

# Context Aware Spacecraft Telemetry Checking

## Satellite Health monitoring by means of Machine Learning

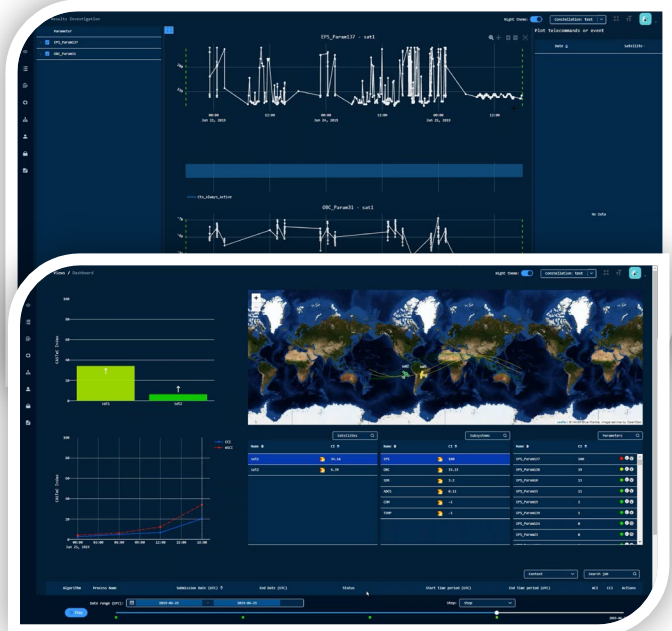
As of today, the increasingly high number of flying satellites will make impracticable for Satellite Controllers (SCs) to monitor effectively the health status of satellites, especially in large constellations.

CASTeC (Context Aware Spacecraft Telemetry Checking) is a software tool improving constellations monitoring and diagnostics, performing:

- Automatic identification of anomalous telemetries and relevant events that require investigation by SCs.
- Early detection of anomalies in the behaviour of the satellites/constellation.
- Automatic identification of correlated telemetries and events.

Therefore, CASTeC can support Satellite Controllers in the identification of critical operative conditions affecting service performance and mitigation strategies definition.

CASTeC diagnostic capabilities are based on an innovative Machine Learning based approach, applied to contextualised periods of satellites operations.



### BENEFITS:

**Predictive capabilities** CASTeC provides **early alerts** on the status of the satellites constellations, based on a detailed analysis of each single telemetry of the constellation.

**Relevant information** CASTeC identifies **relevant events** from the degree on anomaly detected.

**Events understanding** CASTeC supports events **troubleshooting** by guiding the SC in the identification of potential cause-effect relations among events.

**No need for experts' knowledge** The implemented algorithms **do not need experts' knowledge** on Artificial Intelligence to be configured, but only limited information and knowledge to define the relevant operative conditions of the satellites.

**Ease of deployment** CASTeC can be **easily interfaced** with different ground segment operations platforms.

## FEATURES:

- Innovations** CASTeC characterises the expected behaviour of satellites based on an innovative method developed by S.A.T.E., named **FETCH** (*FEaTure Checkability*).
- Checkability** *FETCH* extracts the features of the raw telemetries time series that are “checkable” in a specific context, thereby characterising their expected behaviour.
- Context-specific checks** Automatic definition of checks to be applied to telemetries that are “parameter-specific” and “context-specific”.
- Interpretable AI** The advantage of *FETCH* with respect to a conventional AI is that it is fully interpretable, thus the reasons for the anomalies identified can be explained and understood by SCs.

With CASTeC the user can:

- Check the behaviour of a satellite against other satellites of the same constellation;
- Monitor and understand the spacecraft behaviour during operations through the visualization of: raw parameters timeseries, derived features, CASTeC Index and events (such as telecommands), through different views and maps.

The advantage of CASTeC checking approach with respect to traditional threshold-based approaches is that it allows anticipating the detection of an anomaly even when signals stay within nominal bounds. In addition, compared to conventional Machine Learning, it allows understanding the reasons for an anomaly detected in the telemetry.

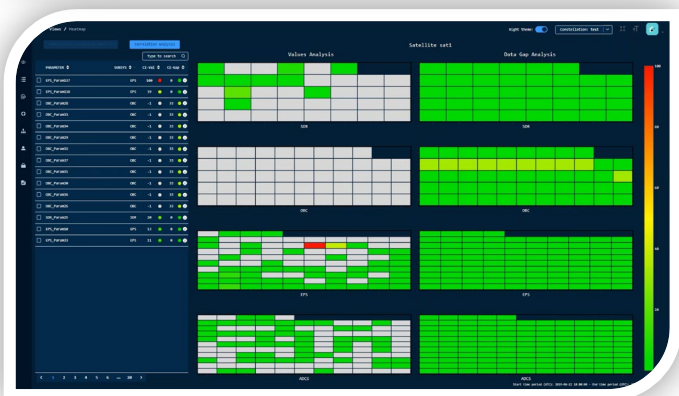
The product is a software module that can be easily interfaced with Ground Segment operations platforms.

CASTeC is delivered as a service with different service options. It is provided on cloud or, upon request, on customer’s premises.

The web-based Human Machine Interface implementation allows the installation of CASTeC on a shared (or external) machine and the investigation of the telemetry from any

different location, through a web browser.

CASTeC can be used as standalone tool or integrated with other end users’ tools, through specific APIs, according to their needs.



CASTeC has been developed by S.A.T.E. and Planetek in the frame of an ARTES 4.0 contract and previous contracts with the Advanced Operations Group at ESOC. The view expressed herewith shall in no way be taken to reflect the official opinion of the European Space Agency.

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