# Reliability constraints in the topology generation of ship architecture

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## ABSTRACT

Ship design involves the integration of numerous subsystems, with potential interconnections and constraints that make identifying a suitable architecture increasingly challenging as the number of components grows. Assessing the reliability of the ship's architecture is essential to achieving a robust design. Many studies evaluate the reliability of ship architectures using predefined topologies Shields et al. (2017); Robinson et al. (2018), which limits the ability to enhance system reliability based on the number of components or connections. A notable contribution to this issue was presented in de Vos and Stapersma (2018), where ship architectures with additional rings (connections between nodes that distribute energy) were selected using a genetic algorithm to improve the global system's reliability. However, this approach still relied on a fixed set of components. In this work, we aim to integrate reliability criteria into the topology generation algorithm, allowing for a flexible number of components and connections. This flexibility enables the inclusion of redundant components in some paths, especially when the number of hubs is small or nonexistent. This improvement enhances the ship architecture's resilience to defects during the early stages of the design process. Our methodology builds on the authors' previous work Dugast et al. (2023), leveraging constraint programming in Prolog to enforce various design constraints. The addition of the reliability criterion is applied to the ship's energy system architecture, encompassing propulsion, hotel loads, and heating requirements. The results are analyzed based on the trade-off between reliability and the complexity of the architecture, defined by the number of components and connections.

## References

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