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Melt Pool Prediction of Selective Laser Melting Process with Incompressible Smoothed Particle Hydrodynamics

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Selective Laser Melting (SLM) is an important production technique from the field of Additive Manufacturing (AM). In SLM a powder bed is fully melted by a laser in order to produce 3-dimensional parts. However, the influence of the process parameters, like laser power, scan rate, scan hatch spacing on the final product is not fully understood. As an example the cooling time of the melt pool can differ, whether the material below the currently melted slice was melted in the process step before or not. Adding up these effects the resulting part can have varying material properties due to overheating or badly melted parts. The simulation of the powder scale mechanisms helps to understand SLM to give a homogeneous resulting part independent of its structure, size, volume-surface ratio or the machine properties.
In this project the simulation of the powder scale mechanisms in the melt pool shall be acquired by the use of Smoothed Particle Hydrodynamics (SPH). The simulation of these processes offers some difficulties, starting from unfavorable material properties, like a low viscosity with high surface tension, over strong temperature and material gradients. For a trustworthy approach of capturing all the physics, this project focuses on the incompressible SPH approach [1] together with the corrected gradient of the corrected kernel which grants C1-continuity [2].

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