

**AIRBUS**

## Anomaly Detection in Time Series Scientific Challenge

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Airbus Commercial Aircraft – Multivariate Anomaly Detection on Flights

**LEGAL NOTICE – issued 18 December 2018**

### **Challenge in brief**

AIRBUS platforms (aircraft, helicopters, satellites, etc.) generate a huge quantity of sensor data that is collected on big data infrastructure. Time Series Analysis has been identified as a technology that will be used in future years by AIRBUS to extract value from this huge source of knowledge on our operated platforms.

AIRBUS is launching this scientific challenge on anomaly detection in time series data to:

- scout for top players in the field of Time Series Analysis;
- encourage the research community to tackle the specific issues of related to the data generated by the aerospace industry during tests and in operations.

### **Why is AIRBUS context is challenging?**

The challenge is to work in an unsupervised context. Almost all data collected from our platforms is considered as normal. The occurrences of faults and failures is very rare and our customers would not appreciate to wait hundreds of faults before we are able to anticipate them. We are thus interested in looking for changes in the behavior of the systems we monitor through the sensors installed on the platforms.

### **What are the tasks?**

- Detect abnormal behaviour in sensor data

### **Who can participate?**

The challenge is intended to be of interest to companies, research labs, schools or individuals. There is no cost to participate.

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## 1. Registration and Terms of Use

When accessing the [AIRBUSAI GYM platform](#) and registering to do the challenge you agree with the rules for the ANOMALY DETECTION IN TIME SERIES CHALLENGE as published on the AIRBUSAI GYM Platform and this Legal Notice.

Registration for this challenge (Airbus Commercial) can be done on AIRBUSAI GYM platform: <https://aigym.airbus.com>

Registration for the two other Times Series use cases is also available on the platform. You will have to register on each challenge you want to participate in.

## 2. What are the tasks?

There is one task: *anomaly detection*.

### 2.1 Anomaly detection

Given an input sequence containing sensor data collected on multiple context sensors during a given period of time, and a prioritized shortlist of focus sensors where anomalies should be investigated, the Participants' system shall at least identify the anomalous dataset (i.e. flight), sensor, and time range where the anomaly occurred.

## 3. Who can participate?

A Participant is defined as an individual participating solely, a team of individuals, a small, medium or large company, or a research laboratory, a University, college, or institute (hereinafter the "Participant").

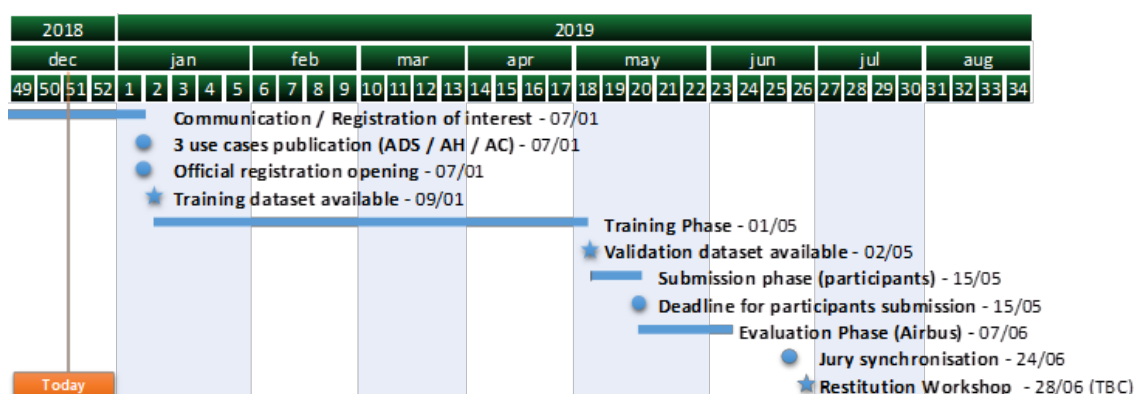
Creating a consortium or sharing human resources is not permitted in order to allow the evaluation of each Participant separately.

Only one participation is allowed per entity.

Participants will designate a focal point for contact with challenge organizers.

Teams who have provided at least one submission are entitled to request a 1h company pitch, including a marketing and technical presentation split evenly. Nevertheless, no information about the challenge will be provided during this meeting.

## 4. Challenge process and schedule



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## 4.1 Registration

Participants can register on the [AIRBUSAI GYM platform](#) from **07 JAN 2019**.

## 4.2 Release of training dataset and training phase

The training dataset is made available to Participants on the **09 JAN 2019** via the AIRBUSAI GYM platform.

The training dataset is the data that is provided to Participants to build their system (anonymized sensor data).

The training phase starts from **09 JAN 2019** and ends on **01 MAY 2019**.

During the training phase, Participants build their system using the training data.

