

SPACE SYSTEMS SYMPOSIUM (D1)  
System Engineering Tools, Processes and Training (1) (3)

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INTRODUCING A CONNECTIVITY INDEX FOR SATELLITE DESIGN PARAMETERS TO  
MANAGE SPACECRAFT COMPLEXITY

**Abstract**

Based on the systems engineering idea, a holistic view on the satellite system is required during its design in order to capture its emergent behavior, originating from the cross-connections between the different subsystems and the interaction of the system with its environment. Hence a large number of system and mission parameters have to be handled in the design process. At the same time, system complexity rises with increasing parameter and relation number since the prediction of effects of parameter changes on the complete system becomes more and more difficult. In this context, the efficient management of the system complexity is integral part of a successful system design process.

The pictured approach to handle this complexity is based on a system parameter network already presented in previous work. The network focuses on the representation of system-level parameters relevant for a scientific satellite in low Earth orbit. As a further step, this paper shows how so called Connectivity Indices are assigned to these parameters, describing the degree of connectivity of the system variables in the network.

The Connectivity Indices are based on Figures of Influence quantifying the direct interdependency between two separately investigated parameters. A Figure describes the averaged sensitivity of a parameter with regard to a specified reference point due to changes of its influential parameter within a given value range. The Connectivity Index of a parameter is then calculated by combining all its corresponding Figures of Influence and considering the number of its indirect interdependencies to further parameters. The larger the Connectivity Index of a parameter, the more influential and/or influenced the parameter is in the network.

With regard to the design process, the Indices can help to quantify the consequences of parameter value changes on the complete system. As several design parameters are changed multiple times during the course of the design process, the system can intentionally or, worse, unintentionally experience significant changes. The Indices can help to prevent dispensable design iterations. Applying the concept of the Connectivity Index further, the Indices can also be employed as support for the interdisciplinary working process: for a holistically balanced system design, a particularly close collaboration with colleagues is recommended for subsystem specific engineers whose related design parameters have high Connectivity Indices.