Hybrid Lightweight Structures by Additive Manufacturing

The Chair of Materials Engineering of Additive Manufacturing in TUM supervised by Professor Peter Mayr joins the Chair of Materials for Additive Manufacturing in Bundeswehr University supervised by Professor Eric Jägle in a joint project. The project is a part of Munich Aerospace research group “Green Aerospace”. The potential of additive manufacturing of metallic materials is exploited and extended to hybrid lightweight structures made of conventionally and additively manufactured components. Thereby, a multitude of questions arise in the area of joining hybrid structures (conventionally manufactured semi-finished products with filigree, additively manufactured components), as well as the build-up of different alloys on top of each other (conventional wrought alloys with alloys optimized for additive manufacturing). A hybrid form of AM will be increasingly established in future due to economic and sustainability reasons.

Professor Mayr’s chair will focus on the development of concepts for building of large-scale multi-material components using Directed Energy Deposition (DED) AM processes like Wire Arc Additive Manufacturing (WAAM) and 3D Plasma Metal Deposition (3DPMD). The DED processes involve feedstock material feed into heat source such as electric arc or laser beam provided by a torch, while the movement of torch is controlled most likely by a robotic arm. This allows the manufacturing of large-scale products due to the elimination of the machine bed size constraint.

Professor Jägle’s chair focuses on solving challenges in producing hybrid lightweight structures through Laser Powder Bed Fusion (LPBF) process. LPBF involves spreading a powder layer and gradually building up layers from it to construct a complete component based on a computer-aided design. Several of these layers are fused to create a three-dimensional component. Through the LPBF process, complex components can be manufactured with excellent resolution. Small-scale structures with complex geometry will be additively manufactured to conventionally manufactured semi-finished products. Since not all conventional Aluminium alloys are suitable to be processed through the additive manufacturing route (L-PBF). Therefore, AM components from AM suitable alloys will have to be manufactured onto conventional alloy components. Joining such dissimilar alloys often results in several challenges, like the formation of intermetallic phases, hot cracking and thus leading to weak joints. In this project, several strategies to avoid such an interface is explored.

The objective of the is to investigate the interfacial properties between the conventionally and additively manufactured alloy or structure. Furthermore, the geometry, structure, mechanical properties, and physical properties are investigated thoroughly to develop and optimized building solution for such structures and materials.