

Additive manufacturing (also called metal 3d printing) is considered the technology of the future. High-density energy sources like lasers, electron beams, plasma arcs are used to deposit molten metal layer by layer to form the desired part.

Unlike subtractive manufacturing, it is highly efficient in terms of material and energy consumption. Unlike casting and forging, it should be flexible enough to allow very rapid manufacturing of complex parts without investment in tooling, moulds and dies. In recent years, the number of parts produced by additive manufacturing has grown significantly, reaching a level that some experts believe heralds the new industrial revolution.

Very specific manufacturing process (layer by layer ) influences the properties of the entire part, which is heated and cooled hundreds of times during its fabrication. Due to the fact that almost every engineering alloy changes its properties when heat treated – the properties of the final part are not only influenced by the type of the material but also by the heat treatment that is taking place during the production.

This project aims to investigate the influence of thermal history on the microstructure and properties of additively manufactured materials. For this reason, a non-obvious method based on observation with an infrared camera will first be developed to determine the thermal prehistory. Later, numerical modelling of the additive manufacturing process will be performed. The influence of the processing parameters on the thermal history of the sample will be studied, and later the influence of the thermal history on the microstructure and properties of the additively manufactured part. Finally, if necessary, post-processing heat treatment will be proposed and the results will be verified. Two direct energy deposition (DED) techniques will be compared - LENS (Laser Engineered Net Shaping) at Warsaw University of Technology and WAAM (Wire Arc Additive Manufacturing) at Ljubljana University to determine the main differences in building of medium to large size parts.