounting for 20%. Both contribute to the actual award determination.
    - The top 25% of teams on the Private Leaderboard (not exceeding 30 teams) must

release their implementation code and related design documents on a designated code hosting platform by the specified deadline (2024/6/4). The organizing committee will provide the team's code and a link to the final report.

- The released code must be licensed under AGPL or SSPL and hosted on a public code hosting platform (e.g., GitHub). The judging panel, consisting of the organizing committee and the expert committee from the Ministry of Education's Artificial Intelligence Competition and Annotation Data Collection Project, will verify and score the submissions. Teams failing to provide complete documentation by the deadline or submitting after the deadline will forfeit the opportunity for evaluation.
- The organizing committee will provide a report template before the end of the competition. The report should follow the format and content outlined in the template, including (but not limited to): (1) team members, (2) model algorithm explanation, (3) data preprocessing, data augmentation, and the use of generative AI, (4) complete code, (5) program execution environment, and (6) model weight files. The assessment criteria for the report (20%) include three parts: (1) Report Completeness (8%), (2) Report Accuracy (8%), and (3) Technical Model Originality or Improvement Effectiveness (4%). Note that the executability and verifiability of the code will impact the report score.
- At least one person within the winning team must be a citizen of the Republic of China or hold a work or student visa in the Republic of China for the team to be eligible to receive the award.
- Prize money will be disbursed in New Taiwan Dollars via bank transfer. The winning team, in accordance with registration specifications and eligibility criteria, should designate a team member with a local New Taiwan Dollar account to receive the prize money. This designated team member will act as the taxpayer for Republic of China tax purposes and must sign relevant documents, including tax and personal information usage agreements.
- Winning teams must delegate at least one representative to participate in the subsequent award ceremony as notified by the organizing committee. If no team member is available, a friend or family member may represent the team in receiving the award and giving a brief presentation.

5. The allocation of award quotas may be adjusted based on the number of participating entries and performance. If the entries do not meet the required standards, the organizing committee's final judging panel reserves the right to decide whether to leave certain award categories unfilled or to select a reduced number of entries.
6. Due to the requirements of registration eligibility review and award document verification, please ensure that the Chinese name in your T-Brain registration account

is accurate. If necessary, you can make corrections by accessing the "My Profile" function in your T-Brain account.

Note 2: If there are non-student teams among the top 11 teams, the Student Group Ranking Awards quotas will be sequentially filled by ranking, and the teams will receive both the Ministry of Education certificate and cash prize.

Scoring Criteria

1. File submissions should be in .zip format and must adhere to the competition format specifications. Please refer to the "Upload Format Instructions" to avoid the risk of grading failure.
2. The scoring system will evaluate each submission, and the highest score will be displayed on the Leaderboard. During the competition, participating teams will receive a Public score for reference. Private evaluation scores will not be disclosed during the competition, and the Private Leaderboard will be released after the competition ends. The team's highest Private evaluation result will determine the final ranking. In case of tied scores among participating teams, the ranking will be determined based on the upload time.
3. The dataset includes the Training Dataset, Public Test Dataset, and Private Test Dataset. Please refer to the "Dataset Format Instructions." Participants are required to upload their predictions to the platform according to the specified schedule for each stage.
4. The Private Test Dataset for the competition will be available for download on 5/21 (Tuesday) at 11:00 AM, and participants can start uploading their answers at the same time. **Please note that there will be no answer upload functionality between 00:00 and 10:59:59 on 5/21 (Tuesday), and it will reopen at 11:00 AM.**
5. From 5/21 (Tuesday) at 11:00 AM to 5/28 (Tuesday) at 23:59:59, participants can upload predictions for the Private Dataset. Submissions after the deadline will not be scored. During this period, the daily upload limit is three times, and it's important to note that the daily upload count is based on the number of files. If predictions for both the Public and Private Datasets are combined into a single file, it will be counted as one submission. If predictions for the Public and Private Datasets are submitted as separate files, it will be counted as two submissions.

