IAF SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Engineering - Methods, Processes and Tools (2) (4B)

Author: Mr. Marcello Sciarra
Deimos Space SLU, Spain, marcello.sciarra@deimos-space.com

Mr. Federico Letterio
Deimos Space SLU, Spain, federico.letterio@deimos-space.com
Mr. Pablo Hermosin
Deimos Space SLU, Spain, pablo.hermosin@deimos-space.com
Dr. Giulio Molinari
beyondgravity, Switzerland, giulio.molinari@ruag.com
Mrs. María Aranda Rosales
Empresarios Agrupados Internacional, Spain, maranda@empre.es
Mr. Sebastian Willems
DLR (German Aerospace Center), Germany, sebastian.willems@dlr.de
Dr. Jeroen Van den Eynde
ESTEC, European Space Agency, The Netherlands, jeroen.van.den.eynde@esa.int

PFAT - POST-FLIGHT ANALYSIS TOOLKIT

Abstract

Throughout each phase of a space mission, from conceptual design until disposal, a large amount of data is generated for every different engineering discipline involved, e.g., aero(thermo)dynamic, structural and thermal analysis, propulsion system modelling, and trajectories design. Most of this data is produced during the design phases, but additional information is gathered during mission operations. This relates directly to flight performance, which needs to be evaluated by conducting post-flight analysis. To this end, and to additionally identify and understand the cause of potential discrepancies between predicted and observed behaviour, the large amount of data needs to be analysed methodically. This is key to increase the fidelity of analysis and prediction tools, as their outcomes are used for future mission design iterations. Manual extraction, manipulation and aggregation of such large datasets is tedious, time consuming, and prone to errors. Furthermore, each discipline relies on different models and simulation tools, often changing between mission phases. Post-Flight Analysis Toolset (PFAT) is an open-source software, developed under an ESA Contract, aimed at overcoming these difficulties. It allows the extraction of figures-of-merit and uncertainties and the derivation of engineering criteria used for further flight vehicle design. Simulated and measured data are imported and stored in a Common Data Structure (CDS), permitting easy manipulation and processing using various unified functions. PFAT contains numerous modules to perform a variety of functions for post-flight analysis, within its four engineering domains: trajectory (e.g. a multiplicative extended Kalman filter, sensor data processing, trajectory performance estimation, and trajectory comparison), aero(thermo)dynamics (e.g. interpolations, statistical analysis, user defined equations processed within a single or across multiple CDS, filtering, data reduction and time series computations, integration of grid data, and uncertainty propagation), propulsion (to compare in-flight data measurements with propulsion system simulation results computed with the European Space Propulsion System Simulation - ESPSS), and structural engineering domains (connected to dedicated engineering tools (e.g., NASTRAN), to asses and compare measured flight data against the reference mission ones). All modules are written in Python3, compatibly with ESA's Open Simulation Framework (openSF), allowing advanced processing chains definition. By virtue of its modular approach, the toolset can be easily

extended with more functionalities, bringing the postprocessing automatization, data exchange simplicity and processing robustness to other engineering disciplines and fields.