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# APPLICATIONS AND DATA REQUIREMENTS FOR DIGITAL TWIN-ENABLED DIAGNOSIS AND PROGNOSIS SYSTEM FOR SPACE HABITATS

**Abstract**

In order to monitor, evaluate, and optimize space habitats, researchers have proposed many functions and modules and integrated them into digital twin (DT) systems. In a DT system, data requirements and workflows between different functions and modules are important since they influence the data exchange and information sharing efficiency of the whole DT system. Therefore, some researchers have investigated coordination and workflows between functions and modules. In particular, integrated computer-aided manufacturing definition for function modeling (IDEF0) is a promising approach to defining and describing the workflow and data exchange between DT functions and modules. However, previous studies have put more effort into individual functions and subsystems of the Environmental Control and Life Support System (ECLSS), such as its performance simulation and its degradation. There are few studies for investigating workflows and data requirements between functions and modules for ECLSS diagnosis and space habitats' prognosis. Our research and prototypes are designed to fill in this gap. In this paper, we design a digital twin (DT)-based framework of diagnosis and prognosis systems to monitor and assess space habitats. By using this framework, we implement a prototype in three office rooms to conduct analogous experiments. This prototype includes a heating, ventilation, and air conditioning (HVAC) system diagnosis module that is defined as an analogy to an Environmental Control and Life Support System (ECLSS) in space habitats. It also includes a room temperature prognosis module that is a pilot study for the prognosis of time to failure in space habitats. Our prototype and research contribute to (1) revealing the workflow of using DTs for monitoring and assessing space habitats and, (2) illustrating the data flow and requirements between various functions and modules in DTs.