B-UP1 – Optimal Design of the Cellular Structures for a Lightweight Car Body

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**Abstract**  
Today’s political objectives and social demands call for a significant reduction in energy consumption and greenhouse emissions in the transport sector. Therefore, it is necessary to consider a reduction in vehicle weight. Cellular lattice structures with a repeating structure of a predefined unit cell can guarantee weight reduction whilst increasing the impact energy absorption. This project aims to identify optimal cellular lattice structures for a lightweight car body through virtual design, numerical calculation as well as experimental testing and production via Laser Based Powder Bed Fusion Additive Manufacturing technology (PBF-LB).

**Work plan:**  
- Virtual design of different types of cellular structures, e.g., strut, shell, and TPMS-based  
- Mesoscale simulation in order to calculate stiffness, elastic anisotropy and energy absorption  
- PBF-LB fabrication of aluminum alloy specimens and experimental validation through various mechanical tests  
- Integration of the optimized structure in a bumper-mounting bracket component  
- Macroscale performance simulation under the operational loading condition  
- Final design optimization of the component and providing a virtual sketch