

Competition 1: Large-Scale SAR Image Multi-Class Oriented Object Detection

1.Competition Background

Synthetic Aperture Radar (SAR) images, due to their unique imaging mechanism, can capture high-quality ground images under conditions of no illumination or adverse weather. They are indispensable observation tools in critical areas such as military reconnaissance, humanitarian rescue, and Earth observation. In the context of an increasingly complex and volatile international environment, improving the accuracy and efficiency of object detection in SAR images is of great significance for enhancing emergency response capabilities, strengthening national defense security, and promoting environmental monitoring. The imaging characteristics of SAR images, however, make them unlike optical images that can be intuitively interpreted by the human eye. Interpreting SAR images often relies on expert knowledge, which is challenging and time-consuming.

2. Competition Application Scenarios

With the rapid development of artificial intelligence, especially the widespread application of deep learning in image processing, accurately and efficiently detecting multi-class oriented objects from complex backgrounds has become a research hotspot. This competition provides the first COCO-scale multi-class SAR oriented object detection dataset: RSAR, aiming to attract broad participation from researchers and technology enthusiasts worldwide. It seeks to promote communication and collaboration between academia and industry in the field of SAR image processing, advance SAR image processing technologies, and improve the automation and accuracy of SAR image object detection. Ultimately, it aims to accelerate the application and practical implementation of AI technologies in critical areas such as the military, humanitarian rescue, and Earth observation.

3. Competition Information

3.1 Organizing Unit

This competition is organized by the competition committee, with experts coordinating the event, and the problems are provided by the Media Computing Laboratory of the School of Computer Science, Nankai University (<https://mmcheng.net/>). Problem setters from the organizing institution are: Mingming Cheng, Xiang Li, Qibin Hou, Yimian Dai, Yuxuan Li, and Xin Zhang.

3.2 Competition Advisors

This competition is advised by Yuxuan Li and Xin Zhang. Yuxuan Li received a first-class honors degree (BSc and MSc) in Computer Science from University

College London (UCL) and is currently pursuing a PhD at the Department of Computer Science, Nankai University. His research interests include neural architecture design and remote sensing object detection. He has won the 2nd Jittor AI Challenge in 2022, placed second in the 2022 Greater Bay Area International Algorithm Competition, and served as a problem setter for the PRCV 2024 SARDet competition. He has published several papers in NeurIPS, IJCV, ICCV, CVPR, TGRS, and other conferences and journals, with over 800 citations on Google Scholar. Xin Zhang is currently pursuing a master's degree at the Department of Computer Science, Nankai University. His research focuses on object detection. He has achieved second place in the 2022 Greater Bay Area International Algorithm Competition, third place in the 3rd Jittor AI Challenge in 2023, and second place in the 2024 ISPRS Remote Sensing Intelligent Interpretation Competition. He has also published papers in CVPR and ECCV.

3.3 Supporting Organizations

This competition is supported by the Media Computing Laboratory of the School of Computer Science, Nankai University, which provides the application scenarios, datasets, and event organization. DeepMad (Shanghai) AI Technology Co., Ltd. provides computing power, website maintenance, and online evaluation support.

4. Competition Tasks

Participating teams are required to use the training and validation datasets provided by the organizers to develop algorithms capable of accurately detecting multi-class objects in SAR images. The algorithms should detect objects in SAR images and output each object's category, confidence score, and location (represented using rotated bounding boxes). Teams may use open-source algorithm frameworks such as PyTorch or MMRotate. The organizers recommend using the domestic framework Jittor for algorithm development and provide the nk-remote remote sensing object detection toolkit and reference benchmark library to help teams efficiently develop high-performance detection models.

5. Dataset and Data Description

5.1 Data Source

The data are sourced from the publicly available RSAR dataset of Nankai University. This dataset is a large-scale, multi-class rotated SAR object detection dataset, containing typical categories such as ships, airplanes, cars, oil tanks, ports, and bridges, with broad representativeness.

Sample data can be accessed at: <https://pan.baidu.com/s/1VMSEiQfF6cDnIN>

[WKNvIjew?pwd=rsar](#). The full dataset will be available for download after registration.

5.2 Dataset Scale

This competition provides a rotated SAR object detection dataset, which includes six typical detection targets: ship, aircraft, car, tank, bridge, and harbor. The training set consists of 89,082 images for participants to train their models. The preliminary test set contains 4,860 images for model performance evaluation, and the final test set includes 4,180 images for the final assessment of model results.

5.3 Data Format

The dataset annotations are stored in the commonly used DOTA format. Each image corresponds to one annotation file in .txt format, and the annotation file shares the same name as its corresponding image file. Specifically, each line in an annotation file represents one instance, with the format: [x_1, y_1, x_2, y_2, x_3, y_3, x_4, y_4, classname, difficulty]. This includes the four-point coordinates of the rotated bounding box, the class name of the instance, and whether the instance is a difficult sample.

