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AI ASSISTANT SUPPORTING SPACE SYSTEMS CONCEPTUAL DESIGN

Abstract

In satellite design, like for any other complex technical system, adjustments of any level can have significant effects throughout the complete design. New Artificial Intelligence (AI) methods like Deep Reinforcement learning (DRL) have the potential to reduce complexity or support the technical design and decision process. ESA and DLR, like many other stake holders for space mission design, use Concurrent Engineering (CE) to support the decision process for which space mission to pursue. These decisions are based on the outcome of CE studies, that are conducted with a tailored team, to develop a preliminary, early design of the space system

Nowadays, commercial off-the-shelf (COTS) satellite components are more abounded than ever and selecting the right components to form the system design best-fitting to a given mission is getting exponentially more complex with every component available.

At TU Darmstadt, a software support tool was developed, show-casing the potential of using AI for building a satellite system design. The developed AI system were tasked with selecting a set of components from a database of COTS satellite components, that together form a CubeSat and fulfils a set of requirements. The selection process was based on Deep Reinforcement Learning, where the learning agent gains experience with the help of a Neural Network (NN) by testing sets of selected components (actions) inside a purpose designed environment, where an evaluation of the selected components is calculated via the same calculations domain experts would use during the regular CE studies. The AI agent learns during the training iterations which component combination yields the highest reward and form therefore the best possible complete system.

Tests show, that the AI is able to learn and pick components that together perform on a par with real-world missions in the trained scenario. In its current pilot design, the AI assistant is tailored to generate CubeSat concepts. However, the demonstrator shows the potential of the method to be applied to other kinds of systems as well. The application of such an AI tool during CE sessions can support the design team with their decision-making process to further improve an efficient mission design process. The tool can generate a tailored system design based on the respective mission definition and design requirements during the CE session in a matter of seconds. Straight forward use cases for such an AI assistant for training purposes to test the feasibility of a given design using real-world components.