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16<sup>th</sup> INTERNATIONAL  
**MARDIN ARTUKLU**  
SCIENTIFIC RESEARCHES  
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# Abstracts Book

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WEAPON PYLON STRUCTURE TOPOLOGY OPTIMIZATION AND STRESS  
COMPARISON

Furkan AKIN \*  
Prof. Dr. Mustafa AY \*\*  
Assist. Prof. Kürşat TANRIVER \*\*\*

**Abstract:** This study focuses on the structural optimization of an aircraft weapon pylon by topology optimization techniques under realistic operational loading conditions. Weapon pylons are critical load bearing components that enable aircraft to carry external stores such as missiles, fuel tanks, and sensor pods. Due to their function, these structures are exposed to complex combinations of aerodynamic forces, inertial loads, and operational stresses, which can significantly influence both flight safety and overall aircraft performance. Therefore, achieving an optimal balance between structural strength and weight reduction is a key design objective in aerospace applications. In this research, multiple load cases representing different flight conditions were defined in accordance with commonly accepted military and aerospace design standards to ensure realistic boundary conditions. The baseline weapon pylon geometry was modeled and analyzed using finite element methods to identify stress distributions and critical regions. Aluminum alloy was selected as the structural material due to its high strength-to-weight ratio, good fatigue performance, and widespread use in aerospace structures. Topology optimization was performed with different mass fraction constraints, specifically 0.4, 0.5, and 0.6, resulting in three optimized design configurations with varying material distributions. The optimized density layouts were subsequently interpreted and transformed into manufacturable solid geometries while preserving the main load paths identified during the optimization process. These redesigned models were then subjected to detailed stress analyses to evaluate their structural performance and to compare them with the original, non-optimized configuration. The results highlights the trade-off between lightweight design and structural durability in weapon pylon structures. Overall, this work presents a practical and systematic methodology for integrating topology optimization with numerical validation, contributing to the development of more efficient and reliable aerospace structural components.

**Keywords:** Weapon Pylon, Structure, Topology Optimization, Aerospace

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