Numerical simulation of laser welding – a review of 3D heat source models

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In general, numerical modelling and computer simulation represent a powerful tool for the design, analysis, and optimization of fusion welding processes, including laser welding. Depending on the process parameters, laser welding can include the interaction of different physical phenomena (thermal, fluid, metallurgical, chemical, mechanical, diffusion, and others). For this reason, the development of a simulation model for laser welding is quite complicated and requires the accurate setting of a considerable amount of input data [1]. In addition to the geometric characteristics of the components to be welded, initial and nonlinear boundary conditions, it is necessary to define the material properties of the base and possibly also the filler materials in a wide temperature range [2-3].

Probably the most difficult problem in the development of simulation models for fusion welding processes is how to model the energy transfer from the laser beam to the welded material, i.e. how to define the heat input to the weld [2-5]. To solve this task, it is necessary to choose a suitable mathematical model of the heat source and to specify the characteristics of the selected heat source.

This paper presents a review of the most important 3D mathematical models of the heat source for numerical simulation of laser welding. The selected heat source models are applied to the numerical analysis of laser welding of aluminium plates. The results of numerical simulations are compared and discussed.

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