Airbus will dedicate 1h of dedicated webconference time to clarify challenge questions in the beginning of the challenge to share Q&A with all participants.

The training dataset is used to perform iterative self-evaluations (validating the accuracy, recall and other metrics of intermediate submissions). Participants can send up to 3 new anomalies weekly that will be qualified by Airbus experts as true or false positives. True positives will be publicly shared to participants using the communication channel on Slack : <https://aigymworkspace.slack.com>

## 4.3 Release of evaluation dataset

The evaluation dataset will be made available to Participants on the **02 MAY 2019** via the AIRBUSAI GYM platform.

The evaluation dataset is used to perform the final evaluation (ranking of the Participants and designation of best performing method).

## 4.4 Submission phase

The submission phase will last from **02 MAY 2019** to **15 MAY 2019**.

During the submission phase, Participants run their system on the evaluation dataset and submit the results of their system on the AIRBUSAI GYM platform. Each Participant can submit up to two different results.

## 4.5 Deadline for results submission

Participants can submit their results on the AIRBUSAI GYM platform until **15 MAY 2019**.

## 4.6 Evaluation phase

The evaluation phase starts from **15 MAY 2019** to **07 JUN 2019**. Evaluation is performed by the challenge organizer (AIRBUS). The submissions of the Participants are compared to the actual true positives that were vetted by human experts. A verification procedure will be made to ensure that the submitted results were obtained without human intervention. For example, Participants may be asked to send (or bring to Toulouse) a trial version of their system. Any other way of demonstrating that the submitted results were obtained without human intervention will be discussed with the organizers of the challenge.

## 4.7 Results announcement and restitution workshop

A one-day restitution workshop will take place on **28 JUN 2019** (exact date to be confirmed at a later date) for all Participants to meet and share knowledge / experience at AIRBUS premises in Toulouse. Challenge organizers will announce the results and the top-ranked will give a speech during the workshop. A poster session (marketplace) will be organized during the workshop to allow Participants to present their system. A Round table on Time Series Anomaly Detection will be organized during the workshop as well.

## 5. Invitation extended to top-ranked Participant

The focal point of the top-ranked Participant will be invited to Toulouse to give a speech at the restitution workshop (round trip transportation to Toulouse, meals and hotel accommodation for 2 nights and 2 days in Toulouse for the focal point of the top-ranked Participant, will be paid by Airbus).

## 6. Support during challenge

A challenge forum [Slack channel: <https://aigymworkspace.slack.com> ] has been created to ensure that all questions and answers are made public and shared among Participants. Access will be granted to focal points of each Participant.

## 7. Participants privacy and personal data protection

### 7.1 Participants privacy

Participation to the challenge is not made public unless the Participant agrees to make it public.

This means that:

- The leader board results (ranking, scores) are anonymized except for Participants who agree to have their name disclosed.
- The challenge results (ranking, scores) are anonymized except for Participants who agree to have their name disclosed.
- Participants are free to publish or report their own score and ranking but they cannot publish other Participants' scores and ranking unless they were authorized to do so by the relevant Participant.

### 7.2 Personal data protection

Participants' personal data will be collected during challenge registration (name of organization, email and name of focal point, timestamp of your registration and submission). This data will be stored on the AIRBUSAI GYM platform and will be protected in accordance with the Airbus Personal Data Protection Policy.

The collection and processing are handled by Airbus are in full compliance with the European Directive 95/46/EC (the "Directive 95/46/EC") of the European Parliament and of the Council of 24 October 1995 on the protection of individuals regarding the processing of Personal Data and on the free movement of such data.

You may object such collection of your personal data for legitimate reasons. In such case, Airbus cannot grant access to the AIRBUSAI GYM platform.

You can exercise these rights by contacting the Data Protection Officer at [dataprotection@airbus.com](mailto:dataprotection@airbus.com) specifying which of the aforementioned rights you wish to exercise and attaching a copy of a document justifying your identity.

### 7.3 Cookies on AIRBUSAI GYM platform

The AIRBUSAI GYM platform may send to your computer small text files called "cookies" which are stored on your computer and can be read by the webserver to ease your internet browsing and to customize your experience. You are free to accept or decline it. As browsers usually tend to automatically accept cookies, if you do not want to accept then you should configure your browser to decline cookies. Please note that if you decline cookies, you may not be able to access all interactive features of the AIRBUSAI GYM, Airbus websites and services.

## 8. Detailed datasets description

We are interested in the detection of abnormal sensor behaviour. Sensors are recorded at 8 Hz and we provide sequences of variable length. Contestants are free to cut or aggregate the data for their training.

### 8.1 Dataset split

#### Training data

The training dataset is composed of 1000 variable length sequences of flight data measured on ground test and actual flights of a certain aircraft system. Filenames starting with a B are flights and filenames starting with "C" are ground tests. All data has been multiplied by a factor so that absolute values are meaningless, but no other normalization procedure was carried out. All sequences should be considered as vastly normal and should be used to learn normal behaviour of aircraft data. Still these datasets contain a small amount of anomalies, some known to Airbus and some not yet, that will be collaboratively uncovered during the training phase (see section 4.2 last paragraph).