6. Algorithm Design Requirements

6.1 Model Type

Participants are encouraged to adopt and improve deep learning algorithms.

6.2 Innovation

Participants are encouraged to propose innovative algorithm architectures or improve existing algorithms to enhance the accuracy and efficiency of SAR object detection and classification.

6.3 Scalability

Algorithms should have good scalability, capable of running on computing devices with different configurations while maintaining stable performance when handling large-scale data. For example, the algorithm should run efficiently on both standard workstations and cloud servers, and its performance should not degrade significantly as the dataset size increases.

6.4 Dataset Restrictions

Only the datasets provided by the competition may be used. To ensure fairness, the use of other public or private SAR object detection datasets is strictly prohibited. After the final round, the organizers will reproduce the submitted code using the official datasets. If the results cannot be accurately reproduced with the provided data, the participant will be disqualified.

7. Performance Metrics Requirements

The machine evaluation for this competition uses the mean Average Precision (mAP), commonly employed in object detection, as the evaluation metric. To encourage precise detection, no restrictions are imposed on inference time or model size.

8. Functional Requirements

8.1 Accuracy

Algorithms must achieve high accuracy in detecting SAR object locations and marking their boundaries, minimizing missed detections and false positives. On the test set, the mean Average Precision (mAP) for detection is required to reach at least 0.5.

8.2 Reliability

Algorithms should operate stably and produce reliable results when handling SAR images of varying quality and from different acquisition devices. Even in the presence of noise, artifacts, or other interference, the algorithm's performance should not fluctuate significantly, maintaining accuracy and stability in SAR detection and classification.

9. Development Environment

Participants are required to develop their algorithms using Python. They may use open-source frameworks such as PyTorch or MMRotate. The organizers recommend using the domestic framework Jittor for algorithm development and provide the nk-remote remote sensing object detection toolkit and reference benchmark library to help teams efficiently develop high-performance detection models.

10. Evaluation Criteria

The preliminary test set is evaluated by machine using mAP, but these results do not count toward the final score; they are intended only for participants to validate and develop their algorithms.

The final test set is also evaluated by machine using mAP, and these results will contribute to the final score.

The final offline competition score is calculated as: 70% objective score + 30% subjective score. The objective score refers to the standardized score from the final machine evaluation, while the subjective score comes from the presentation evaluation after standardization. Standardization sets the highest score to 100, and all other scores are adjusted proportionally. (For National Level 2 and 3 participants, the 30% subjective score component does not apply.)

11. Submission Requirements

11.1 Preliminary Round Submission Content and Requirements

Participants are required to perform inference on the preliminary test set provided by the organizers and save the detection results as a .pkl file. When loaded using `np.load`, the file should return a list.

Each element in the list is a dictionary containing the following four key-value pairs:

`image`

Meaning: The filename of the corresponding test image.

Data type: String (str)

Example: '0000001.png'

`poly`

Meaning: The polygon vertex coordinates of detected objects, describing the location and shape of rotated objects.

Data type: NumPy array (array)

Shape: `[n, 8]`, where `n` is the number of detected objects. Each row contains 8 numbers representing the four vertices in order (`x1, y1, x2, y2, x3, y3, x4, y4`).

Element type: Float (float)

Example: `array([[567.0703125, 607.28747559, 582.2923584, 597.86804199, 604.56018066, 633.85375977, 589.33813477, 643.27319336], [386.74880981, 133.46098328, 399.05410767, 138.62980652, 385.62966919, 170.58909607, 373.32437134, 165.42027283]])`

`scores`

Meaning: Confidence scores of the detected objects, reflecting the model's certainty.

Data type: List of floats (list[float]), values in `[0, 1]`

Length: Matches the number of rows in `poly`

Example: `[0.9977, 0.9956]`

`labels`

Meaning: Class labels of the detected objects

Data type: List of strings (list[str])

Length: Matches the number of rows in `poly`

Example: `['bridge', 'aircraft']`

Notes:

Ensure that the submitted .pkl file strictly follows this format, otherwise the

submission may be invalid.

For multiple objects in the same image, the order of poly, scores, and labels must correspond exactly (i.e., the i -th object's polygon, score, and label must align across the lists).

Image filenames must match exactly with those in the test set, including case and extension, to avoid mismatches.

Confidence scores should truthfully reflect the model's certainty and must not be artificially altered or reordered to ensure fairness and accuracy in evaluation.s

11.2 Final Round Submission Content and Requirements

Participants are required to perform inference on the official final round test set, and the submission format should be the same as that of the preliminary round.

11.3 Grand Final Submission Content and Requirements

Submissions should be organized and submitted in accordance with the "Algorithm Competition Submission Requirements".