Scoring Formula

The image evaluation method for this competition employs the Fréchet Inception Distance (FID) metric, which calculates the feature distance between real and generated images. A lower FID value indicates better image quality. The calculation method is as follows:

$$FID = \|m - m_w\|_2^2 + Tr\left(C + C_w - 2(CC_w)^{1/2}\right)$$

In which m and m_w respectively represent the mean vectors of the distributions of real images and generated images; C and C_w respectively represent the covariance matrices of the distributions of real images and generated images.

Final Score Calculation:

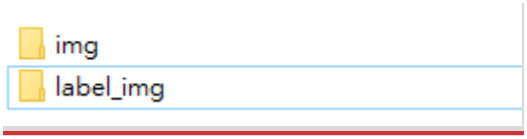
Separate FID scores will be calculated for river images and road images, and a weighted evaluation will be performed to derive the overall final score, referred to as the FINAL SCORE.

$$\boldsymbol{FINAL\ SCORE = \frac{FID_{river} + FID_{road}}{2}}$$

Dataset Format Instructions

The Training Dataset format for this competition is outlined as follows:

1. Within the Training Dataset, there are two folders named "img/" and "label_img/". The "img/" folder contains images in .jpg format, while the "label_img/" folder contains images in .png format.



2. The file naming format is as follows: TRA_XX_XXXXXXX, where

XX: RI indicates that the data is related to a river；

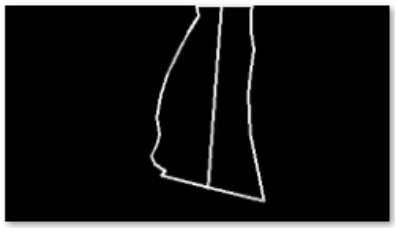
RO indicates that the data is related to a road.

XXXXXXX: Represents the data serial number, starting from 0 and incrementing sequentially.

Files with the same name but different extensions (jpg and mask) are considered a set of data. For example, TRA_RI_1000000.jpg and TRA_RI_1000000.png together represent one set of data.

Example: TRA_RI_1000000.jpg, TRA_RI_1000000.png

TRA_RI_1000000



TRA_RI_1000000

3. The jpg files contain raw drone images, while the png files are black and white images. In the png files, white lines represent the boundaries and centerlines of roads or rivers. Both the raw drone images and the black and white images have a size of 428*240.
4. The Training Dataset consists of a total of 4320 sets of data, with the first half pertaining to rivers and the second half to roads.

The format for the Public Testing Dataset in this competition is outlined as follows:

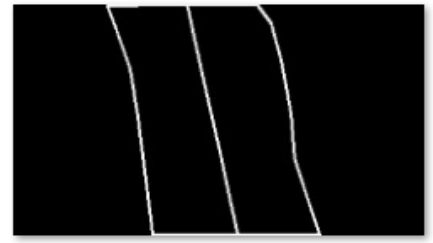
1. The Public Testing Dataset contains 720 black and white images in .png format.
2. The file naming format is as follows: PUB_XX_XXXXXXX, where

XX: RI indicates that the data requires generating river images；

RO indicates that the data requires generating road images.

XXXXXXX: Represents the data serial number, starting from 0 and incrementing sequentially.

Example: PUB_RI_1000000.png represents data in the public testing dataset that requires generating river images.



PUB_RI_1000000

3. In the black and white images, white lines represent the boundaries and centerlines of roads or rivers. The image size is 428*240.
4. The Public Testing Dataset consists of a total of 720 data entries, with the first half pertaining to rivers and the second half to roads.

The format for the Private Testing Dataset in this competition is outlined as follows:

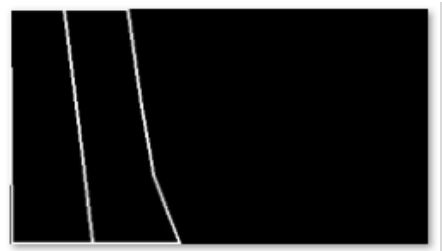
1. The Private Testing Dataset contains 720 black and white images in .png format.
2. The file naming format is as follows: PRI_XX_XXXXXXX, where

XX: RI indicates that the data requires generating river images；

RO indicates that the data requires generating road images.

