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3rd International Workshop on

# Reliability and Design of Additively Manufactured Materials


Faculty of Mechanical Engineering, Univ. of Belgrade
& online
Belgrade, Serbia, 4th - 6th October 2022

# Workshop Programme & Book of Abstracts

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# Evaluation of fatigue life of damaged UAV's attachment produced using additive manufacturing

**Nikola Raičević[1], Miloš Petrašinović[1], Danilo Petrašinović[1], Gordana Kastratović[2], Aleksandar Grbović[1]**

[1] University of Belgrade, Faculty of Mechanical Engineering
[2] University of Belgrade, Faculty of Transport and Traffic Engineering

Email: nraicevic@mas.bg.ac.rs[1], g.kastratovic@sf.bg.ac.rs[2]

## ABSTRACT

To become a reliable and widely accepted production process, additive manufacturing (AM) must provide metal structures with the same or better structural integrity than those produced using traditional methods. In the AM process, multiple build attempts are often required to obtain the part of standardized quality. Another crucial issue is the fatigue behaviour of AM structures (particularly in the presence of voids) which must be assessed and predicted with satisfactory accuracy. There are several major challenges connected to this issue, including obtaining the exact material properties and assessing the life of the complex shapes produced using AM.
Bearing this in mind, numerical simulations of AM processes, as well as of the fatigue crack growth in structures of complex shapes, become crucial factors in speeding up the industrial implementation of AM. The aim of this paper is to demonstrate current abilities and performances, as well as the restrictions of the numerical methods in simulating AM processes and fatigue crack growth in metallic structures of complex geometry. In this study, numerical simulations were first carried out on the standard CT specimen (Fig. 1), and then on the real shape of an UAV's attachment used to hold the composite arm and transfer loads to the main body of the UAV (Fig. 2, 3). For this purpose, the finite element method (FEM) was used, and the results of 3D numerical analyses, performed in Ansys Workbench software, were compared to experimental findings.

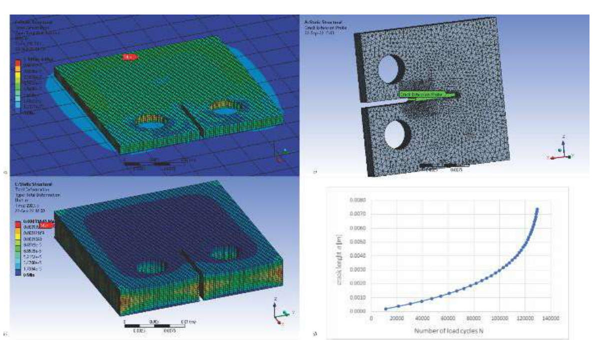

*Fig. 1 CT specimen: a) AM numerical simulation, step 14 (of 49); b) AM numerical sumulation, finish; c) crack propagation; d) fatigue life*

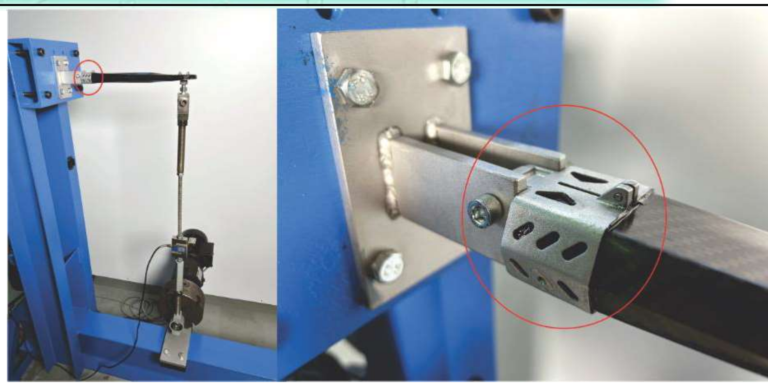

*Fig. 2 UAV's attachment*

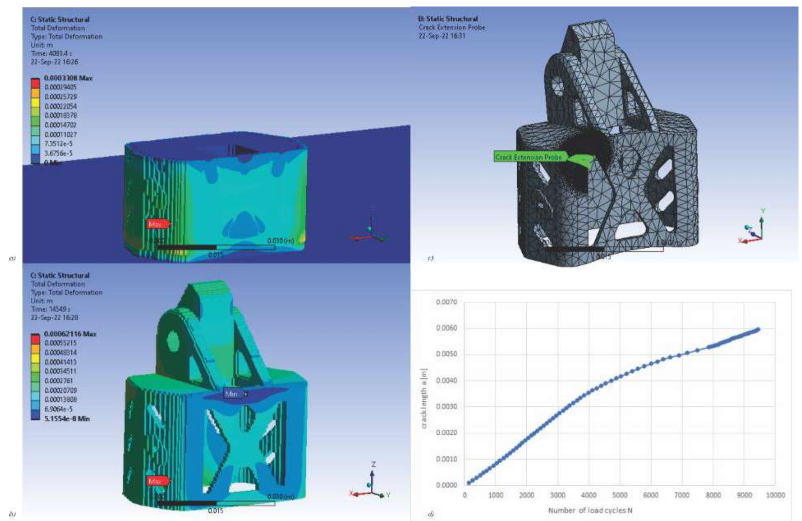

*Fig. 3 UAV's attachment: a) AM numerical simulation, step 106 (of 251); b) AM numerical sumulation, finish; c) crack propagation; d) fatigue life*

## REFERENCES

[1] Yusuf SM, Cutler S and Gao N, Review: The Impact of Metal Additive Manufacturing on the Aerospace Industry, Metals 2019, 9(12), 1286; https://doi.org/10.3390/met9121286
[2] Macías JGS, Chola Elangeswaran C et al., Fatigue crack nucleation and growth in laser powder bed fusion AlSi10Mg under as built and post-treated conditions, Materials & Design 2021, 210, 110084, https://doi.org/10.1016/j.matdes.2021.110084
[3] Đukić D, Grbović A, et al., Stress intensity factors numerical calculations for two penny shaped cracks in the elastic solid, Engineering Failure Analysis 2020;112: 104507, https://doi.org/10.1016/j.engfailanal.2020.104507
[4] Grbovic A, Kastratovic G et al, Experimental and numerical evaluation of fracture characteristics of composite material used in the aircraft engine cover manufacturing, Engineering Failure Analysis, 2022, 137, 106286, https://doi.org/10.1016/j.engfailanal.2022.106286