12. Other Notes

12.1 Updates and Q&A

Participants are advised to regularly check the official website for updates. It is recommended that participants add the technical advisors on WeChat (lyxBird or zhasion) and include a note in the format **SARDet-Organization-Name**. After verification, they will be allowed to join the competition discussion group.

12.2 Fairness

Any form of cheating is strictly prohibited, including but not limited to data leakage, overlap between pretraining data and test data, and copying others' code. Any violations will result in immediate disqualification and may involve accountability measures.

12.3 Intellectual Property

The competition only allows the use of datasets provided by the organizers. To ensure fairness, the use of other public or private SAR object detection datasets is strictly prohibited. After the final round, the organizers will reproduce the submitted code using the official datasets. If the results cannot be accurately reproduced, the participant will be disqualified.

Submissions must be original works that have not won awards or been publicly published in other competitions. The organizers have the right to display and promote the submitted works, but intellectual property rights remain with the participants.

The intellectual property of the submitted algorithms and executable models is

jointly owned by the participants and the organizers. Competition videos and image data are owned by Nankai University. Upon agreement, winning algorithms may be used for research related to the competition funding.

Each participating team must ensure that their submitted results are reproducible. The organizers commit to maintaining confidentiality and not using the submissions for any purposes outside of this competition.

Teams must guarantee that the proposed solutions and algorithms are their own intellectual property. The organizers are not responsible for any actual infringement or third-party claims resulting from the use of the submitted algorithms or results. Should such situations arise, the participating team must bear all legal and financial responsibilities and protect the organizers from any related liabilities.

13. Reference Resources

[1] Zhang, Xin, Xue Yang, Yuxuan Li, Jian Yang, Ming-Ming Cheng, and Xiang Li. "Rsar: Restricted state angle resolver and rotated sar benchmark." CVPR (2025).

[2] Li, Yuxuan, Xiang Li, Weijie Li, Qibin Hou, Li Liu, Ming-Ming Cheng, and Jian Yang. "SARDet-100K: Towards Open-Source Benchmark and ToolKit for Large-Scale SAR Object Detection." NeurIPS Spotlight (2024) .

[3] Li, Yuxuan, Xiang Li, Yimain Dai, Qibin Hou, Li Liu, Yongxiang Liu, Ming-Ming Cheng, and Jian Yang. "Lsknet: A foundation lightweight backbone for remote sensing." International Journal of Computer Vision (2024) .

[4] Hu, S.M., Liang, D., Yang, G.Y., Yang, G.W. and Zhou, W.Y. "Jittor: a novel deep learning framework with meta-operators and unified graph execution." Science China Information Sciences, 2020

14. Contact Information

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Registration website: <https://www.bohrium.com/competitions/7687826632?tab=introduce>

Appendix: Competition Process and Awards

1. Registration Stage

Participants complete registration on the official competition website and submit personal or team information.

<https://www.bohrium.com/competitions/7687826632?tab=introduce>

2. Preliminary Round

Participants use the training dataset provided by the organizers to design and develop their algorithm models and validate them using the preliminary test set. During the preliminary round, each team can submit results up to 2 times per day, and the leaderboard is updated in real time.

3. Final Round (Provincial Level)

After the preliminary round, the final round begins, and the download links for the final round dataset are made available. Only teams that submitted valid results in the preliminary round are eligible for the final round. During this stage, participants use the provided dataset to fine-tune their algorithms and submit inference results on the final round test set. The final round lasts 3 days, and each team has only 2 submission opportunities; the last submission will be considered final.

4. Final Round Results Announcement (Provincial Level)

Final round results are published on the official competition website. The number of teams that entered the final round and achieved an mAP score above 50% is used as the base for awards. First, second, and third prizes are awarded at ratios of 15%, 25%, and 30%, respectively, with certificates issued. Teams winning first and second prizes advance to the national competition grand final.

5. Grand Final Stage

5.1 Online Evaluation for the Grand Final: Teams advancing to the grand final are ranked based on the final round leaderboard. Using the number of qualifying teams as the award base, first prize candidates and second and third prize winners are determined at ratios of 15%, 25%, and 30%, respectively. Certificates are issued for second and third prizes.

5.2 Final Submission: First prize candidate teams must submit technical documentation, algorithm code and model files, demonstration videos, and supplementary materials within the specified time. No modifications or additions are allowed after the submission deadline.

5.3 Evaluation Stage: A professional judging panel evaluates the submissions based on performance metrics, as well as the completeness and quality of submitted

materials, to assign comprehensive scores. Judges may request participants to provide explanations if necessary.

5.4 Offline Defense: First prize candidate teams must submit finalized technical documentation, code and model files, demonstration videos, and supplementary materials within the specified time and participate in the national grand final offline defense. The final first prize winners and their rankings are determined based on a combination of algorithm performance scores and offline defense scores. Teams not participating in the offline defense will be considered to have forfeited the award. Certificates of honor are awarded to first prize winners.