Casting the Future: A Versatile and Cost-effective Approach to Metallic Components

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Abstract

Foam-filled tubes offer a promising approach for enhancing mechanical performance, particularly in applications demanding lightweight yet high-strength components. Their advantageous properties include increased strength-to-weight ratios, sound insulation, effective thermal management, and enhanced energy absorption capabilities. However, the widespread adoption of additive manufacturing (AM) for producing such structures is hindered by high production costs, limited material availability, and resolution constraints.

To overcome these challenges, we introduce an innovative hybrid manufacturing process combining additive manufacturing with lost-wax investment casting, namely AM-assisted Investment Casting. This hybrid technique significantly expands the range of available materials, improves achievable resolutions, and reduces overall manufacturing costs. Additionally, to thoroughly understand and optimize this novel method, we conducted computational simulations of the casting process using Flow3D. These simulations provide critical insights into fluid dynamics and solidification phenomena, guiding process optimization and ensuring structural integrity and consistency.

Our initial findings indicate that this hybrid method has the potential to produce complex designs and enhance the mechanical properties and functional versatility of foam-filled tubes, making them suitable for advanced applications in aerospace, automotive, and structural engineering sectors where lightweight yet high-strength components are crucial. This study contributes to both the practical and theoretical understanding of AM-assisted Investment Casting, highlighting its potential to revolutionize the production of complex, high-performance materials.

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