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PARTICLE FUSION AND HEAT SOURCE MODELING FOR SELECTIVE LASER MELTING

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Selective Laser Melting (SLM) is an emerging Additive Manufacturing (AM) technology for metals. Complex three dimensional parts can be generated from a powder bed by locally melting the desired portions layer by layer. The necessary heat is provided by a laser.

The laser-matter interaction is a crucial physical phenomena in the SLM process [1]. Various modeling approaches with different degrees of complexity exist in the literature to represent the laser-matter interaction in a numerical framework. Often, the laser energy is simply distributed into a specified volume. Another common approach is ray tracing. The laser beam can be divided into moving discrete energy portions (rays) that are traced until they hit the irradiated part [2].

In order to compute the reaction and absorption usually a triangulation of the free surface is necessary. On the other hand meshfree methods are very attractive for modeling SLM processes because the fusion of particles is intrinsic to the formulation. However a triangularization is a very expensive operation in meshfree methods.

Hence a computationally more efficient algorithm will be presented. It avoids a triangulation and can easily be combined with other meshfree methods. The presented ray tracing algorithm is exemplary coupled with the stabilized Optimal Transportation Meshfree (OTM) Method [3]. The accurate coupling is shown by several examples. The importance of ray tracing is evaluated by simulating the fusion of metal powder particles and by comparing the results to a volumetric heat source approach. The transition between the solid and the melt is prescribed by a finite deformation phase change model.

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