

Advancing the European Space Industry with AI: Introduction to the ECSS-E-HB-40-02A Machine Learning Qualification Handbook

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As the role and impact of machine learning continue to grow, the call for clear, reliable guidelines for the space industry on crafting dependable and safe AI software has never been louder. However, examining the current ECSS software standards, while valuable, do not seamlessly incorporate software solutions using machine learning. Furthermore, understanding how to accommodate the unique aspects of AI development practices is likewise far from universally grasped.

Rising to this challenge, the ECSS initiated a collaborative working group, to harvest and polish the best practices around machine learning qualification for software, specifically customized for the space industry's needs, currently focussed on the criticality categories B, C, or D. The result was the first version of the *ECSS-E-HB-40-02A Space engineering - Machine learning qualification handbook*.

The handbook initiates with the recommendation to consider the practical implications for the specific application. This understanding should serve as the foundation for subsequent steps, and help to decide whether to use AI or not. It then proceeds to offer advice on data preparation and evaluation, which represents the critical process of selection and qualification of data in accordance with relevant parameters. Once the data is deemed ready, the guidelines provide the further advice on the training phase, which involves 'teaching' the machine learning models using the prepared data. After the training phase, the models must undergo the correct testing to ensure their functionality and reliability before they are deployed and put into operation. However, beyond the focus on AI SW as an isolated factor, the guidelines next delve into the evaluation of AI functions as part of the broader system engineering approach to space systems. Here, the guidelines introduce the concept of "safety cage architecture" - a strategy designed to enhance the safety and reliability of systems using AI. Additionally, a discussion on the implementation of further mission-specific qualification processes is presented, which would be tailored to the specific needs of individual space missions.

In our upcoming talk, we are thrilled to present the current status of these guidelines, which are now open for public review. Given the audience's wealth of expertise, we hope to initiate the space community to engage in the exciting discussion related to the usage of machine learning applications, further enriching our European space industry.