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QUESTION ANSWERING OVER KNOWLEDGE GRAPHS FOR EXPLAINABLE SATELLITE SCHEDULING

Abstract

Schedules for satellite missions consist of thousands, if not millions, of interconnected activities executing many times across days, months, and years to fulfil mission objectives. The complexity of a schedule can make it difficult for Ground Station Operators (GSO) to understand the relationship between activities as part of a complete mission, especially when schedules have been created autonomously and decisions may be obscured. Text-based explanations are helpful in establishing the reasoning behind decision suggested by algorithms and their impact on the overall execution plan.

Whereas Knowledge Graphs can provide the underlying data structure to record what has happened and is scheduled, as well as the interconnected elements that are impacted by the scheduled activities. The relationship between satellite components, environmental conditions, operational constraints, and mission objectives are complex and high dimensional, which are not easy for the single operator to manage concurrently. A system that can gather information from a KG, and infer on the information stored within, can assist human operators in building a deeper understanding of the relationships of automatically scheduled decisions. A natural language query interface to the KG is the simplest way for a human to interface and extract the knowledge. Additionally, manual access to the KG can be provided alongside textual answers, enabling exploration of schedule branches to understand what else can change throughout the mission's execution. This improves the robustness of a systems responses to queries and allows for greater flexibility.

An overview is therefore examined of how KG technologies can be used to facilitate Explainable Artificial Intelligence (XAI) in satellite scheduling, how to model the information stored in the graph, how to access information stored through a natural language interface and how to infer on the stored knowledge. An example is presented demonstrating the capabilities of flexible query interpretation on an Earth Observation (EO) satellite scheduling problem. Finally, the capabilities of KG technologies to provide more explainable insights into satellite scheduling tasks is discussed in the frame of future possible developments.