The dataset's parameters should be separated into "context" and "parameters of interest" by the participants. The following parameter IDs make up the "parameters of interest":

- parameter\_48
- parameter\_49
- parameter\_50
- parameter\_53
- parameter\_86
- parameter\_11
- parameter\_12
- parameter\_9
- parameter\_10

The rest of the available parameters can then be considered "context". It is important to note that the "context" is sufficient to describe any of the "parameters of interest". We highly recommend to start finding anomalies on one of the parameters (begin with parameter\_48) in the "parameters of interest" before moving on to the others.

#### Validation Data

The validation dataset is a smaller separate dataset of the same kind containing known anomalies by Airbus. The reported anomalies will be benchmarked against the known list of anomalies, which will be reviewed by an expert committee during the evaluation phase.

### 8.2 Dataset usage

The dataset is made available to the Participants for the challenge only from January 2019 to June 2019. Participants are not granted the right to share it or re-use it for other purposes. Participants are required to destroy the dataset once the challenge is over.

### 8.3 Dataset format description

Datasets are provided in a CSV zipped format.

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Each dataset has 81 "context" sensors and 9 prioritized "focus" sensors. We encourage participants to start with the higher priority sensor(s). We will tag which of the sequences are flights and which are on-ground tests in the file name.

## 9. Results submission rules and procedure

### 9.1 Results submission rules

Participants run their system on the evaluation dataset and submit the results of their system to the AIRBUSAI GYM platform for evaluation.

The Participants agree to process the data in accordance with the following rules:

- The Participants agree to abide by the terms guiding the training conditions (any additional data used for training the system shall be mentioned);
- The Participants agree not to have the evaluation data processed or improved via manual/human means;
- The Participants are allowed to use any automatically derived information for training;
- The Participants are allowed to submit up to two results for the final evaluation;
- Only one participation is allowed per entity/organization (University, School, Company, one or a team of individuals);
- Participants agree to have their system screened if required by challenge organizers to ensure that the evaluation data has not been data processed or improved via manual/human means.

### 9.2 Results submission procedure

The system's results should be uploaded on the using a web form similar to:

Submission form

The system's results are uploaded in the form of a tab-delimited .csv file.

### 9.3 Results submission format

Participants are expected to deliver their results in the form of an XLSX format of detected anomalies:

FLIGHT_FILE	SENSOR_ID	TIME_FROM	TIME_TO	CONFIDENCE	COMMENT
name of csv input file	identifier of sensor (column name from file)	relative time index to the file, when the anomaly starts, in seconds	relative time index to the file, when the anomaly ends, in seconds	a score from 0 (unsure) to 1 (sure)	any text, 128 chars [optional]

Entries shall not overlap or be adjacent timewise. Maximum 50 entries.



## 10. Detailed evaluation methodology and Participant ranking procedure

3 indicators will be built from the submission results:

- Precision
- Recall
- $F_{\beta}score = \frac{(1+\beta^2)*precision*recall}{\beta^2precision+recall}, \beta = 2$

## 11. Challenge- level ranking and winner designation procedure

### 11.1 Participants' ranking

Submissions will be ranked privileging the Recall score, on a rank based sample from the participant submission limited to 50 anomalies.

We will factorize the degree of overlap of submitted anomalies to actual anomalies.

Eg. :

100% overlap : 1p

reported anomaly fully contains the actual anomaly, but is 3 times longer: 0.33p

reported anomaly overlaps the actual anomaly by half, and has the same length: 0.5p

### 11.2 Participants' system screening for winner designation

A verification procedure will be made to ensure that the submitted results were obtained without human intervention. For example, Participants may be asked to send (or bring to Toulouse) a trial version of their system. Any other way of demonstrating that the submitted results were obtained without human intervention will be discussed with the organizers of the challenge.

### 11.3 Designation of top ranked Participant

The winner of the challenge is the Participant whose system has been screened by the challenge organizers and whose submission is ranked 1.

## 12. Confidentiality – Intellectual Property

Results submitted by Participants will remain the property of each Participant. However, each Participant authorizes challenge organizers to use the results for evaluation purposes.

## 13. Governing Law and Severability

This Legal Notice shall be governed by and construed in accordance with the laws of France, subject to any local applicable non derivable public policy rule.

Should one of the provisions of this Legal Notice or the TIME SERIES ANOMALY DETECTION CHALLENGE become partly or entirely invalid, the validity of the remaining provisions shall not be affected thereby. The invalid provision shall be replaced by a valid one best achieving the economically desired result. The same applies in the event of gaps or omissions.