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DESIGN, PROTOTYPING, AND PERFORMANCE ASSESSMENT OF THE ANGIOLOGY IN MICROGRAVITY (AIM) EXPERIMENTAL PLATFORM FOR ESA SPACE RIDER'S MAIDEN FLIGHT

Abstract

The Angiology in Microgravity (AIM) experiment, conducted by young professionals at the European Space Agency (ESA), investigates the process behind clot formation in the Internal Jugular Vein (IJV) to understand the pathophysiology of Deep Vein Thrombosis (DVT) induced by long-term exposure to microgravity. The phenomenon is modelled with a specifically formulated blood mimicking fluid circulating in a closed fluidic loop. A part of the fluidic loop is an IJV phantom, where the flow is probed using two distinct laser and optical diagnostics techniques, including a PIV setup demonstrator.

The aim of this paper is to present the comprehensive mechanical design process synthetising this challenging experimental setup with the space mission requirements imposed by Vega-C launch environment and Space Rider flight profile. This process has led to the final mechanical design of the AIM payload - hermetically sealed, orthogrid-stiffened square box enclosing the secondary structure for the optical, fluidic, and electrical subsystems. The primary structure is hosting mechanical, electrical and power interfaces with the Space Rider. The inside of the pressurised box is accessed by removing the external cover, bolted to the base of the structure. The main function of the secondary structure is to

ensure the integrity of the experimental setup during launch phase. It is achieved by protecting the optical components from excessive mechanical loads and substantial misalignments in the optical path, which could lead to the failure of the experiment. The characteristic design feature of the secondary structure is its modularity, required for late access to the payload, and final optical alignment checks.

Design process is concluded with the Qualification and Acceptance campaign compliant with ECSS standards, to validate that the final payload design meets all the scientific objectives and can withstand the harsh environmental conditions encountered during spaceflight.