XXXXXXX: Represents the data serial number, starting from 0 and incrementing sequentially.

Example: PRI_RI_1000000.png represents data in the private testing dataset that requires generating river images.



PRI_RI_1000000

3. In the black and white images, white lines represent the boundaries and centerlines of roads or rivers. The image size is 428*240.
4. The Private Testing Dataset consists of a total of 720 data entries, with the first half pertaining to rivers and the second half to roads.

Upload Format Instructions

The upload format for both the Public Testing Dataset and Private Testing Dataset in this competition is consistent. Please refer to the following instructions:

1. The generated image filenames should match those in the Testing Dataset, with the file extension being .png. For example, if there is an image named PUB_RI_1000001.png in the Public Testing Dataset, the corresponding generated image filename should be PUB_RI_1000001.jpg.
2. There are 720 images in the Testing Dataset, so you should generate 720 .png images, all with a size of 428*240.
3. The data identifier "RI" indicates the need to generate river images, while "RO" indicates the need to generate road images. The first 360 images should be rivers, and the remaining 360 images should be roads.
4. Compress the 720 .png images into a .zip file. You can choose the filename, but it should consist of alphanumeric characters only and should not contain any special symbols.
5. Upload the .zip file to the TBrain platform for scoring.

Competition Rules

1. The Public Testing Dataset (Public Dataset) and Private Testing Dataset (Private Dataset) allow a maximum of 3 submissions per day for predicted results. The upload count is based on the number of files. If the predicted results for the "Public Dataset" and "Private Dataset" are combined into the same file, it counts as 1 submission. If the predicted results for the "Public Dataset" and "Private Dataset" are submitted as separate files, it counts as 2 submissions.
2. Participants are not allowed to manually correct the answers they submit to maintain fairness in the competition.
3. The techniques and code used in the entries should be original or obtained with legal authorization by the participating teams. If any third party claims infringement of intellectual property rights or other illegal activities, the participating teams should handle it on their own. If there is a proven case of infringement, the organizing committee reserves the right to cancel the competition and disqualify the team, following the terms of use of the "T-Brain Machine Learning Competition " and the "Competition Rules for Participants Using T-Brain AI Platform."
4. Except for the regulation in point 2 above, participating teams can use generative AI to augment data or use additional open-source resources to enhance model training results. However, any manual corrections are prohibited. If additional self-made or external open-source data is used, including but not limited to third-party open-source programs found on the internet or reference code provided by the instructor in class, the participating team must provide the relevant sources in the written report submitted at the end of the competition. A detailed explanation of how the external data contributes to the competition results should also be included. In case of disputes, the organizing committee has the final decision-making authority.
5. The top 25% of teams on the Private Leaderboard (not exceeding 30 teams) after the end of the competition must submit the original code for the model algorithm and the final report. The report should follow the format and content provided by the organizing committee and include (but not limited to): (1) Team members, (2) Model algorithm explanation, (3) Data preprocessing, data augmentation, and the use of generative AI, (4) Complete code, (5) Program execution environment, (6) Model weight file. The program must be executable, and the execution results should be consistent with the uploaded results for the final ranking. Violations may affect eligibility for awards. The report will be reviewed and scored by a judging team composed of experts from the Ministry of Education's AI competition and annotation data collection project office.
6. Post-competition reports should be independently written. However, it can be publicly discussed in the official discussion forum. Sharing and transferring data, code, or related ideas among teams during the competition are strictly prohibited. If reports and codes

submitted by different teams are found to be similar, it will affect the evaluation scores for all involved teams. In severe cases, all relevant teams may be disqualified from winning awards.

