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Development of an Automated Correlation Tool (ACT) for Thermal Spacecraft Analysis to Enhance Design and Optimisation Processes

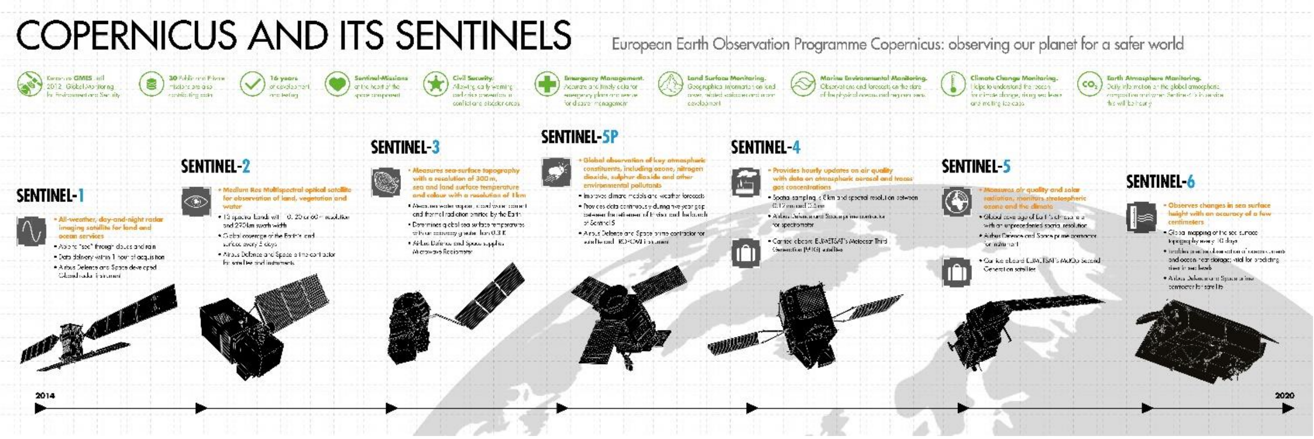

Figure illustrates various satellite configurations using the example of the Copernicus Sentinels, whose Thermal Models are correlated according to their individual requirements.

<u>Introduction:</u>

In spacecraft design, thermal analysis plays a crucial role in ensuring optimal performance and mission success. Spacecrafts, instruments and other payloads are operating in a harsh environment with extreme temperatures, fluctuations, and under vacuum conditions. Accurately predicting their thermal behaviour is essential for managing heat dissipation, power efficiency, and structural integrity.

However, thermal analyses often involve complex simulations with multiple parameters which can be time-consuming and prone to human error. The development of an Automatic Correlation Tool (ACT) for spacecraft thermal analysis targets a streamlined process by automating the comparison, validation, and optimisation of thermal models and the corresponding simulations, leading to a more agile and accurate evaluation and thus contributing to a highly efficient thermal design.

This thesis aims to create an Automatic Correlation Tool (ACT), based on statistical / machine learning techniques that can interface with existing thermal modelling software and quickly analyse large datasets to identify key thermal behaviours, trends, and correlations. ACT will be particularly valuable in iterating spacecraft designs or comparing different mission scenarios.

Airbus Defence and Space GmbH
Vorsitzender des Aufsichtsrates: Dr. Thomas Toepfer
Geschäftsführung: Dr. Michael Schoellhorn (Vorsitzender), Marcella Hoffmann, Andrea Willmeroth, Harald Mannheim
Sitz der Gesellschaft: Ottobrunn Registergericht: Amtsgericht München, HRB 107 648
Ust. Ident. Nr. /VAT reg. no. DE167015661

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Tasks/Methodology:

The thesis methodology will/can involve the following key tasks:

1) Review:
    - Review current methods/processes for thermal analysis and identify the main challenges in automating the correlation of thermal data.

2) Tool Conceptualisation:
    - Define the scope of the Automatic Correlation Tool, including its key features (e.g., data, input formats, output correlations and (links to) visualisation tools).

3) Data Integration:
    - Develop the tool's data input/output framework to interface with thermal modelling software. This includes creating import/export capabilities for different file formats commonly used in thermal simulations (e.g., *.xml, *.txt, *.csv, *.yaml).

4) Pattern Recognition and Correlation Algorithms:
    - Implement statistical / machine learning techniques to identify correlations and trends in the thermal data.
    - Explore advanced techniques such as neural networks for more complex data correlations or prediction tasks, if applicable.

5) Tool Development and User Interface:
    - Create a user-friendly interface for the tool that allows engineers to input parameters, run simulations, view correlations, and access optimisation suggestions.
    - Include features for visualising data (e.g., heat maps, scatter plots) to enhance decision-making.

6) Testing and Evaluation:
    - Validate the tool's performance using existing thermal models and/or experimental data.

The thermal analysis and design process always results in exciting tasks for students of the following disciplines, among others: mechanical engineering, aerospace engineering, **automation engineering** or **computer science**. Basic thermodynamic and engineering knowledge is helpful.

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Framework:

The thesis/internship is planned for a six-month period, and shall be performed in the “Thermal Systems & Space Physics Germany” department of Airbus Defence and Space GmbH, Friedrichshafen, Germany.

The student is responsible for supervision and acceptance of his work by the university. Circulation of results of the work to other institutions than the university needs permission of Airbus Defence and Space GmbH.

Contact (Supervisor at Airbus):

Martin Altenburg
Thermal Analysis and Design Expert
martin.altenburg@airbus.com

Airbus Defence and Space GmbH
Claude-Dornier-Straße
88090 Immenstaad, Germany

Online: (JR10322153)

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