7. Teams are reminded to protect data processing, model programs, and related concepts. Do not share or transmit reports, codes, or other data privately with other teams during the competition. If any team's reports or programs are found to be identical to others due to sharing, it will affect the evaluation scores for all involved teams. Severe cases may lead to the disqualification of all relevant teams from winning awards.
8. If necessary, the organizing committee has the right to adjust the dataset during the competition.
9. The intellectual property rights of the competition results belong to the participating teams. Matters related to copyright licensing, patent applications, technology transfer, and equity distribution shall be handled in accordance with relevant laws.
10. The organizing committee has the right to disqualify a team or revoke award eligibility without prior notice under the following circumstances:
    - There is concrete evidence that the team has engaged in plagiarism, cheating, or fraud.
    - There is concrete evidence that the team has violated the intellectual property rights of others.
    - There is concrete evidence that the team has attacked the Leaderboard system.
    - There is concrete evidence that the team has influenced other participating teams, leading to unfair instances.
    - There is a violation of the rules of this competition, the "T-Brain Machine Learning Competition" terms of use, or the "Competition Rules for Participants Using T-Brain AI Platform."
11. The organizing committee reserves the right to interpret and adjudicate the activities and competition rules.

Awards Description

[Student Group Ranking Awards]

Award Categories	Number of Awards	Prize money
The first place	1	NTD 50,000
The second place	1	NTD 20,000
The third place	1	NTD 12,000
The excellent award	1	NTD 8,000
The honorable mention award	7	NTD 5,000

[Trend Micro Sponsorship Awards]

Award Categories	Number of Awards	Prize money
The first place	1	NTD 15,000
The second place	1	NTD 10,000
The third place	1	NTD 5,000

The top 11 teams in the Student Group, in addition to cash prizes, will receive the "Certificate of Merit" from the Ministry of Education. Teams ranked 12th and above, up to the top 25% of the overall rankings (not exceeding 30 teams), regardless of their identity, are eligible to receive the "Office Project Electronic Certificate" after submitting the required report and being reviewed by the organizing committee's judging panel.

Competition Schedule

Events	Date	Detail
Registration Time	2024/03/13 – 2024/05/14	The registration will open on 03/13, and the competition will officially begin on 03/20.
Training Dataset available for download	2024/03/20 – 2024/05/28	Competition teams can download the competition training dataset on the same day the competition officially begins.
Public Dataset available for download and upload prediction	2024/04/10 11:00 AM – 2024/05/28	Starting from 11:00 AM on April 10, competition teams can download the Public Dataset for testing and upload their answers. The scoring system will evaluate each team's answers and provide the Public evaluation scores as a reference. The maximum number of uploads per calendar day is limited to 3 times. Please ensure that the answers are uploaded in the specified format to avoid any upload failures.
Private Dataset available for download and upload prediction	2024/05/21 11:00 AM – 2024/05/28	1. **Please note that there will be no answer upload functionality between 00:00 and 10:59:59 on May 21. The upload feature will resume at 11:00 AM on May 21.** 2. Starting from 11:00 AM on May 21, competition teams can download the Private Dataset for testing and upload their answers. The scoring system will evaluate each team's answers and provide Public evaluation scores as a reference. 3. The maximum number of uploads per calendar day during this period is limited to 3 times. Please be aware that this upload limit is based on the number of files. If the Public and Private Dataset predictions are combined in a single file, it will be counted as 1 submission. If predictions for Public and Private

		Datasets are submitted as separate files, it will be counted as 2 submissions. 4. Ensure that answers are uploaded following the specified format to avoid any upload failures.
Announcement of private leaderboard scores	2024/05/29 17:00 PM	Announcement of the Private Leaderboard scores
Upload the reports and submit related code	2024/05/29 – 2024/06/04	The winning teams in the top 25% of the Private Leaderboard are required to submit specified documents, including documentation of the predictive model, relevant reports and code, and any self-made training datasets, as stipulated by the rules.
Announcement of final rankings	2024/07/22 17:00 PM	The final list of winners will be announced on the T-Brain platform and the AI CUP official website.
Award Ceremony	Early 2025(Tentatively Q1)	Details of the award ceremony will be announced separately. Winners are requested to attend the award presentation as notified by the AI CUP Project Office.

Q&A

If you have any questions about the competition, feel free to raise them in the discussion forum or send your questions via email to t_brain@trendmicro.com.

Promotion courses

The organizing committee will conduct a nationwide AI CUP touring course. All courses are free to attend. Interested participants are welcome to check the latest updates on the AI CUP website (https://moeaincu.wixsite.com/aicup) or follow the Facebook fan page (https://www.facebook.com/AICUPrealtask).